How To Read and Use the WestEd Review

Colorado Model Content Standards
In
Reading & Writing, Mathematics, Science, and Music

1. Study carefully the current Colorado Model Content Standards. Begin to identify areas of strengths and weaknesses based on your own knowledge and experience, especially as they relate to the shift to grade-by-grade articulation in Kindergarten through Grade 8, and integration of 21st century skills and Postsecondary and Workforce Readiness skills.

2. Read the WestEd report in sections. First, be sure to understand the purpose of the report (i.e., review of current Colorado Model Content Standards) and what was not the purpose (i.e., revision of the Colorado Model Content Standards). Next, become familiar with the review criteria. Third, read the various summaries, conclusions, and recommendations. Finally, compare your initial reactions with the WestEd conclusions: How similar and different are they? Where different, is it because you used different criteria than WestEd's analysts? Which criteria do you consider most important for standards evaluation? Why?

3. Study the relevant appendices from the WestEd report to fully understand the specific ratings for each standard reviewed. Be prepared to justify each revised standard at this level of detail.

4. Prioritize the criteria for determining quality standards based on steps 1 - 3; begin to apply these criteria to the current Colorado Model Content Standards and any additional standards you believe should be added to the set.

5. When revising the current Colorado Model Content Standards, keep in mind that external parties will be reviewing your work using a procedure similar to that followed in the WestEd report--will your work stand up to that level of scrutiny?

Colorado Model Content Standards Review

Phase I: Reading & Writing; Mathematics; Science; and Music

Final Report

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Prepared for the Colorado Department of Education
by

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EXECUTIVE SUMMARY

Scope of Work

The Colorado Department of Education (CDE) contracted WestEd to conduct a review of Colorado's K–12 Model Content Standards (MCS). The findings and recommendations from this review are intended to inform decision-making by the CDE during its standards revision process. Periodic standards review is critical to help ensure that the content (skills, knowledge) students are expected to learn reflects the changing priorities, needs, and values of the state and society more broadly, and continues to prepare students for the challenges they will face in successive grades or post-secondary endeavors.

This standards review consists of three phases, each focusing on a different set of content areas:

- Phase I: Review of the MCS in reading and writing, mathematics, science, and music were examined (completed).
- Phase II: Review of MCS in civics, economics, geography, history, and financial literacy (to be completed in Spring 2009).
- Phase III: Review of MCS in world languages (foreign language), physical education, visual arts, dance, and theatre (to be completed in Summer 2009).

Organization of the Report

This report presents the methodology, findings, and recommendations for Phase I of the standards review. The complete report for Phase I is organized as follows:

- **Section I: Introduction.** The background and purpose for the study.
- **Section II: Methodology.** The processes used and criteria applied during each step in Phase I are described.
- **Section III: Content Area Findings and Recommendations.** Study findings analysis, and specific recommendations for improvement are presented by content area.
- **Section IV: References.** References and documents reviewed in the analysis.
- **Section V: Appendices.** Ratings and comments from analysts are provided for each standard in all grades for each content area.

Overview of the Methodology

The standards review involves the following three components:

- Review of the **internal quality** to determine the degree to which the standards demonstrate depth, coherence, rigor, and breadth.
- Review and comparison of respected **external referent** standards to better understand overall strengths and limitations of the MCS, with particular attention paid to the organization/structure and content of the standards.

- Analysis of the degree to which Colorado's MCS contain the skills described in Colorado's draft **21st Century Learning Skills and Abilities** (21st Century Skills) and definition of **Postsecondary and Workforce Readiness** (PWR Skills), and are amenable to their inclusion. This analysis is intended to help integrate the state's two initiatives of the revision of the MCS and the development of definitions of 21st Century and readiness for postsecondary education and the workforce.

Key to the review, across all components listed, are the objective, third-party analysis and subsequent recommendations related to improving the quality of Colorado's MCS. Outcomes of the review are intended to inform and guide the work of those revising Colorado's standards.

The WestEd analysts who conducted the Phase I MCS review possess extensive knowledge and skills in standards review and development, in their respective content areas (i.e., English language arts, mathematics, science, and music), K–12 curriculum, instruction, assessment, and alignment, as well as experience in the classroom. These analysts were trained in specific protocols designed to (1) articulate and operationalize the criteria and processes used to judge internal quality and (2) ensure the accuracy and consistency of the application of the criteria across content areas. The protocols and related criteria were applied systematically to each MCS standard, at both the grade span and cross-grade span levels.

For the review of **internal quality**, the specific criteria applied to the analysis of each standard were as follows:

- *Depth:* Do the benchmarks describe content of sufficient and appropriate depth in the standard *within each grade span*? Do the benchmarks describe content of sufficient and appropriate depth in the standard *across the grade spans*?

- *Coherence:* Are the benchmarks for each standard sequenced appropriately across the grade spans? Do the benchmarks begin and end at appropriate points in the content?

- *Rigor:* Do the benchmarks describe content and skill expectations of a reasonable and appropriate level for this grade span? Do the standards and benchmarks communicate an appropriate level of rigor?

- *Breadth:* Do the benchmarks describe sufficient and appropriate breadth of content across standards *within each grade span*? Do the benchmarks contain the essential content for this subject *within and across grade spans*? If not, what content is missing? Are the benchmarks free from extraneous content *within and across grade spans*? If not, what content is extraneous?

The standards were rated as meeting each criterion (Depth, Coherence, Rigor, Breadth) according to the following designations: Fully, Partially, No, Insufficient Information.

Additionally, analysts provided comments that explained their rationale for ratings, as appropriate.

For the analysis of the **external referent** standards, the following criteria were used:

- *Organization/Structure* — Similarities and differences in (1) *grade articulation*; (2) *hierarchy of standards*; (3) *number of standards*; and (4) *design/format*.

- *Content* — Similarities and differences in (1) *standards scope and sequence;* (2) g*rade spans*; and (3) w*ording*.

For each criterion (Organization/Structure, Content), analysts recorded a holistic rating reflecting the similarity of the external referent standards to the MCS (i.e., as Similar or Different). Analysts also provided descriptive comments, rationale, and evidence related to the specific similarities and differences observed between the standards compared.

For the examination of Colorado's draft **21st Century Skills** and definition of **PWR Skills**[1], analysts used the following ratings to reflect the degree to which evidence of one or more 21st Century or PWR Skills was present in each MCS: Fully Present, Partially Present, Not Present. No rating was recorded if a 21st Century or PWR Skill was not reflected in a MCS and that standard was not judged to be an appropriate fit for a skill.

The outcomes of this review have both standard-specific and cross-standard implications for CDE's consideration during its MCS revision process. It is intended to provide the CDE with an objective analysis and recommendations that can inform and guide the work of those revising Colorado's standards.

[1] Because PWR Skills represent skills required after high school, the review was limited to the 9–12 grade span and did not include the elementary or middle grades.

I. INTRODUCTION

Rigorous standards serve as a major lever for improving student achievement by articulating goals, focusing instruction, and guiding the development of assessments that can yield information for states, districts, and schools to use to guide improvement (Rabinowitz, Roeber, Schroeder, & Sheinker, 2006). But state standards must be dynamic, evolving over time to meet changing purposes, priorities, and needs. Periodic standards review helps states ensure that the content that their students are expected to learn continues to prepare them for the challenges they will face in successive grades or in post-secondary endeavors. Recognizing this, the Colorado Department of Education contracted WestEd to conduct a review of Colorado's K–12 Model Content Standards (MCS). The findings and recommendations that emerge from this review are intended to inform decision-making by the Colorado Department of Education (CDE) during the standards revision process.

This report presents findings from Phase I of a scope of work that will include three phases of review of the MCS, each with a different content area focus. In Phase I, the MCS in reading and writing, mathematics, science, and music were examined. In the coming months, WestEd will begin Phase II work, which will focus on the MCS in civics, economics, geography, history, and financial literacy. The last phase, Phase III, will focus on the MCS in world languages (foreign language), physical education, visual arts, dance, and theatre. The content areas were distributed across phases in part in order to allow for lessons learned in each phase to be applied in subsequent phases. The selection of specific content areas analyzed in each phase was determined through discussions with CDE; these discussions included an interest in applying the review protocol to a diverse range of content areas from the outset, including mixing No Child Left Behind Act (NCLB) accountability areas with non-accountability areas.

The standards review involved the three components described below.

- Review of the **internal quality** of the MCS through systematic application of a protocol to determine the degree to which the standards demonstrate depth, coherence, rigor, and breadth.
- Review and comparison of respected **external referent** standards from other states (Massachusetts, Virginia) and nations (Singapore, Finland), selected by the Colorado Department of Education (CDE), to better understand overall strengths and limitations of the MCS. In particular, analysts attended to the organization/structure and content of these referents.[2]
- Analysis of the degree to which Colorado's MCS contain the skills described in Colorado's draft **21st Century Learning Skills and Abilities** (21st Century Skills) and definition of **Postsecondary and Workforce Readiness** (PWR Skills), and are amenable to their inclusion. This analysis is intended to help integrate the state's two initiatives of the revision of the MCS and the development of

[2] Future reviews will also include International Baccalaureate and Advanced Placement standards.

definitions of 21st Century and readiness for postsecondary education and the workforce.

The overriding intent across all of these components was to provide third-party information and recommendations related to improving the quality of Colorado's MCS that would contribute to informing and guiding the work of those revising Colorado's standards.

The remainder of this report is organized along the following sections:

- **Section II: Methodology.** The processes used and criteria applied during each step in Phase I are described.
- **Section III: Content Area Findings and Recommendations.** Study findings analysis, and specific recommendations for improvement are presented by content area.
- **Section IV: References.** References and documents reviewed in the analysis.
- **Section V: Appendices.** Ratings and comments from analysts are provided for each standard in all grades for each content area.

II. METHODOLOGY

This section describes the research-based processes and protocols used during WestEd's examination of Colorado's K–12 Model Content Standards (MCS) in reading and writing, mathematics, science, and music. As described in the Introduction, this work included three components.

Findings from these three components were used to develop recommendations for improvement of the content and structure of the MCS. These recommendations are intended to help guide decision-making during the standards revision process. Each of the three components is described in greater detail below.

Using their collective expertise and experience, WestEd analysts were asked to systematically apply protocols developed specifically for each step. These protocols helped to (1) articulate and operationalize the criteria and processes used to judge internal quality and (2) ensure the accuracy and consistency of the application of the criteria across content areas.

Training and Calibration Procedures

Training was facilitated by WestEd project leaders. Training and calibration of analysts ensured that approved procedures were implemented and the judgment criteria applied accurately and consistently throughout the course of the study, within and across content areas.

In all components, the WestEd analysts who conducted the work possess extensive knowledge and skills in standards review and development, in their respective content areas (i.e., English language arts, mathematics, science, and music), K–12 curriculum, instruction, assessment, and alignment, as well as experience in the classroom.

Prior to training, WestEd analysts independently reviewed all relevant standards, related documents, and external referents for their respective content areas. During training, the WestEd facilitator guided analysts in a review of all procedures, evaluation criteria, format for the rating sheets, and the appropriate unit of analysis for the content area. The facilitator then guided analysts as they applied the review criteria to a few standards to verify their understanding of the criteria and procedures. In each content area, analysts discussed their decisions and rationale for each judgment with the facilitators. The facilitators examined the analyst's judgments, and if they did not concur with the rating, they provided additional guidance to recalibrate the analyst. This step was repeated, with ongoing calibration, until analysts' decisions were fully aligned with their facilitator's judgments.

Internal Quality Review of Colorado's Model Content Standards

For this step, analysts were asked to apply a protocol focused on evaluating the quality of the K–12 Model Content Standards.

The Colorado MCS are organized as broad cross-grade standard statements that are further articulated in grade spans through benchmark statements. The unit of analysis and reporting for this step was the MCS standard, at both the grade span and cross-grade span levels. The benchmark statements for each grade span were used to interpret the state's intent with regard to the development and application of the knowledge and skills described in the standards. Each benchmark was reviewed and used to inform the analyses at the standard and grade-span levels.

Quality Review Criteria. WestEd analysts applied general evaluation criteria to this review of standards. The general criteria, explained in greater detail below, were depth, coherence, rigor, and breadth. These criteria, supported by research and best practices at the state and local levels, (see, for example, Webb, 1997, Rabinowitz, Roeber, Schroeder, & Sheinker, 2006, among others), were adapted through discussions with the CDE to ensure the information in the findings would be appropriate for Colorado's context, and thus maximally useful. Criteria for each dimension were designed as responses to questions of sufficiency and appropriateness that were applied by analysts as they reviewed each standard.

- *Depth:* Do the benchmarks describe content of sufficient and appropriate depth in the standard *within each grade span*? (For example, is the depth of content of the standard appropriate for a school year?) Do the benchmarks describe content of sufficient and appropriate depth in the standard *across the grade spans*?

- *Coherence:* Are the benchmarks for each standard sequenced appropriately across the grade spans? For example, do they scale or spiral appropriately across the grade spans? Do the benchmarks begin and end at appropriate points in the content?

- *Rigor:* Do the benchmarks describe content and skill expectations of a reasonable and appropriate level for this grade span? Do the standards and benchmarks communicate an appropriate level of rigor?

- *Breadth:* Do the benchmarks describe sufficient and appropriate breadth of content across standards *within each grade span*? Do the benchmarks contain the essential content for this subject *within and across grade spans*? If not, what content is missing? Are the benchmarks free from extraneous content *within and across grade spans*? If not, what content is extraneous?

For each standard, analysts independently recorded their ratings for each criterion. The rating sheets were used to guide the analysis and reporting of holistic findings. The standards were rated as meeting each criterion using the following holistic designations and scale: "Fully" (F); "Partially" (P); "No" (N); or "Insufficient Information" (I).

In order to ensure consistency across analysts and content areas, a scale was approximated to guide analysts' ratings:[3] "Fully" was operationalized as being able to answer the question(s) associated with the criterion with a "yes" approximately 85–100% of the time, or with a strength of 85–100%. "Partially" was operationalized as being able to answer the question(s) with a "yes" approximately 40–84% of the time, or with a strength of 40–84%. "No" was operationalized as being able to answer the question(s) with a "yes" less than 39% of the time, or with a strength of less than 39%.

If analysts found that there was insufficient information on which to base a judgment, they assigned a rating of Insufficient Information (I). Additionally, analysts provided comments that explained their rationale for some ratings, as appropriate.

Comparison of Colorado's Model Content Standards to External Referents

Analysts for each content area systematically reviewed sets of external referent standards vis-à-vis the MCS using the criteria described below. The unit of analysis and reporting for this step of work was the MCS standard, at both the grade span and cross-grade span levels. The benchmark statements for each grade span were used to interpret the state's intent with regard to the development and application of the knowledge and skills described in the standards. The unit of analysis for the external referents was the most comparable level in each set of standards. For the purposes of review and presentation, data were organized using the current structure and sequence of the Colorado MCS.

The External Referents. CDE selected the external referents to which the MCS would be compared. Included in the selection criteria was whether the standards were from states or countries respected for their strong overall academic performance and quality of their standards. To enable maximal usefulness in guiding standards reform, sets of standards were sought that would be relevant in all content areas. Additionally, it was hoped that by reviewing each set of external referent standards for multiple content areas, the comparison would benefit from any cross-content elements or guiding philosophies that might not be apparent in any one content area. To this end, they selected standards from the following entities:

- From other states: *Massachusetts* and *Virginia*
- From other countries: *Finland* and *Singapore*
- From organizations: *International Baccalaureate* and *Advanced Placement* (review to be completed at a future date)

The CDE recognized that through their experience in standards development and revision, WestEd may have recommendations for other respected referents, especially ones whose value may be content-specific. These recommendations are included in the Findings and Recommendation sections of this report for each content area.

[3] The percentages in these ranges emerged from extensive experience in the field and are generally understood as representing different levels of quality.

Criteria Used for Comparative Analyses. The external referent comparison was intended to serve as a holistic review of the similarities and differences between each external referent and the Colorado MCS. These data may be used to inform the CDE during the MCS revision process. Specifically, comparisons were documented for two criteria, organization/structure and content. Analysts' considerations for judging each are defined below.

- *Organization/Structure.* Analysts' considerations related to standards organization and structure included similarities and differences in (1) *grade articulation:* standards articulated by individual grade, grade-span, course, etc.; cross-grade strands versus no repetition of content; (2) *hierarchy of standards:* number of levels in standards (e.g., strand, standard, benchmark, indicator); (3) *number of standards:* number of strands, standards, indicators; (4) *design/format:* organization and structure of standards, and ways in which intended knowledge and skills are communicated.

- *Content.* Analysts' considerations related to standards content included similarities and differences in (1) *standards scope and sequence:* the depth and breadth of content described in the standards; (2) g*rade spans:* the sequencing and distribution of content within and across the grade spans; and (3) w*ording:* specificity of language; focus on action verbs, knowledge, etc.

Holistic Rating Scale. For each criterion, analysts recorded a holistic rating reflecting the similarity of the external referent standards to the MCS. These ratings were as follows:

- *Similar* — Referent standards are mostly similar to CO MCS in substantive ways
- *Different* — Referent standards are mostly different from CO MCS in substantive ways

In order to arrive at these holistic ratings, analysts recorded descriptive comments on the specific similarities and differences between the two sets of standards. Comments included rationale and evidence to support their judgments and conclusions about the impact or relative importance of the differences (or in some cases, similarities). The rating sheets used to record these holistic ratings and descriptive comments are included in the Appendices section of this report.

It is important to note that the referents have similarities and differences among one another, as well as with Colorado's MCS. However, no one approach is intended to be presented as necessarily more or less effective than another. Differences in structure or content of a state or country's standards may be qualitative, but may also be attributable to differences in history, purpose, and/or context. Thus, the implication is that a variety of approaches and combinations of approaches may be considered, should they be determined to be appropriate for Colorado.

Examination of Colorado's 21st Century Skills and Abilities and Definition of Postsecondary and Workforce Readiness vis-à-vis Colorado's Model Content Standards

The purpose of this step of work was to provide the CDE with information about the extent to which the state's draft 21st Century Skills and definition of Postsecondary and Workforce Readiness (PWR) are embodied in or supported by the existing MCS. The unit of analysis was the MCS standard for each grade span, as elaborated in the benchmarks. Because the PWR skills represent skills required *after* high school, the review was limited to the 9–12 grade span, and did not include the elementary or middle grades. The draft 21st Century Skills and Abilities and definition of Postsecondary and Workforce Readiness are below.

21st Century Skills and Abilities. "Colorado's description of 21st Century Skills is a synthesis of the essential abilities students must apply in today's rapidly changing world. These essential skills are as follows:

- Critical thinking and reasoning (e.g., problem solving, analysis), logic, and cause/effect)
- Information literacy (e.g., knowledge acquisition, source discernment, and systems management)
- Collaboration (e.g., synergy, team resourcing, social skills, leadership)
- Self-direction (e.g., adaptability, initiative, personal responsibility, work ethic, self-advocacy)
- Invention (e.g., creativity, innovation, integration of ideas)"

Postsecondary and Workforce Readiness. "Colorado's description of postsecondary and workforce readiness is a student's capacity to demonstrate the knowledge, skills and competencies required for success in a global, interdependent society. Students must demonstrate:

- Application of reading, writing, and computing skills with minimal remediation or training (e.g. skills and performance necessary for entrance in to a postsecondary institution or the workforce)
- Logical reasoning and argumentation abilities (e.g. identifying a reasoned viewpoint which a student can persuasively and successfully communicate)
- Identification and solving of problems (e.g. monitoring and self-correcting performance, finding dilemmas, gaps and needs and generating accurate solutions; initiating, innovating, creating)
- Information management skills (e.g. system thinking competencies, financial awareness, increasing productivity and adapting to new information)
- Human relation skills (e.g. students are self-directed, applying integrity and work ethic, cooperation, tolerance)
- Analysis and interpretation skills (e.g. capacity to read into facts, patterns and conclusions which advance information and understanding)"

Rating Dimensions. The MCS were reviewed to determine the degree to which the 21st Century and PWR Skills were present in the current standards language. For each MCS, analysts assigned one of the following ratings to signify the degree to which evidence of one or more 21st Century or PWR Skills was present:

- (F) Fully Present: The standard includes a fundamental skill or concept as explicitly stated in the 21st Century or PWR Skill. The standard taps a central idea of the skill statement. A standard does not need to address all elements of the 21st Century or PWR Skill to receive a rating of F.

- (P) Partially Present: The standard may address the skill statement in a superficial or less complex way than is stated in the 21st Century or PWR Skills.

- (N) Not Present: The standard is a reasonable and appropriate place to include the skill, but the skill is not present in the standard as currently written.

If a 21st Century or PWR Skill was not found to be contained in a MCS but that standard was not judged to be an appropriate fit for that skill, no judgment was recorded for that relationship (cell) on the rating sheet.

Recommendations to Improve Inclusiveness. For each MCS rated as Partially Present (P) or Not Present (N), the WestEd analysts considered strategies for revising the standard to more fully incorporate a 21st Century or PWR Skill. Recommendations that emerged had both standard-specific and cross-standard implications for consideration during the MCS revision process. These specific recommendations are included on the individual data collection sheets and are summarized for each content area in the Findings section of this report.

III. CONTENT AREA FINDINGS AND RECOMMENDATIONS

III-A. Reading & Writing Findings and Recommendations

This section contains findings and recommendations related to the internal quality review, the external referent reviews, and the review of 21st Century Skills and PWR Skills. Detailed review criteria can be found in the Methodology section of this report. A brief description of the criteria and guiding questions also are provided here for convenience.

Internal Quality Review

As described in the Methodology section of this report, the Colorado MCS were reviewed for their quality according to four criteria: depth; coherence; rigor; and breadth. The scale used for evaluating each criterion was as follows: Fully (F), Partially (P), No (N), or Insufficient information to determine (I). Findings from these analyses are presented below.

Depth

Ratings for depth are assigned based on the questions below.

- Do the benchmarks describe content of sufficient and appropriate depth in the standard *within each grade span*? (For example, is the depth of content of the standard appropriate for a school year?)
- Do the benchmarks describe content of sufficient and appropriate depth in the standard *across the grade spans*?

The table below shows the ratings for depth in the reading and writing standards, reported for each standard at each grade span, as well as across the grade spans. The across grade span ratings are holistic ratings of the depth of the standards in K–12.

Table 1. Ratings for Depth in the Reading and Writing MCS

Standard	K–4	5–8	9–12	Across Grade Spans
1	N	N	N	N
2	P	P	P	P
3	P	F	F	F
4	F	F	F	F
5	P	F	F	F
6	P	P	P	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

The ratings for depth of content varied across Colorado's six standards. Three standards—3, 4, and 5—were rated as F, fully describing content of sufficient and

appropriate depth across grade spans; three standards—1, 2, and 6—were rated either as P, partially describing sufficient depth across grade spans or as N, not describing sufficient depth.

Standard 4 was the only standard to be rated as F for depth of content at every grade span as well as across spans. The benchmarks for standard 4 describe the application of in-depth thinking skills, such as "using reading, writing, speaking, and listening to define and solve problems" and "analyzing what they read, hear, and view" at every level, from K–4 through 9–12. Standards 3 and 5 also received ratings of F within the 5–8 and 9–12 grade spans, with Partial ratings for the K–4 span reflecting a lack of specificity about the application of skills in the benchmarks for this level. The K–4 benchmarks for standard 3, for example, do not specifically require the application of students' knowledge of conventions to their writing or speaking (as they do at other grade spans).

In general, those standards that received ratings of P or N for depth of content were limited by a lack of specificity in the grade level benchmarks. Standard 1 describes substantial depth of content in its bulleted list of reading comprehension skills and strategies (under the standard statement); however, these skills are not reflected in benchmarks describing the specific types and levels of performance expected for each grade span. Instead, the one very broad, general benchmark for standard 1 at all grade spans distinguishes the types of materials students read at that level but not the specific skills and knowledge students apply to their reading. To clarify the depth of content for standard 1 at each level, benchmarks would need to define the types of applications of reading comprehension skills and the level of skills to be demonstrated at each grade span. including key foundational skills in the K–4 span, such as phonemic awareness; decoding; and comprehension of oral language and literature.

Standards 2 and 6 received ratings of P for depth of content within and across all grade spans. The benchmarks for standard 2, for example, make limited reference to specific skills in using the elements of composition (pre-writing, focus, organization, development, sentence structure, point-of-view, etc.) or the elements of fiction (plot, setting, character, dialogue, etc.) in writing stories. The benchmarks for standard 6 focus on broad topics approached through literature ("the American experience," for example) but depth is limited by the lack of emphasis on analytic skills and attention to the literary characteristics of individual works, authors, or genres.

Coherence

Ratings for coherence are assigned based on the questions below.

- Are the benchmarks for each standard sequenced appropriately across the grade spans? (For example, do they scale or spiral appropriately across the grade spans?)
- Do the benchmarks begin and end at appropriate points in the content?

The tables below show the ratings for coherence in the reading and writing standards, reported as appropriate sequence across the grade spans, and as appropriate beginning and endpoints for each standard at each grade span, as well as across the grade spans.

Table 2. Ratings for Coherence in the Reading and Writing MCS

Standard	Appropriate Sequence Across Grade Spans
1	N
2	P
3	F
4	F
5	F
6	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Table 3. Ratings for Coherence in the Reading and Writing MCS

Standard	Appropriate Beginning and Endpoints			
	K–4	5–8	9–12	Across Grade Spans
1	N	N	N	N
2	P	P	P	P
3	P	F	F	F
4	F	F	F	F
5	F	F	F	F
6	P	P	P	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

The coherence ratings of Colorado's six reading and writing standards closely mirror those for depth, with three standards—3, 4, and 5—receiving ratings of F, fully coherent sequencing across grade spans and three—1, 2, and 6—receiving ratings of either P for Partial coherence or N for insufficient coherence.

Two standards, 4 and 5, received ratings of F for coherence within and across all grade spans, while standard 3 received ratings of F across the 5–8 and 9–12 grade spans. The standard 4 benchmarks, for example, show considerable continuity across spans as well as also some indicators of progressive growth or expansion of skills from one grade span to the next. For example, a K–4 benchmark, "formulating questions about what they read, write, hear, and view," is developed into "analyzing what they read, hear, and view" at 5–8. Similarly, a 5–8 benchmark calls for students to recognize "an author's or speaker's point-of-view and purpose," while the 9–12 benchmark expands this to "an author's point-of-view, purpose, *and historical and cultural context*." Overall, the standard 3, 4, and 5 benchmarks show a coherent sequence of growth in related knowledge and skills across spans.

Standard 1 received a rating of N for coherence as the single benchmarks for each grade span do not adequately differentiate the levels of skill and knowledge expected for each span. Standards 2 and 6 received a rating of P. Although the benchmarks for both standards showed some sequencing across grade spans, the progression of skills from one span to the next was not always clear. For example, a 5–8 benchmark for standard 2 is "drafting, revising, editing, and proofreading" writing; the related 9–12 benchmarks adds "selecting a focused topic," a skill one would expect to be part of the drafting process at the earlier span(s) as well. A K–4 benchmark for this standard is "organizing their speaking and writing;" organization is not mentioned in the 5–8 and 9–12 grade spans. Overall, the sequential progression of skills and knowledge in standards 2 and 6 could be more clearly and specifically articulated.

Rigor

Ratings for rigor are assigned based on the questions below.

- Do the benchmarks describe content and skill expectations of a reasonable and appropriate level for this grade span?
- Do the standards and benchmarks communicate an appropriate level of rigor?

The table below shows the ratings for rigor in the reading and writing standards, reported for each standard at each grade span, as well as across the grade spans.

Table 4. Ratings for Rigor in the Reading and Writing MCS

Standard	K–4	5–8	9–12	Across Grade Spans
1	N	N	N	N
2	P	P	P	P
3	P	F	F	F
4	F	F	F	F
5	P	F	F	F
6	P	P	P	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Ratings for rigor were similar to those for depth and coherence. Only standard 4 received a rating of F across and within all grade spans. Standards 3 and 5 received a rating of F across the 5–8 and 9–12 spans but received a rating of P for K–4. Standards 2 and 6 received a rating of P within and across all grade spans, and standard 1 was rated N across all grade spans.

Standards that received a rating of F for rigor tended to be elaborated through more specific benchmarks for each grade span as well as through benchmarks describing the application of skills to integrated tasks. Benchmarks for standard 5, for example, include specific skills such as "using organizational features of printed text such as citations, end notes, and bibliographic references to locate relevant information." The benchmarks for grades 5–8 and 9–12 also call for students to integrate these research skills in the creation of a product, "using available technology to access information, conduct research, and

produce a carefully documented product." Benchmarks for standard 3 also describe a range of specific knowledge and skills students apply to their writing and speaking. The K–4 benchmarks for standards 3 and 5, rated as "partial," do not explicitly require the application of knowledge and skills to writing and speaking (3) or the creation of a product (5).

Standards that received a rating of P or N typically lacked specificity in the grade span benchmarks (making rigor more difficult to determine) and/or placed less emphasis on higher order or integrative skills and tasks. The P rating for standard 6, for example, reflects both the lack of specificity in the benchmarks and the lack of emphasis given to analytic, interpretive, and evaluative skills. The skill and knowledge required to "use literary terminology accurately," for example, is not explicitly applied to the analysis or interpretation of literary works. The verb "identify" in the 9–12 benchmark "identifying recurrent themes in United States literature" suggests less rigor than verbs such as "analyze" or "interpret" (or combinations such as 'identify and provide evidence to illustrate"). A broad benchmark, such as "comparing the diverse voices of our national experience" in a variety of texts, implies rigor and depth but is somewhat vague in terms of the skills and knowledge required. Slight revision to clarify the focus of this benchmark could strengthen its rigor.

Breadth

Ratings for breadth are assigned based on the questions below, each of which is reported in a separate table.

- Do the benchmarks describe sufficient and appropriate breadth of content across standards *within each grade span*?
- Do the benchmarks contain the essential content for this subject *within and across grade spans*?
- Are the benchmarks free from extraneous content *within and across grade spans*? If not, what content is extraneous?

Each of the three aspects of breadth examined is reported in a separate table in order to distinguish between essential and extraneous content.

Breadth represents the sufficiency of content across the standards. The table below shows the ratings for overall breadth *across* the reading standards within each grade span and across the grade spans.

Table 5. Ratings for Overall Breadth in the Reading and Writing MCS

Grade Span	Across Standards
K–4	P
5–8	P
9–12	P
Across Grade Spans	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

The overall rating for breadth within grade spans was P for all grade spans. These holistic ratings reflect the lack of *some* essential content in the benchmarks for three or more standards for each span. For example, standard 1 includes content in the standard statement but the skills and knowledge summarized in the standard's bulleted lists are not reflected in grade span benchmarks articulating the specific skills and knowledge expected for each span. Standards 2 and 6 also under-emphasized some knowledge and skills one would expect to see included as essential content.

The table below shows the breadth ratings for essential content in the Reading and Writing standards, reported for each standard at each grade span, as well as across the grade spans.

Table 6. Ratings for Breadth—Essential Content in the Reading and Writing MCS

Grade Span	1	2	3	4	5	6	Across Standards
K–4	I	P	P	F	P	P	P
5–8	I	P	F	F	F	P	P
9–12	I	F	F	F	F	P	P
Across Grade Spans	I	P	F	F	F	P	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Overall, the K–4 grade span received the most P ratings for breadth, with four standards (2, 3, 5, and 6) rated as P, one standard rated as I, and one standard (4) rated as F for breadth. In particular, the benchmarks for K–4 do not describe the acquisition of foundational knowledge and skills in reading in grades K–2 and only partially describe the early development of writing skills. The benchmarks for some other standards appear to focus primarily on skills typical of the upper range of the grade span (i.e. "knowing and using subject-verb agreement" for standard 3). Given the broad scope of this grade span, and the importance of foundational learning in all areas of the language arts, the benchmarks for this span would be strengthened by more specific elaboration of developing skills and knowledge across the span.

The table below shows the breadth ratings for freedom from extraneous content in the Reading and Writing standards, reported for each standard at each grade span, as well as across the grade spans.

Table 7. Ratings for Breadth—Free of Extraneous Content in the Reading and Writing MCS

Grade Span	1	2	3	4	5	6	Across Standards
K–4	F	F	F	F	F	P	F
5–8	F	F	F	F	F	P	P
9–12	F	F	F	F	F	P	F
Across Grade Spans	F	F	F	F	F	P	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Overall, Colorado's standards and benchmarks are free of extraneous content. Only one standard, 6, received a rating of P for freedom of extraneous content. The standard 6 benchmark for all spans, "using new vocabulary from literature in other contexts," is a benefit of studying literature, but is not intrinsic to the study of literature itself.

External Referent Review

As described in the Methodology section of this report, analysts reviewed four sets of content standards to serve as an external referent comparison with Colorado's MCS in reading and writing. The following documents were used as external referent standards for the reading and writing review:

- Massachusetts English Language Arts Curriculum Framework (June 2001)
- Supplement to the Massachusetts English Language Arts Curriculum Framework (May 2004)
- English Standards of Learning for Virginia Public Schools (November 2002)
- National Core Curriculum for Basic Education 2004 (Finland)
- National Core Curriculum for Upper Secondary Schools 2003 (Finland)
- English Language Syllabus 2001 For Primary and Secondary Schools (Singapore)

These external referent standards were reviewed for two broad criteria, organization/ structure and content. Each criterion contained several subcategories about which analysts recorded observations before determining a final overall holistic rating of mostly similar (Similar) or mostly different (Different). Findings from these analyses are presented below.

The table below summarizes the holistic external referent standards in comparison with Colorado's MCS.

Table 8. Holistic Comparison Ratings for Reading and Writing External Referents

Rating Category	Massachusetts	Virginia	Finland	Singapore
Organization/ Structure	Different	Different	Different	Different
Content	Different	Different	Different	Different

The holistic ratings above reflect the analyst's judgment that in all of the four external referent standards, there were more differences overall, in both content and structure, than there were similarities with Colorado's MCS. The analyses below highlight various similarities and differences between the MCS and pertinent categories in each referent's documents. It is important to note that the referents have similarities and differences among one another, as well as with Colorado's MCS. However, no one approach is intended to be presented as necessarily more or less effective than another. Differences in structure or content of a state or country's standards may be qualitative, but may also be attributable to differences in history, purpose, and/or context. Thus, the implication is that

a variety of approaches and combinations of approaches may be considered, should they be determined to be appropriate for Colorado.

Organization and Structure

In relation to structure, all of the external referents differed to some extent from Colorado's MCS and from each other. All of the external referents shared with Colorado the basic structure of broader standards that are either identical or closely related across grades, elaborated by benchmarks describing the specific skills and knowledge expected for each grade span or level. Beyond this similarity, however, there were far more differences, large and small, across the five sets of standards, in grade articulation, hierarchy and number of standards, design and format.

Colorado has six broad standards across all grade spans and an average of approximately 30 benchmarks per grade span. All of the external referents had a greater total number of standards and most had more benchmarks than Colorado, with Massachusetts having the highest number of overarching standards (27) and grade level benchmarks (approximately 50 per grade span). Virginia and Singapore are similar in their number of standards (9 for Virginia; 10 for Singapore) and grade level benchmarks (35–45 for Virginia, closer to 50 for Singapore). Finland's very different organization makes comparison more difficult; at the primary level (grades 1–9), its four overarching objectives are elaborated through 12–16 more specific objectives per grade span; these in turn are elaborated through approximately 25 end-of-span performance descriptions (similar to Colorado's benchmarks) for each span.

To some extent, the higher number of standards in the referents reflects differences in Colorado's strategies for organizing its content. Colorado has the broadest grade spans (four-to-five years) of any of the standards reviewed, which leads to a smaller overall number of benchmarks, especially compared to states with single or two-year grade spans. Some of Colorado's benchmarks also "bundle" multiple skills or components that are commonly separated in the referents: "drafting, revising, editing, and proofreading," for example, or "making predictions, drawing conclusions, and analyzing what they read, hear, and view;" the latter would be represented in at least three separate benchmarks in most of the referents. Colorado also includes a considerable amount of content in some of its standard statements, particularly in its standard 1; integrating that content into grade level benchmarks would lead to a higher total number of benchmarks.

Colorado's six standards cross all grades while some of the referent standards (Virginia and Finland) differentiate their standards for individual grade spans or levels. Colorado's MCS also integrate multiple strands of the language arts in the standards to a greater extent than most of the referent standards; in effect, some of its standards (particularly 2 and 4) are more tightly "bundled" than those of most referent standards. Most of the referents address oral language skills in separate standards, for example, while the skills described in standard 4 (thinking skills) would typically be organized into at least two standards related to the analysis of non-fiction and the interpretation of literature. Overall, the differences between the numbers of standards and benchmarks in Colorado's MCS

and those of the four referents are partly due to Colorado's organization, or condensation, of its content.

As noted above, Colorado has broader grade spans across all grades than any of the external referents. Virginia articulates standards by individual grade level; Massachusetts and Singapore both organize their standards by two-year spans (although Massachusetts has added grade level benchmarks in reading and vocabulary for grades 3, 5, and 7 to comply with NCLB). Finland is distinctive in having one two-year (grades 1–2), one three-year (3–5), and one four-year (6–9) grade span in its primary system (1–9) while its four-year secondary level (approximately comparable to 9–12) is not organized by grades but by courses.

The difference between Colorado's four- to five-year spans and the smaller spans in the referent standards is significant; it allows the referent standards to give greater definition to the specific skills and capacities expected for each grade level or span and to the incremental progression of skills across levels or spans. One key difference is in the articulation of standards for the primary grades; all of the external referents give significantly more definition to the development of reading, writing, and oral language skills in the early years. Overall, Colorado's broad grade spans provide distinctly less sense of the progression of skills and knowledge within four to five-year spans; its benchmarks also tend at times to be broader in scope (skills which apply to all four years in a span) than those of the referents, or to emphasize skills at the upper range of the span.

One other distinctive difference between the referent standards and Colorado's MCS is that all the referents organize their standards by some overarching principle or structure, such as strands of the language arts. Both Massachusetts and Virginia organize their standards by strands, although each defines their strands somewhat differently. Virginia's are Reading, Writing, Oral Language, and Research (9–12 only); Massachusetts also has a "Media" strand and a "Language" strand that includes oral language, vocabulary, and the structure and origins of English. Singapore emphasizes function, organizing its standards by three types of language use: "Language for Information, Language for Literary Response and Expression, and Language for Social Interaction." Finland's four broad objectives for student learning also emphasize different functions of language use but focus more specifically on the students' growth in "interaction skills," in "interpreting and utilizing various texts," in "producing texts and utilizing them for different purposes," and in developing their "relationship with language, literature, and other culture." Each strategy for organizing standards has its advantages and disadvantages but all provide a guiding structure for the content.

Content

Though there were a significant number of similarities with Colorado's MCS across all four external referent standards, the differences found were substantive. Overall, the greatest similarities in content between the MCS and all referent standards were found in the following areas represented in Colorado standards 1, 3, 4, and 5: reading comprehension skills and strategies (*beyond* learning to read in K–2); skills and strategies

for locating and using information; knowledge and use of conventions in writing and speaking; and analytic or critical thinking skills, particularly those applied to non-fiction texts.

In some cases, the external referents may have included more breadth or depth of content in these areas, but all included content paralleling that of Colorado's, sometimes using identical phrasing.

All of the external referent standards gave greater emphasis than Colorado to the acquisition of reading and writing in the primary grades, with Massachusetts and Virginia providing the most detailed descriptions of these foundational skills. Virginia, for example, in its first grade standards, includes three standards and 16 indicators (comparable to Colorado's benchmarks) addressing the development of phonological and phonemic awareness, decoding skills, and concepts of print. Massachusetts includes a separate "General Standard" for "Beginning Reading" in grades PreK–4 to describe the development of "phonemic awareness, knowledge of the relationships between sounds and letters, and of an understanding of the features of written English texts." Colorado's standards were unique in not providing any grade span benchmarks to address these skills.

Although much of the content of Colorado's standards 2 (writing/speaking) and 6 (literature) was also found in the referent standards, there were significant differences in the following areas, which received notably less emphasis in Colorado's MCS than in the four referents: interpretation, analysis, and evaluation of literature; speaking and listening skills, especially those related to dialogue and discussion; and skills in using the writing process and elements of composition, such as organization, focus, and development.

In general, Colorado's MCS literature standard and benchmarks tend to emphasize the historical and cultural significance of literature to a greater extent than most of the external referents, and to give less emphasis than the referents to the knowledge and skills used in the interpretation, analysis, and evaluation of literary elements, works, and genres.

All of the referent standards also gave more emphasis than Colorado's MCS to the writing process and to the progression, across grades, of specific skills in using elements of composition, with Massachusetts providing the most detailed and comprehensive elaboration of these skills, and Finland providing notable depth and richness. As with its standard 1, Colorado's standard 2 (writing and speaking) lists some writing skills in its standard statement (organization, for example) that are not elaborated in specific benchmarks for each grade span. Colorado's MCS do include the process of "revising, editing, and proofreading" at every grade span; however, most of the referent standards separate revision from editing, and describe more specific revising skills, such as "revising for clarity," "condensing," or revising to "improve level of detail." All of the referent standards also include skills for evaluating one's own and peers' writing for some or all grade levels.

Compared to Colorado's MCS, all four referent standards also included fuller and more specific elaboration of oral language skills, applied to both formal and informal contexts. Although several of the referent standards, like Colorado, integrated speaking and writing in some standards, all of the external referents also described oral language skills in separate standards and benchmarks as well. All gave greater emphasis than Colorado to oral language skills used in group discussions and other informal contexts. Massachusetts' standard 2, for example, focuses on skills in "Questioning, Listening, and Contributing," primarily in the context of group discussions. Virginia has a similar standard for most grade levels, with an increased focus on more formal oral presentations at the high school level. Finland's "interaction" objectives focus on students' skills in communicating in a wide variety of classroom contexts, including discussion, dialogue, giving and receiving feedback, self-expression, conflict resolution, and more. Singapore also gives substantial emphasis to a broad range of oral language skills, including "interacting effectively with people from own or different cultures/religions." Referent standards that emphasize speaking and listening skills used for dialogue and discussion also tend to include more references to collaborative activities throughout the standards, such as group oral presentations, peer editing groups, etc.

All of the external referents also included more content than Colorado related to the comprehension, analysis, evaluation, and use of media. Colorado's standard 5 includes benchmarks related to the use of electronic resources and technology to locate information and conduct research, content included in all of the external referents. In addition, Massachusetts' "Media Strand" includes one cross-grade general standard focused on the analysis of media (radio, television, film, internet, etc.) and one focused on media production (audio, video, multimedia, internet, etc.). Virginia includes standards for the analysis of media in some of its oral language standards, primarily in grades seven and above. Finland and Singapore both explicitly include electronic and non-print media in their definition of "texts;" both integrate skills used in the comprehension and analysis of media throughout their broader language arts standards.

Massachusetts

Like Colorado, Massachusetts articulates its standards by grade spans and like Colorado's six cross-span standards, its "General Standards" recur across all spans. Also like Colorado, Massachusetts organizes their standards vertically, presenting each broad standard one at a time across all grade spans. Both states also elaborate their standards through the more specific knowledge and skills described in span level benchmarks, or "learning standards," for Massachusetts.

Massachusetts organizes its standards by four strands: Reading and Literature; Language (includes oral language, vocabulary, and the structure/origins of English); Composition; and Media. Both strands and General Standards play a key role in Massachusetts' standards, providing an overarching structure within each grade span as well as continuity across all grades. Colorado's six standards provide the only organizing structure for its standards document.

Two of the most significant differences in the structure of Massachusetts' standards include its greater overall number of standards compared to Colorado, and the more specific and detailed elaboration of those standards through the span level learning standards (comparable to benchmarks). Massachusetts' grade spans are considerably smaller than Colorado's; most are two-year spans, with one three-year span for PreK–2. However, the PreK–2 General Standards for vocabulary, reading and composition are further subdivided into Pre-K and 1–2 clusters. These smaller grade spans allow Massachusetts to describe more specific knowledge and skills in the learning standards for each span as well as a clear progression of knowledge and skills that build on each other from span to span. The vertical organization of the standards highlights this careful scaffolding of skills and knowledge across spans, as does the use of parallel language across learning standards.

The specificity of Massachusetts' learning standards help to create a vivid picture of the kinds of activities, projects, and assignments students would carry out to meet each standard. In fact, most of Massachusetts' learning standards are accompanied by examples of specific assignments, in parentheses following the standard. Colorado's benchmarks typically describe skills and knowledge in broader terms, leaving greater scope for interpretation in terms of assignments and tasks that would fulfill the standard. Both approaches to the level of specificity of standards or benchmarks have advantages and disadvantages. There is less freedom, flexibility, and potential breadth in Massachusetts' very specific standards but also more clarity and focus. In this regard, Virginia's standards might be considered to represent a middle ground between Colorado and Massachusetts, with indicators that are typically more specific and focused than Colorado's benchmarks, but less circumscribed and detailed than Massachusetts' learning standards.

Massachusetts has also chosen to differentiate the content of its standards to a far greater extent than Colorado or than any of the other referent standards. Massachusetts has 27 General Standards compared to Colorado's six standards (and Virginia's average of nine per grade), including three standards for oral language, ten standards that address literature and seven standards that address different aspects of writing. If Colorado's approach, at least in some standards and benchmarks, is to "bundle" multiple strands and skills, Massachusetts has taken the opposite approach, "unpacking" its Composition strand, for example, into separate standards for: Writing (General), Consideration of Audience and Purpose, Revising, Conventions, Organizing Ideas in Writing, Research, and Evaluating Writing and Presentations.

Massachusetts' standards describe substantial breadth and depth of content, elaborated through learning standards of considerable specificity and detail. However, the differentiation of their standards also leads to some overlapping categories and duplication of content. Massachusetts' standard 8 ("Understanding a Text"), for instance, includes some of the identical content and learning standards as standards 12 ("Fiction"), 13 ("Non-fiction"), and 14 ("Style and Language"). In addition, the scope of some of Massachusetts' standards is quite narrow. While most General Standards have at least two learning standards per grade span, some, like standard 1 ("Discussion") have only

one learning standard for each grade span; in this case, the single skill is that of "using agreed-upon rules for informal and formal discussions."

Overall, Massachusetts' choice of creating a higher number of differentiated standards, with relatively few learning standards for many of those, has a clear advantage in terms of articulating more specific skills and knowledge in each standard; it would appear to have some drawbacks in terms of overlapping content in multiple standards, some notably narrow standards, and perhaps less sense of the cohesion or interdependence of some very closely related skills and knowledge.

Massachusetts' General Standards and learning standards are generally concise, focused, and concrete. General Standards are conveyed in a single sentence, and like the learning standards, are characterized by the use of active verbs and specific nouns.

In terms of content, Massachusetts' standards include nearly all of the content of Colorado's standards but in general, Massachusetts elaborates their standards in greater depth and breadth. Massachusetts gives more emphasis to the development of foundational skills in reading and writing in the primary grades, and to oral language across all grades. In contrast to Colorado, which combines writing and speaking in multiple standards, Massachusetts has three separate standards for oral language skills, with two of those focused on skills used in discussion and other less formal contexts.

Perhaps the greatest difference in content, however, is the much greater emphasis in Massachusetts' standards on a broad range of knowledge and skills used to comprehend, interpret, analyze, and evaluate literature. Colorado's standards and benchmarks related to literature are far fewer in number; very few require students to interpret particular works of literature or to analyze/evaluate the effects of specific literary elements, such as plot structure, characterization, imagery, diction, etc.

Massachusetts' literature standards describe greater breadth, depth, and rigor in the interpretation, analysis, and evaluation of literature across all grade spans, as well as a more clearly defined sequence of learning from one two-year span to the next. The Dramatic Literature standard, for example, begins by asking PreK–2 students to "identify the elements of dialogue and use them in informal plays" and progresses to learning standards calling for the analysis of "setting, plot, and characterization" in plays and films, types of dramatic literature, and the use of "dramatic conventions." Many of Massachusetts' literature standards show a comparable progression from the identification of (and response to) literary elements in the primary grades to analysis and evaluation at higher grades. Very few benchmarks in Colorado's standards use words such as analyze, evaluate, or interpret. The combination of rather broad or general language in some benchmarks and the use of verbs like *identify* and *recognize* contributes to an overall impression of less rigor and depth in Colorado's approach to literature.

Virginia

Both Colorado and Virginia have a broad set of standards elaborated through more specific benchmarks or "indicators." In contrast to the broad grade spans of Colorado's MCS, however, Virginia articulates their standards by grade level, allowing them to give greater definition to the specific skills and capacities expected for each grade and to the progressive growth of skills from year to year. In addition, while Colorado's six overarching standards remain constant across all grade spans, Virginia differentiates both their standards and their indicators (comparable to the MCS benchmarks) for each grade level. There are more standards, for example, in Virginia's primary grades—an average of 12 per grade for K–3—to allow for the description of foundational skills in reading and writing, compared to an average of nine for the upper grades. Even closely related standards often vary by grade level, showing a progression of skills across grades; for example, an oral language standard for grade three focuses on the use of "effective use of communication skills in group activities" while a grade six standard focuses on the student's ability to "analyze oral participation in small-group activities."

Overall, Virginia's choice of organizing standards by grade level allows them to describe more specific skills and knowledge for each level as well as a more finely gradated sequence of learning across levels. For example, a Colorado benchmark for the organization of writing across the K–4 span is "organizing their writing." A Virginia indicator for a grade-two writing standard is to "organize their writing to include a beginning, middle, and end." At grade four, indicators for the related standard ask students to "a) focus on one aspect of the topic, b) organize writing to convey a central idea, and c) write several paragraphs on the same topic."

While Colorado's MCS are organized vertically, presenting each standard one at a time across all grade spans, Virginia's standards are organized horizontally, presenting a unified picture of all standards and indicators for each grade level. Colorado's format emphasizes broader goals across all grade spans. However, Virginia's standards also have considerable continuity and coherence across grades, due to Virginia's organization of their standards by strands, which provide an overarching structure across all grades. In addition, most of Virginia's standards describe the same core skill or knowledge across all grades, with expansion of the types or complexity of its applications from one grade to the next primarily articulated in the grade level indicators. All grades have a standard for the comprehension of non-fiction texts, for example, expressed in similar language across all grades, but shifting from "read and demonstrate comprehension" in grades 1–7 to "read and analyze" in grades 9–12 to reflect grade-appropriate depth and rigor.

Colorado's standards and benchmarks are generally clear and accessible. However, some standard statements contain substantial content tightly packed into bulleted lists under the standard. Some benchmarks also "bundle" multiple skills and strands in one benchmark. In such cases, the focus of the standard or benchmark can appear diffused, spread over multiple topics or concepts. Virginia's standards and indicators, by contrast, are notably concise; all standards are conveyed in one sentence, and the standards and indicators for most grades take up no more than two pages per grade. Most grades have fewer than ten total standards, and as evident in the example above, the language used (in both standards

and indicators) is concrete, focused, and spare. The clarity and conciseness of Virginia's standards, combined with the continuity of strands and core skills across grade levels, creates a highly accessible and cohesive standards document, conveying substantial depth and breadth of content with striking economy.

In terms of content, as noted in the general summary, nearly all of the content of the Colorado MCS can be found in Virginia's standards. Both states include much of the same content related to knowledge and use of conventions, for example, and both include many similar skills related to locating and using information. Both also address many of the same reading comprehension skills and strategies, although Colorado summarizes these in its standard statement while Virginia defines specific skills and strategies in multiple reading standards and indicators for each grade level. However, Virginia's standards and indicators describe greater breadth and depth of content for foundational skills in reading and writing in K–3; and the interpretation and analysis of literature, and oral language skills and knowledge across all grades.

Virginia's K–3 standards and indicators include a progression of beginning reading skills such as developing concepts of print, phonemic and phonological awareness, decoding, and fluency. Standards and indicators for writing in Virginia's also show a progression from beginning steps in Kindergarten, "Draw pictures and/or use letters and phonetically spelled words to write about experiences, stories, people, objects, or events" to more organized and developed writing in grade three: "The student will write descriptive paragraphs." Colorado's K–4 standards and benchmarks provide very little differentiation of knowledge and skills, including foundational skills, within the five-year span.

Virginia also takes a different approach from Colorado to the comprehension and analysis of literature. Colorado's standard 1 summarizes a broad array of reading comprehension skills ("previewing, predicting, comparing and contrasting," etc.) that apply to both literary and informational texts, while Colorado's standard 6 focuses primarily on the study of literature for its cultural and historical significance.

Virginia also combines reading comprehension skills that apply to both fiction and non-fiction in grades K–2 but begins describing separate standards and indicators for the comprehension of fiction and non-fiction at grade three. Standards for the comprehension of literature branch out further starting in grade six to encompass fiction, literary non-fiction, and poetry; high school standards also address the comprehension and *analysis* of drama and a greater variety of poetry. This increasing differentiation of literature standards allows Virginia to include many more specific indicators focusing on the skills students use to understand and analyze literary works and their elements, such as plot, character, theme, diction, and imagery, as well as genres, such as poetry, drama, and fiction.

Finally, Virginia standards describe a greater breadth and depth of oral language skills than Colorado's. Colorado standards combine writing and speaking in several standards but describe very few skills specific to oral language. Virginia includes at least two standards at every grade focused on oral language, and its standards and benchmarks

emphasize a wider range of oral language skills, including formal oral presentations, dramatic readings, participation in small group activities and discussions, and the analysis/evaluation of oral presentations by others.

Finland

Like Colorado with its six cross-span standards, Finland articulates four broad "objectives" for Mother Tongue and Literature across all grade spans in its primary education (grades one through nine). In its upper secondary education (roughly comparable to Colorado's 9–12 span) Finland articulates a more specific set of objectives for each of six "compulsory" courses and for a selection of "specialization" or elective courses. The upper secondary system is not organized by grade spans or levels but by progression through these courses. The organization and structure of Finland's primary and upper secondary systems are thus quite different, and will be discussed separately below.

Primary Education. Finland is unique among the referent standards in having grade spans of varying size, from two years to four years. Within their primary or "comprehensive" schools, Finland organizes their objectives by three grade spans: grades 1–2, 3–5, and 6–9. (Finland's "pre-primary" education, the equivalent of kindergarten, has its own separate curriculum and objectives and is not included in the primary school).

Finland's four overarching objectives for its primary grades are more comprehensive than Colorado's standards; they refer to broad dimensions and functions of the language arts, such as "interaction" and "interpreting and utilizing texts." They are also notably student-centered in their language, focusing on students' skills, abilities and relationships, rather than on content strands, such as reading or writing. Although differentiated to some extent for each span, the four objectives are closely parallel in language and content across spans. For grades 6–9, the objectives are: The pupils' interaction skills will increase; The pupils' skills in interpreting and utilizing various texts will develop; The pupils' skills in producing texts and utilizing them for different purposes will develop; and The pupils' relationship with language, literature, and other culture will deepen.

Each of Finland's broad objectives is developed through three-to-four more specific objectives for each grade span. For example, the objective for "interaction skills" at grades 1–2 calls for pupils to "learn to listen with concentration" and to "learn to ask and answer questions." These span-specific objectives are further elucidated by descriptions of the "Core Contents" describing the knowledge and skills to be mastered for each objective within each grade span. In relation to each broad objective, the core contents answer the question, "What are students doing and learning over the course of this span?" For example, core contents for reading and writing skills in the 1–2 span include "analyzing printed and electronic texts through group discussion" and "word recognition, progressing from short words towards long, unfamiliar ones."

Both the specific objectives and the core contents are fairly similar to Colorado's benchmarks in describing knowledge and skills for each grade span. In addition, Finland also provides end-of-span descriptions of "good performance" to define the level of attainment at the completion of each span. Also organized by the four broad objectives, these define more concrete learning goals for students at the end of grades two, five, and nine. For example, at the end of grade five, students' interaction skills should allow them to "recount and describe their own observations and ideas, and compare them with the observations of others" and "to make a clear, small-scale oral presentation to a familiar audience." At each grade span, Finland had similar numbers of end-of-span performance descriptions as Colorado had benchmarks across each of its spans. For example, Finland has 26 total performance descriptions at the end of grade five and 33 at the end of grade nine; Colorado has 33 benchmarks for its 5–8 span.

Taken together, Finland's span-specific objectives and core contents, and the end-of-span performance descriptions provide a fuller, more complete picture of the knowledge and skills students are expected to master within each primary grade span than Colorado's benchmarks. The core contents fill out the picture of skills and knowledge addressed across each span, while the performance descriptions provide a focused picture of the level of culminating skills and knowledge students are expected to attain by the end of each span. Colorado's benchmarks must describe general knowledge and skills that can be addressed by students at all levels across its four-year spans; this constrains Colorado's ability to describe the progression of learning within spans or to indicate the level of performance students will attain by the end of the span.

Secondary Education. At the upper secondary level, Finland organizes its objectives by courses. Comparison with Colorado's standards for the 9–12 span focused on Finland's objectives and core contents for its six "compulsory" courses, and not the elective courses. Finland does not provide end-of-span descriptions at the secondary level. However, it should be noted that Finland's primary and secondary systems do not correspond precisely to United States grade articulation. Students in Finland enter first grade at age seven and enter the four-year upper secondary system at age 16. Thus there is some overlap between Colorado's 9–12 standards and benchmarks with Finland's objectives for both primary 6–9 and those for its upper secondary system.

Finland's upper secondary objectives and core contents integrate all strands of the language arts in theme-based courses; "reading, writing, oral communication, language, literature, and the media will be linked to the objectives and contents of each course, in order for skills and knowledge to be learnt in continuous interaction." The objectives for each course parallel Colorado's benchmarks, describing what students will learn or do: (Pupils will) "learn to justify their interpretations of texts both orally and in writing."

The language of Finland's objectives is richly descriptive. Sentences can become long at times, with liberal use of coordinate clauses and semi-colons. In some cases, performance descriptions might benefit from being "unpacked" to give more focus to their component parts. Overall, however, the objectives are clear, specific, and accessible.

In terms of content, nearly all the content of Colorado's standards and benchmarks can be found in Finland's objectives, core contents, and end-of-span performances (for grades 2, 5, and 9). In many areas, however, Finland's "standards" describe greater breadth and depth of content. Like the other external referents Finland gives more emphasis than Colorado to foundational reading and writing skills in their 1–2 grade span, such as "breaking down speech into words, syllables, and sounds" or "gradually shifting from reading aloud to reading silently." However, Finland does not elaborate the progression of early reading and writing skills in as much specific detail as either Virginia or Massachusetts.

Finland also includes greater breadth and depth of content for the study of literature than Colorado's standard 6. In the 6–9-grade span, for example, Finland includes knowledge of the "main genres" of literature, the "main stylistic range of texts" (romantic, realistic, and modernist), "Finnish literature's main historical phases," and "some literary classics representing different eras." At the upper secondary level, the objectives for "Devices and interpretation of literature" focus almost entirely on the analysis and interpretation of individual works and genres, while "Language, literature, and identity" focuses on "key works and themes in Finnish literature" in relation to both "cultural and individual identity" (similar to Colorado's focus on the cultural/historical dimensions of literature in standard 6).

Finland differs from Colorado and also from the other referent standards in the depth, breadth, and rigor of its "Interaction skills," one of Finland's four overarching objectives across all primary grade spans. Although it includes oral language skills, such as "active listening" and making oral presentations, this objective also addresses interaction in much broader terms. For example, across the primary grade spans, students learn how to listen critically to others, to "evaluate what they read and hear," and form and defend their own opinions, but also "become accustomed to the existence of differing viewpoints and ways of interacting." Core contents for the 6–9 grade span include skills for resolving "conflict situations," for "giving and receiving feedback," and for "assessment" of one's own "media-use, reading habits, and communication habits and skills." At the secondary level, students continue to develop their knowledge of "group communication" and "to assess their own participation in terms of group interactions, atmosphere and teamwork." Across all levels, Finland's objectives describe a rigorous and in-depth range of both conceptual knowledge about and practical skills in communication, including self-knowledge about one's own communication habits and methods.

Also relevant to Colorado's current standard review and revision is Finland's integration, throughout its objectives, of a set of skills and abilities closely aligned to those described in Colorado's description of "21st Century Skills and Abilities." Although critical thinking and information literacy are well represented in Finland's objectives, the strong emphasis on collaboration, self-direction, and invention throughout all content areas and across all grade spans is particularly distinctive in Finland's objectives and unique among the referent standards.

Self-direction, initiative, and personal responsibility, for example, are evident in both primary and secondary objectives in which students choose what to read based on their interests; plan and develop their own topics for writing and oral presentations; plan research, and choose and evaluate their sources of information; and observe, evaluate, and take responsibility for their own skills as readers, writers, and communicators. Students in the 3–5 span, for example, "learn to select reading material that is interesting and appropriate to them;" they "consider the text's meaning and dependability for themselves" and "use their reading skills for both benefit and fun." They also "know how to describe themselves as readers," and "how to orient themselves in many text environments."

Collaboration skills are emphasized throughout Finland's primary and secondary systems in the objectives for "interaction" discussed previously. By the end of grade nine, for example, students are expected to "demonstrate skill in inferential and evaluative listening," participate in "problem-solving and idea-sharing discussions," and know how to "present a proposal, a position, further information, and justifications." They also accept and use feedback and "furnish constructive feedback to others."

Capacities for invention, creativity, and the integration of ideas are represented in many of Finland's objectives at the primary level, and throughout the integrative courses at the secondary level. In writing, students are expected to write texts based on their own "experience and imagination" from the earliest grades, including fiction that "builds new worlds;" to develop their own voice in writing, and in upper secondary, their own "manner of expression and literary style." In reading, students make connections with "ideas awakened by texts" and their "own lives and environment;" they also search for connections between literature and other arts. Skills in "self-expression" are emphasized in the "interaction" objectives.

Upper secondary course**s** integrate the study of texts (literary, informational, media) with analysis of their relationship to culture, values, world-views, and individual identity. The objectives ask students to examine and assess texts, including their own, from a variety of perspectives; "Text, style and context," for example, focuses on the interaction between texts and their styles with cultural contexts, world-views, values, and ideologies. (Colorado's benchmarks for standard 6 also integrate the study of literature with an understanding of cultural and historical factors but lack the greater specificity and rigor of Finland's objectives). In most upper secondary courses, students are both analyzing and producing texts with the same perspectives and contexts in mind (i.e. writing texts that use the same literary devices they are analyzing in literary works).

Finland's presentation of objectives, core contents, and end-of-span performance descriptions make clear its educational values and philosophy embodied in this content. In contrast to the language of Colorado's standards and that of the other external referents, which tends to be more value-neutral, Finland explicitly describes personal and human capacities and attributes students are expected to attain through their study of language and literature. Words like *creativity, imagination, interest, enjoyment, confidence, ethical awareness, courage, tolerance, motivation, and self-awareness* appear

not only in the introductory material, but also in the language of the objectives, core contents, and performance descriptions themselves. For example, students in the 1–2 span write texts based on their "own observations, everyday experiences, opinions and imagination, with an emphasis on the *joy of creating*." In end-of-span descriptions for interaction at grade nine, students "*want* and venture to express themselves in writing and orally," and in literature, they can "find factual and fictional literature and other texts that *interest* them, and are able to justify their choices."

The values reflected in Finland's objectives are also articulated in the introductions to the objectives as a whole at the primary level and to the courses at the upper secondary level. The introduction to the primary objectives, for example, states that the overall objective of instruction in language and literature is "that the pupil becomes an active and ethically responsible communicator and reader who gets involved in culture and participates in and influences society."

Singapore

Like Colorado with its six cross-grade standards, Singapore articulates 10 overarching standards or "Learning Outcomes," that apply across all grade spans, primary and secondary. Singapore's spans are smaller than Colorado's however, with two-year grade spans across the six primary (primary grades1–6) and four secondary grades (secondary grades 1–4 or 5) in their educational system. (A fifth year of secondary education is optional in Singapore). Kindergarten has its own curriculum in Singapore and is not included in the primary grades.

Colorado's benchmarks apply across the four-to-five grades within each of its spans, K–4, 5–8, and 9–12. Singapore's "benchmarks" describe "attainment targets for pupils at the end of each two-year period." (The word "benchmarks" will be used to refer to the "skills, strategies, or attitudes" Singapore describes for each span). However, unlike individual grade level standards, the end-of-span benchmarks describe the goals towards which students are working throughout the two-year period. This is made explicit in the introduction to the learning outcomes: "This two-year period for the attainment of each set of Learning Outcomes will give teachers time and flexibility to cater to the different learning needs and abilities of their pupils."

Singapore's learning outcomes are organized by three broad "areas of language use:" "Language for Information; Language for Literary Response and Expression; and Language for Social Interaction." Each of the three areas integrates reading, writing, and speaking used for these functions of language. Learning outcomes 1–7 describe skills and knowledge that apply to all three areas of language use; for example, "Speak fluently and expressively on a range of topics" can be applied to informational topics, responses to literature, or the sharing of personal experiences or opinions. Learning outcomes 8–10 describe skills and knowledge that apply to the three specific areas of language use. For example, "Interact effectively with people from own or different culture(s)/religion(s)" is a learning outcome specific to "Language for Social Interaction." This organizing structure for Singapore's learning outcomes is supported by the different page layouts for

outcomes 1–7 and 8–10 (three columns); the document is very clearly structured and user-friendly.

At the level of each of its two-year spans, Singapore has more benchmarks than Colorado has for its four-year spans. For example, Singapore has 56 specific benchmarks for the end of primary grade six. Colorado has a total of 33 benchmarks for its 5–8 span. The higher number of benchmarks partly reflects the greater depth and breadth of content for oral language skills in Singapore's learning outcomes; two learning outcomes address oral language skills separately while oral language skills are also integrated into four other learning outcomes. Benchmarks for reading comprehension are also elaborated much more specifically in Singapore's learning outcomes than in Colorado's standards.

In contrast to Colorado's vertical organization of its standards, Singapore's learning outcomes and benchmarks are organized horizontally, presenting a unified picture of all learning outcomes and benchmarks for each two-year grade span. Singapore's format emphasizes grade span goals, but with sufficient cross span repetition to show the continuity of learning outcomes across all grade spans. Colorado's format places the emphasis on broader goals across all grade spans but does not provide a unified picture of individual grade spans.

The language of Singapore's learning outcomes and benchmarks is concise, concrete and less formal than that of most of the referents. Learning outcomes and benchmarks are both conveyed in single sentences that employ active verbs and specific nouns and are typically quite crisp. Very few modifiers are used and most sentences do not combine multiple verbs or long strings of noun phrases (i.e. "Select a central idea with teacher guidance" or "Identify gist in messages, dialogues."). Overall, Singapore's learning outcomes and benchmarks are clear, accessible, focused, and economical.

Nearly all the content of Colorado's standards and benchmarks can be found in Singapore's learning outcomes and benchmarks. In many areas, however, Singapore's "standards" describe greater breadth and depth of content. Like the other external referents, Singapore gives more emphasis than Colorado to foundational reading and writing skills and to oral language, which is described in considerably more breadth and depth than in Colorado's standards. Oral language is addressed separately from writing in Singapore's learning outcomes 2 ("Listen for information from a variety of sources"), 3 ("Speak fluently and expressively on a range of topics"), and 10 ("Interact effectively with people from own or different cultures/religions").

In relation to Reading, Singapore's learning outcomes and benchmarks also differentiate between skills used to comprehend literary, informational, and social/interactive texts (speeches, dialogue, etc) to a much greater extent than in Colorado's standards. At every grade span, Singapore's learning outcome 8 includes three parallel sets of skills (8.1–8.3) to address the comprehension of texts used for informational, literary and social purposes. Singapore's learning outcome 9 also addresses three parallel sets of skills (9.1–9.3) for acquiring and using knowledge from the three areas of language use. This differentiation

allows Singapore to define more specific benchmarks for these skills, linking them more closely to the context in which they are applied.

Most of the content of Colorado's standard 3 ("Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling") can be found in Singapore's learning outcomes. Like Colorado, Singapore integrates the knowledge and use of conventions in both speaking and writing. In other respects, however, Singapore's approach to grammar and conventions is quite different from Colorado's.

Colorado includes benchmarks describing specific skills in the use of conventions at each grade span (i.e. "knowing and using subject-verb agreement" at K–4). Although each benchmark is prefaced by the word "using," the content for each span is essentially a list of discrete spelling, punctuation, and grammar skills to be covered in that span. This is the case in some of the conventions standards of other referents (Virginia) as well. Singapore integrates the knowledge and use of conventions in its benchmarks for writing, speaking, and comprehending texts at all grade spans. For example, a benchmark for learning outcome 5 ("Write legibly, coherently, and cohesively for different purposes") is "Use grammar, punctuation, and vocabulary appropriately." This benchmark is the same across all grade spans. Conventions are not addressed in a separate learning outcome and lists of specific conventions to be mastered are not included in their benchmarks.

Following the learning outcomes and benchmarks for each two-year grade span, however, Singapore provides the "Grammar Focus" for that span. Although not presented as a learning outcome, the Grammar Focus identifies the specific grammatical structures students in each span will need to know and use in order to read and write the types of texts specified for that span. For example, students in P4 write "Factual Accounts" and will need to know and use "simple past tense, nouns and noun phrases, adverbs and adverbials," etc. This explicit linking of grammatical knowledge and skills for each span to the progression in students' reading and writing skills is unique among the referent standards. It could provide an interesting model for states interested in a more integrated approach to conventions.

Singapore also provides an additional resource for teachers in *Grammar*, an appendix to the learning outcomes that provides a highly detailed summary of the grammar curriculum across all grade spans. The Grammar appendix is organized by topics (such as "Active and Passive Voice," "Types of Sentences") and grade span. It illustrates the sequence in which the conventions are to be taught and learned, specifying when each skill is to be "explicitly taught," "taught at a more sophisticated level," or "revised and reinforced." In addition, most content is linked to the text types students are to read and write at each grade span.

Review of Colorado's Reading and Writing Standards for 21st Century Skills and Abilities and Postsecondary and Workforce Readiness

As described in the Methodology section of this report, analysts analyzed Colorado's draft 21st Century Learning Skills and Abilities (21st Century Skills) and definition of Postsecondary and Workforce Readiness (PWR Skills) to determine the degree to which Colorado's MCS contain the skills described in those draft documents. Findings from those analyses are presented below.

21st Century Skills and Abilities

All of the skills described as 21st Century Skills and Abilities can be addressed in Colorado's English Language Arts standards and benchmarks. The standards already describe some "critical thinking" and "information literacy" skills; these could be strengthened through revision or more specific elaboration of the standards and benchmarks. Some of the current standards and benchmarks also imply a degree of "self-direction" but this skill could be more fully and explicitly integrated throughout the standards. None of the current standards and benchmarks explicitly describes skills in "collaboration" and there is also little emphasis on "invention." The standards and benchmarks would need to be rewritten to incorporate these skills.

Critical thinking and reasoning: In some benchmarks, changes in language could more fully describe critical thinking. For example, "identifying recurrent themes" could be revised to "analyzing recurrent themes." The use of verbs such as *analyze, interpret, develop, explain, infer, and draw conclusions* would strengthen the element of critical thinking in these benchmarks. For example, a benchmark requiring students to 'define a problem, identify and evaluate possible solutions, then develop and explain their own solution' would explicitly require both critical and inventive thinking.

Information literacy: To the extent that "Information literacy" includes skills and strategies used to comprehend "technical publications" or online sources of news, opinions, and information, it would seem appropriate to address this skill more fully in standards for reading comprehension (standard 1) as well as in research (standard 5).

Collaboration: No language in any of the current standards and benchmarks explicitly addresses collaboration skills. Collaboration could be addressed in most standards. Some examples include peer review/editing of writing, class or group publications, collaborative oral or multi-media presentations, dramatic readings or performances of literary texts.

Self-Direction: A degree of self-direction is implicit in some of Colorado's benchmarks ("choosing vocabulary"); to give more emphasis to this skill, the standard could incorporate more references to students planning their work, generating ideas and selecting topics, developing criteria and evaluating their own writing, publishing, etc.

Invention: Some standards and benchmarks suggest opportunities for invention but could more explicitly require or emphasize it. Invention skills applied to the comprehension and interpretation of texts could include asking students to compare and contrast the

experience of a fictional character with an experience from their own life; rewrite a story or fictional scene from a different point-of-view; write an alternate ending to a story; convey an interpretation of a text through visual art, multi-media presentation, or dramatic performance; compare and contrast the expression of an idea in literary and non-fiction texts.

In writing, invention can be integrated into benchmarks that call for students to compose their own works of fiction, poetry or other form of creative writing; or to use diction and figurative language in fresh and creative ways.

Postsecondary and Workforce Readiness

With a few exceptions, all of the skills and competencies described in the "Postsecondary and Workplace Readiness" description can be effectively addressed through a high school level English Language Arts curriculum and its standards. However, Colorado's 9–12 standards and benchmarks do not appear to have been written with this set of integrated skills in mind. Some of the competencies, such as those described as "Human relation skills," are minimally addressed by one of Colorado's standards; one, "Information management skills," is not addressed by any of the standards. Other standards partially address some skills, such as "Logical reasoning and argumentation abilities" or "Analysis and interpretation skills" and have the potential to address them more fully and effectively. To accomplish this, Colorado's standards and benchmarks for 9–12 would need to be rewritten with the content of these skills in mind.

The following are some specific suggestions for addressing the readiness skills in the content areas of Colorado's standards and benchmarks.

Application of reading, writing, and computing skills with minimal remediation: The current standards and benchmarks do not describe reading, writing, and computing skills specifically enough to determine the level of performance expected for students in the 9–12 span (i.e. readiness for college without remediation). To more fully address these competencies, standards and benchmarks would need to describe the level of specific reading, writing, and computing skills and the types of applications of those skills for 9–12 students. For example, an objective for Finland's upper secondary (high school) level clearly describes the level of competency students are expected to demonstrate in writing by "carrying through an independent writing process from choice of a subject and point of view, collection and organization of material, through editing the text and polishing the style." Specific skills used for the analysis, interpretation, and evaluation of informational texts and resources (including online resources) also need to be more specifically articulated. Colorado might want to include a review and updating of computing skills to include more analysis and use of online information and tools.

Logical reasoning and argumentation: These skills are addressed by a number of benchmarks in Colorado's standards 4 and 2 but the skills tend to be described in rather general terms, without language characterizing the level of performance expected or describing any of the specific skills and strategies students are to demonstrate. For example, the standard 4 benchmark "critiquing the content of written work and oral

presentations" implies critical thinking, analysis, and logical reasoning but is extremely broad; there is no indication of the kinds of criteria that might guide a critique or what kinds of support students might be expected to provide. The successful and persuasive communication of a "reasoned viewpoint" typically requires providing sufficient support in the form of factual information, expert testimony, examples, analogies, or evaluation of evidence. The ability to evaluate the reliability and credibility of information and evidence, and to anticipate and respond to questions, objections, and counter-arguments are also essential. These skills can be addressed through standards for writing, oral language, and research, but the current benchmarks would need to be revised to more specifically address these skills.

Problem-solving skills can be more fully integrated into research, writing, and oral language standards and benchmarks. For example, group discussions can focus on identifying and solving problems and oral presentations can focus on presenting or evaluating proposals to address problems. In research, students can identify "dilemmas, gaps, and needs" and plan and carry out research to generate solutions. Creativity and initiative can be encouraged by giving students responsibility for generating ideas for topics in writing, speaking, and research. Colorado's standard 4 includes a broad benchmark for problem-solving; Colorado might consider defining this skill more specifically and integrating it into benchmarks which address specific rather than multiple strands.

Information management skills: Some of the skills described as "information management," such as "financial awareness" and "increasing productivity," are probably not a good fit for English Language Arts standards. However, "systems thinking" and the skill of "adapting to new information" can be addressed in standards for writing, textual analysis, oral language, and research.

Human relation skills can be integrated into many standards. For example, benchmarks can give students more responsibility for generating their own topics in writing and speaking; for developing criteria and evaluating their own writing and speaking as well as that of others; for developing and defending their own interpretations, evaluations, and opinions; for working cooperatively and collaboratively with others in peer editing groups, pair or group presentations; dramatic presentations, and other projects.

Analysis and interpretation skills: The benchmarks in Colorado's standard 4 are particularly related to this skill but are described in broad, general terms. Colorado might consider describing specific analytic and interpretative skills applied to informational texts, media, oral language, etc.

Recommendations

This section contains specific recommendations from the WestEd reviews, organized by the components of the analysis.

Internal Quality Review of Colorado's Reading and Writing Model Content Standards

The CDE may want to consider implementing the following recommendations, where appropriate:

- Incorporate essential content from the elaborated standard statement into grade span (or level) benchmarks, thus differentiating the specific skills and knowledge expected for each span. This is especially relevant for standards 1 and 2.
- Revise benchmarks that are overly broad or complex to clarify and sharpen the focus of each benchmark. In some cases, individual benchmarks may combine three or more different skills in one benchmark (i.e., "recognizing an author's point-of-view or purpose, separating fact from opinion" or "using fictional, dramatic, and poetic techniques in writing").
- Increase depth and rigor by using more active verbs (describe, explain, analyze, interpret, evaluate, etc.) in standards that require students only to "recognize" or "identify" elements or concepts and by linking more discrete knowledge or skills to the integrative skills they support (i.e. link accurate use of literary terms to interpretation of literature).
- Give more emphasis to the skills and knowledge specific to speaking and listening rather than only describing skills and knowledge that can be applied to both speaking/listening and reading/writing.
- Incorporate skills in the analysis and evaluation of different forms of media.
- Include additional benchmarks to address the acquisition of foundational skills in reading and writing in grades K–2 and additional benchmarks to address skills in the interpretation, analysis, and evaluation of literary works. Should any new content be added, the state will need to ensure that all required content can be taught within the time allotted for instruction.
- Narrow the scope of grade spans to allow for more articulation of the progression of skills and knowledge within spans and revise benchmarks for each standard as appropriate to clarify both the continuity and the growth of skills and knowledge from one grade level or span to the next.
- Review benchmarks across standards to ensure consistency. For example, a 5–8 benchmark for standard 4 (thinking skills) requires students to "defend a point-of-view orally and in writing;" however, benchmarks for standard 2 (writing and speaking) do not introduce persuasion until 9–12.

External Referent Review for Reading and Writing

The depth of content in Colorado's standards could be improved by defining the skills, knowledge, and applications of skills and knowledge expected at each grade span in more concrete and specific terms. For example, a K–4 benchmark for standard 2 is "organizing their writing and speaking." However, the benchmarks do not specify the types of writing and speaking expected of students within this span (i.e. narrative, descriptive, expository,

etc.) or the types of organizational structures they are expected to use (i.e. chronological, sequential, etc.). The organization of written or spoken text can certainly require the in-depth application of skills and knowledge, but the benchmark as written could refer to anything from a simple list to a chronological narrative.

CDE may also wish to consider whether the combination of writing and speaking in standard 2, in particular, tends to contribute to an under-representation of skills that are specific to speaking (effective use of volume, pitch, pacing, gesture, visual aids, etc.). Although some skills clearly apply equally to both writing and speaking, others are more specific to one or the other form of communication. The standard 2 benchmarks seem to focus more heavily on writing; for example, only two of the seven benchmarks for the 9–12 span address speaking.

In some cases, benchmarks would gain greater depth if the skill or knowledge they describe were linked to a broader application of that skill or knowledge. For example, a standard 6 benchmark refers to the accurate use of "literary terminology," such as "theme, mood, diction," etc. A more in-depth skill would involve accurately using such terms in the analysis or interpretation of literary works.

To some extent, the lack of specificity or concreteness in some Colorado standards and benchmarks may reflect the scope of the grade spans. Benchmarks that describe expected skills and knowledge across a four- or five-year grade span must be more general than those focused on one or two grades. If Colorado chooses to revise its standards and benchmarks to address narrower or single grade spans, it would likely be easier to describe more specific types and levels of knowledge and skill for each span.

The coherence of benchmarks could be improved by describing the expected knowledge and skills for each span in more specific and concrete terms. In the case of standard 1, for example, the grade span benchmarks call for students to use "a full range of strategies to comprehend" the range of reading materials for that span. However, students' ability to apply comprehension skills (such as inferring or comparing and contrasting) to text does not remain static across grades and grade spans. (Students in the K–4 span, for instance, may be able to make simple inferences based on explicit information but not to draw conclusions based on implicit information). One would expect to see some progression in the range of skills and the sophistication of their application across the spans.

Coherence could also be strengthened by clearly articulating the continuity of skills and knowledge across spans. For example, a 9–12 benchmark for standard 6 is "developing and supporting a thesis about the craft and significance of particular works of literature." No benchmark for K–4 or 5–8 describes a related skill for these spans; specifically, no earlier benchmark requires students to interpret an individual work of literature ("significance") or to evaluate the author's use of literary elements ("craft") in a work. Given the importance of this skill, one would expect to see it build from simpler to more complex applications across the spans.

Breadth could be strengthened in the 5–8 and 9–12 spans by incorporating more specific benchmarks for standard 1 and adding or refining some content for standards 2 and 6. For standard 2, for example, some under-emphasized areas include skills in planning and pre-writing compositions as well as skills in using elements of writing, such as organization, focus, development, sentence variety, etc. The standard 2 benchmarks for the 9–12 span were considered to describe slightly more breadth but the skills described above are still under-represented. Standard 2 combines skills in writing and speaking but does not address skills that are specific to speaking (i.e. the use of appropriate volume, pacing, and gestures; the use of visual aids or technology, etc.). The benchmarks for standard 6 do not contain the expected breadth of interpretive and analytic skills. For example, the benchmarks do not include the interpretation of theme or character in a literary work or the analysis of an author's use of figurative language or setting. These skills could be addressed through revision of the benchmarks; for example, the accurate use of literary terminology could be tied to the interpretation of literary works and the analysis of elements such as theme, plot, point-of-view, etc.

The CDE may want to consider implementing the following recommendations, where appropriate:

- Reduce the size of grade spans to two years or transition to grade level standards, if preferred. Massachusetts' strategy of articulating standards by two-year grade spans but filling in grade level standards for some content as needed also appears reasonable. Either option would allow Colorado to articulate the expected skills and knowledge for each span or level more specifically as well as clarifying progression of learning across spans/levels.
- Increase the number of standards to strengthen the specific focus of individual standards and to allow for fuller development of benchmarks for key content areas (i.e., oral language). Some of Colorado's six standards and their benchmarks are highly condensed and complex, combining multiple strands and skills. An average of 12 broader standards or objectives per grade level or span was typical of the external referents and appeared to be effective in conveying sufficient breadth and depth of content.
- Seek to balance an appropriate degree of specificity and focus in standards with the breadth intended by the state. For example, Virginia was fairly typical of the referents in articulating a few standards per grade level for each strand (reading, writing, oral language) of the language arts. These standards are more specific and focused than some of Colorado's current standards, but not as narrow as some of Massachusetts' highly specific standards. Developing finely grained and closely interrelated standards can lead to significant overlapping across benchmarks, and the state will need to determine if this is their intent.
- Organize standards according to some broader organizing principle, such as content strands (Massachusetts and Virginia) or functions of language (Finland and Singapore) to give greater coherence to the standards themselves.
- Organize both standards and benchmarks by numerical or alphabetic sequence to facilitate ease of use.

- State standards as single sentences and incorporate descriptions of specific skills and knowledge related to each standard into the span or grade level benchmarks.
- Give fuller development to standards and benchmarks for oral language skills, including skills in group communication, collaborative or team projects, the use of media in oral presentations, and skills used to present proposals, explain research findings, and justify positions or interpretations.
- Expand and integrate skills for the comprehension, use, and analysis of media more fully into the standards. Media literacy—the ability to understand, analyze, evaluate, and use online tools and information—is crucial for 21st Century students.
- Provide more specific descriptions of the development of foundational skills in reading and writing in the primary grades. The referents provide a range of examples, from the more elaborate and detailed descriptions in Massachusetts and Virginia to the more condensed descriptions in Finland and Singapore; all, however, give more specific articulation to the development of these skills in the early grades.
- Define the skills and strategies used to interpret, analyze, and evaluate informational texts more specifically for each grade span or level.
- Revise standards and benchmarks for the comprehension, analysis, interpretation, and evaluation of literature to increase the breadth, depth, and rigor of content in this area.
- Revise and expand standards for writing to describe more specific skills in using elements of composition and skills and strategies used in the writing process, particular in revising (possibly with peer review and feedback). Types of writing for each level could also be described more specifically.
- Enrich the approach to grammar and conventions, by integrating knowledge of grammar with the structure and origins of language (as in Massachusetts and Finland) or more fully integrating knowledge and use of conventions with the development of students' skills in producing different types of writing (as in Singapore).
- Revise or develop benchmarks for research (standard 5) that place greater emphasis on the use of research skills in writing or speaking at all grade spans and on research as a multi-step process, from generating questions for research to evaluating the results.

Additional External Referents

Mid-continent Research for Education and Learning (McREL) revised their language arts standards in 2001 to include media literacy in their standards 9 and 10. They would be a worthwhile resource for Colorado to consider, particularly in light of the state's interest in integrating 21st Century Skills. McREL's standard 8 also addresses oral language skills (another area which is under-developed in Colorado's current MCS) in substantial breadth and depth across all grade levels. Overall, McREL's language arts standards and benchmarks are clear, focused, and concise, with an appropriate level of specificity at the level of benchmarks. They articulate 10 core standards across all grades with

benchmarks describing specific skills and knowledge for each of four grade spans (K–2, 3–5, 6–8, 9–12).

Recommendations from the Review of 21st Century Skills and Abilities and Postsecondary and Workforce Readiness

Because of the interconnectedness of the findings and recommendations related to the 21st Century Skills and Abilities and Postsecondary and Workforce Readiness definition, recommendations related to the 21st Century and PWR skills are presented together in the Findings section of this report.

III-B. Mathematics Findings and Recommendations

This section contains findings and recommendations related to the internal quality review, the external referent reviews, and the review of 21st Century Skills and PWR skills. Detailed review criteria can be found in the Methodology section of this report. A brief description of the criteria and guiding questions also are provided here for convenience.

Internal Quality Review

As described in the Methodology section of this report, the Colorado MCS were reviewed for their quality according to four criteria: depth; coherence; rigor; and breadth. Findings from these analyses are presented below.

Depth

Ratings for depth are assigned based on the questions below.

- Do the benchmarks describe content of sufficient and appropriate depth in the standard *within each grade span*? (For example, is the depth of content of the standard appropriate for a school year?)
- Do the benchmarks describe content of sufficient and appropriate depth in the standard *across the grade spans*?

The questions are answered with a rating of Fully (F), Partially (P), No (N), or Insufficient information to determine (I).

The table below shows the ratings for depth in the Mathematics standards, reported for each standard at each grade span, as well as across the grade spans. The across grade span ratings are holistic ratings of the depth of the standards in K–12.

Table 9. Ratings for Depth in the Mathematics MCS

Standard	K–4	5–8	9–12	Across Grade Spans
1	F	F	F	F
2	F	F	F	F
3	P	F	F	F
4	F	F	P	P
5	F	P	I	P
6	F	F	I	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Both standards 1 (dealing with number) and 2 (dealing with algebra) have sufficient and appropriate depth within and across spans. In grade span K–4, standard 3 (dealing with data, statistics, and probability) was rated Partially because although it seems appropriate that K–4 students generate data based on chance devices (benchmark 3), analyzing and predicting could be beyond expectations for grade 4. Also, although generating some

combinations of objects is reasonable for this span, students might not fully accomplish benchmark 3.K–4.4 (i.e., standard 3 of the K–4 grade span, benchmark 4: *solve problems using various strategies for making combinations [for example, determining the number of different outfits that can be made using two blouses and three skirts]*) as indicated by the example until they reach benchmark 3.5–8.7 (*use counting strategies to determine all the possible outcomes from an experiment (for example, the number of ways students can line up to have their picture taken).* Note that the wording of 3.K–4.2 is problematic (*interpret data using the concepts of largest, smallest, most often and middle*) because the four concepts listed represent examples, not an exhaustive list.

In grade span 5–8, standard 5 (dealing with measure) was rated Partially because benchmarks 1, 2, and 3 are not explicit enough to guarantee an appropriate and sufficient amount of depth. Also, benchmark 5 is too specific (not sufficiently crossing the grade span) although overall depth will be appropriate with proper implementation.

In the 9–12 grade span, standard 4 (dealing with geometry) was rated Partially because the upper range of depth is not evident. Standards 5 (dealing with measure) and 6 (dealing with operations and calculations) were rated as having Insufficient information in the standards to determine if depth was appropriate and sufficient. As indicated in the History section of the mathematics MCS, the standards were developed to indicate "What mathematics should every Colorado student learn?" Students have many options for course-taking in the 9–12 grade span that lead to in-depth learning in these areas. The benchmarks for these standards are too specific and/or reflect expectations in which depths do not differ significantly from the grade 5–8 span nor reflect the range of depths within the 9–12 span as within the other spans. It is often unclear that there is sufficient content to cross the full span. For example, in standard 5, only benchmark 1 takes previous benchmark 5.5–8.2 to a deeper level, and the other two benchmarks are too specific to sufficiently span the 9–12 grades. Across the grade spans, these three standards were rated partial because the "ceiling" is too low; or overall, the depth is not as "deep" compared to standards 1, 2, and 3. However, it is also possible the depth of the content is sufficient for each of these standards, assuming limited emphasis in the upper grades.

Coherence

Ratings for coherence are assigned based on the questions below.

- Are the benchmarks for each standard sequenced appropriately across the grade spans? (For example, do they scale or spiral appropriately across the grade spans?)
- Do the benchmarks begin and end at appropriate points in the content?

The tables below show the ratings for coherence in the Mathematics standards, reported as appropriate beginning and endpoints for each standard at each grade span, as well as across the grade spans, and appropriate sequence across the grade spans.

Table 10. Ratings for Coherence—Appropriate Sequence in the Mathematics MCS

Standard	Appropriate Sequence Across Grade Spans
1	F
2	F
3	F
4	F
5	F
6	F

Table 11. Ratings for Coherence—Appropriate Beginning and Endpoints in the Mathematics MCS

Standard	Appropriate Beginning and Endpoints			
	K–4	5–8	9–12	Across Grade Spans
1	F	F	F	F
2	P	F	F	F
3	N	F	F	P
4	F	F	F	F
5	F	F	F	F
6	P	F	P	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

In standards 2 (algebra), 3 (data and statistics), and 6 (operations), the starting points for grades K–2 need more specificity. For this reason, standards 2 and 6 were rated as Partially in the K–4 grade span. Also, for standard 3 the endpoints are likely above grade 4 for students to fully demonstrate the benchmarks (particularly benchmarks 3 and 4). Thus, standard 3 was rated No in the K–4 span. In addition, in the 9–12 grade span, standard 6 was rated as Partially because the endpoints do not include material for the entire span. Sequencing was considered Fully within and across the standards.

Rigor

Ratings for rigor are assigned based on the questions below.

- Do the benchmarks describe content and skill expectations of a reasonable and appropriate level for this grade span? Do the standards and benchmarks communicate an appropriate level of rigor?

The table below shows the ratings for rigor in the mathematics standards, reported for each standard at each grade span, as well as across the grade spans.

Table 12. Ratings for Rigor in the Mathematics MCS

Standard	K–4	5–8	9–12	Across Grade Spans
1	F	F	F	F
2	F	F	F	F
3	P	F	F	F
4	F	F	P	P
5	F	P	I	I
6	F	P	I	I

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Within and across the standards 1 (number) and 2 (algebra), ratings reflect that although statements are general and subject to interpretation, there are opportunities to provide the appropriate amount of rigor in student learning experiences. In standard 3 (data and statistics), rigor for grade span K–4 was rated as Partially due to benchmarks 3 and 4 requiring rigor beyond grade 4 expectations, though across the grades rigor seems appropriate.

Rigor across standard 4 (geometry) was rated Partially due to the rating in the 9–12 span. In this span depth was rated Partially, because it was not clear that depth goes sufficiently beyond the grade 5–8 span. Across the standard, rigor was rated Partially because most benchmarks reflect appropriate rigor.

Across standards 5 (measurement) and 6 (operations) rigor was rated Insufficient Information because for both standards rigor was rated Partially in the 5–8 grade span and rigor was rated Insufficient Information in the 9–12 span. The partial ratings were based on benchmark descriptions not specifying the full range of rigor that might be expected in the 5–8 grade span. For example, the actions described in most of the benchmarks in both standards 5 and 6 involve students estimating, using, describing, explaining, reading, and selecting, with limited interpreting, applying, constructing, or developing. Seemingly, students are not really required to demonstrate higher order thinking skills as might be expected in these grade levels. The Insufficient Information ratings were based on benchmark descriptions lacking depth as well as sufficient detail to guarantee the amount of rigor. When depth is not evident, it is not clear that rigor can be sufficient. In these cases, there cannot be rigor without depth. Having two grade spans rated Partially and Insufficient Information indicated that there is insufficient evidence for the appropriate amount of rigor across the grade spans.

Breadth

Ratings for breadth are assigned based on the questions below.

- Do the benchmarks describe sufficient and appropriate breadth of content across standards *within each grade span*?
- Do the benchmarks contain the essential content for this subject *within and across grade spans*?
- Are the benchmarks free from extraneous content *within and across grade spans*? If not, what content is extraneous?

Each of the three aspects of breadth examined is reported in a separate table in order to distinguish between essential and extraneous content.

Breadth represents the sufficiency of content across the standards. the table below shows the ratings for overall breadth *across* the mathematics standards within each grade span and across the grade spans.

Table 13. Ratings for Overall Breadth in the Mathematics MCS

Grade Span	Across Standards
K–4	F
5–8	F
9–12	F
Across Grade Spans	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

The overall breadth of the mathematics standards was found to Fully contain necessary and sufficient content, without extraneous content, across the grade spans and across the standards. However, certain assumptions and possible omissions in particular standards or grade spans could warrant additional considerations, as indicated in the recommendations section of the report.

The table below shows the breadth ratings for essential content in Mathematics standards, reported for each standard at each grade span, as well as across the grade spans.

Table 14. Ratings for Breadth—Essential Content in the Mathematics MCS

Grade Span	Across Standards	1	2	3	4	5	6
K–4	F	F	F	F	F	F	F
5–8	F	F	F	F	F	F	F
9–12	F	F	F	F	F	F	P
Across Grade Spans	F	F	F	F	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

The table above indicates that within and across the grade spans and within and across the standards, the content described can be considered essential content. The rating of

Partially for standard 6, grade span 9–12 reflects the possible need for further specificity to distinguish from grade 5–8 content, other than using real numbers.

The table below shows the breadth ratings for freedom from extraneous content, reported for each standard at each grade span, as well as across the grade spans.

Table 15. Ratings for Breadth—Free of Extraneous Content in the Mathematics MCS

Grade Span	Across Standards	1	2	3	4	5	6
K–4	F	F	F	P	F	F	F
5–8	F	F	F	F	F	F	F
9–12	F	F	F	F	F	F	F
Across Grade Spans	F	F	F	F	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Overall, within and across the standards and within and across the grades, the standards are free from extraneous content. In grade span K–4, standard 3 (data and statistics) was rated as Partially free of extraneous content because benchmarks 3 and 4 include content (involving predictions and combinations) beyond grade 4 expectations, although that content is appropriate and should be included in the grade 5–8 benchmarks for standard 3.

External Referent Review

As described in the Methodology section of this report, analysts reviewed four sets of content standards to serve as an external referent comparison with Colorado's MCS in Mathematics. The external referent standards documents reviewed for Mathematics were:

- Massachusetts Mathematics Curriculum Framework (November 2000)
- Supplement to Massachusetts Mathematics Curriculum Framework (May 2004)
- Mathematics Standards of Learning for Virginia Public Schools (October 2001)
- National Core Curriculum for Basic Education 2004 (Finland)
- National Core Curriculum for Upper Secondary Schools 2003 (Finland)
- Mathematics Syllabus Primary (Singapore, 2006)
- Secondary Mathematics Syllabus (Singapore, 2006)

The external referent standards were reviewed for two broad criteria, organization/ structure and content. Each criterion contained several subcategories about which analysts recorded observations before determining a final overall holistic rating of mostly similar (Similar) or mostly different (Different). Findings from these analyses are presented below.

The table below summarizes the holistic external referent standards in comparison with Colorado's MCS.

Table 16. Holistic Comparison Ratings for Mathematics External Referents

Rating Category	Massachusetts	Virginia	Finland	Singapore
Organization/ Structure	Different	Different	Different	Different
Content	Similar	Similar	Different	Different

The analyses below highlight various similarities and differences between the MCS and pertinent categories in each referent's documents. It is important to note that the referents have similarities and differences among one another, as well as with Colorado's MCS. However, no one approach is intended to be presented as necessarily more or less effective than another. Differences in structure or content of a state or country's standards may be qualitative, but may also be attributable to differences in history, purpose, and/or context. Thus, the implication is that a variety of approaches and combinations of approaches may be considered, should they be determined to be appropriate for Colorado.

Organization and Structure

As indicated in the table, the overall organization/structure of the Colorado mathematics MCS differs from the organization/structure of the referent documents in substantive ways, based on the four subcategories of grade articulation, hierarchy of standards, number of standards, and design/format. It is important to note that the referents differ from one another in these subcategories as well.

In mathematics, Colorado has six standards repeated across three grade spans: K–4, 5–8, and 9–12. The MCS are described by benchmarks at each grade span. Colorado's grade articulation is most like Massachusetts, which has seven two-year grade spans for preK–12. However, in addition, Massachusetts provides grade level standards for grades 3, 5, and 7, and course standards for four high school courses. Virginia provides grade-level standards for K–8 and course standards for 10 high school courses. Both Finland and Singapore provide curriculum syllabi rather than standards. In the lower grades, Finland lists objectives, core content, and descriptions of good performance for three grade spans: grades 1–2; 3–5; and 6–9. Beyond grade 9, Finland provides syllabi listing objectives and core content topics for courses in advanced and in basic mathematics. Singapore has syllabi for eight grades and one secondary two-year grade span.

As to hierarchy of standards, Colorado's six mathematics standards cross all grade spans and contain benchmark statements describing what students should know and be able to do within each span. Both Massachusetts and Virginia label content strands (five in Massachusetts and six in Virginia), which correspond to the topics described in Colorado's six standards. Each referent state's content strand contains standards statements that are similar in function to Colorado's benchmarks. In the referent

countries, Finland's five content areas also correspond to the topics described in Colorado's six standards, though they are grouped differently across the grade spans. Bullet points in Finland's lists of objectives and core content within the content areas are similar in nature to Colorado's benchmarks. Of the four referents, Singapore is probably least like Colorado in hierarchy of standards. Singapore syllabi list topics, which change across the grades, but correspond somewhat to content described in Colorado's six standards.

When comparing the number of "standards," we focused more on the statements corresponding to Colorado's benchmarks rather than on Colorado's six standards. The referent states' standards are the statements describing the content within each labeled strand. For this analysis, the referent nations' "standards" are the syllabi listings organized by content area or topic. Colorado mathematics standards have 86 benchmarks that all students are expected to meet, with an additional 20 optional benchmarks for those taking higher mathematics. Across the grades, Massachusetts has 241 standards that students are expected to meet, with an additional 20 course-specific standards; Virginia has 249 standards that students are expected to meet, with an additional 122 standards for higher mathematics courses; Finland has 165 core content statements, with an additional 19 statements describing upper level specialization courses; and Singapore lists 122 subtopics that most students encounter in grades 1–8, with additional subtopics in upper grades.

Compared to the referent documents, the design/format of Colorado's document is the most concise at 18 pages, six of which describe the grade-span benchmarks for each of the six standards. The document, which is organized by standard, includes detail about the progression and development of content within a standard from one grade span to the next. Additional curriculum- and grade-specific documents are needed to detail more precisely what is taught and at each grade level. In contrast, each referent document presents information by grade span or grade level, which provides detail about what is included in the curriculum for a specific grade/span. The external referent standards documents are longer (for example, the Massachusetts document is 131 pages), and many include additional standards presentations, and supplemental material.

Content

The content of the Colorado mathematics MCS both shares common features with and differs from the content of the referent documents in key ways. As with organization and structure, it is important to note that the referents also share common features with and differ from one another in key ways as well. Highlighting similarities and differences in content is intended to assist readers in examining the different ways that successful states and countries introduce and emphasize various content. This information is not intended to imply one methodology is more effective than another. When comparing Colorado MCS and referent standards or syllabi documents, analysts focused on the most comparable unit of comparison, whether a grade level (grades K–8) or course-specific (grades 9–12) standard.

Across the referent documents, there is a considerable overlap in content with the MCS. As indicated in the table, Colorado shares content emphases with Massachusetts and Virginia more so than with Finland and Singapore. This is partly due to the fact that the three states—Colorado, Massachusetts, and Virginia—view their documents as standards, whereas Finland and Singapore documents represent curriculum syllabi. Overall, each referent document was more detailed and specific about its content than Colorado, where benchmarks are typically quite broad to encompass content across the grade spans. Like Colorado standards, the strands for Massachusetts and Virginia are consistent across grades K (or preK) through grade 8. Like Colorado, Massachusetts continues the strands/standards across all grade spans or grade levels, though Massachusetts's course-specific standards do not incorporate all the strands.

Of the four external referents, only Virginia separates the Number and Number Sense strand from their Computation and Estimation strand, which is comparable to Colorado's organization. The other three referents combine this content under one heading. For Colorado and three of the four referents, emphasis on Algebra generally increases as the grade spans increase. However, Algebra is not labeled as a distinct topic in the Singapore course syllabi until the sixth year. In general, emphasis on data and statistics increases as the grade spans increase for Colorado, Massachusetts, Virginia, and Finland. In Singapore the emphasis and the types of concepts represent less content than Colorado, with emphasis remaining steady through the seventh year, increasing for the next two years and decreasing in the final grade span. Colorado and three of the referents designate from one-seventh to one-fifth of their standards or subtopics to geometry in the lower grades, with increased emphasis in the upper grades.

Finland designates a greater percentage of its core content to geometry across the grades, with generally decreasing emphases as the grades increase. Much of Finland's content either is not directly specified or appears later in the Colorado MCS. Especially in the lower grades, Colorado, Massachusetts, and Virginia designate about the same amount of their benchmarks/standards to measurement. Both Finland and Singapore specify more content at earlier years than Colorado and have limited overlap in content at the later years.

In Colorado, Massachusetts, and Singapore, about one-sixth of the benchmarks/standards/topics represent operations and computation, with heavy emphasis in grades K–8, and generally decreasing as grade spans increase. Although there is overlap in content between the MCS and Finland standards in K–8, there appear to be no direct matches for Colorado grades 9–12 benchmarks with Finland grades 10–12 content. All referent documents, like Colorado, emphasize problem solving across the standards.
For all referents, there is a considerable amount of similarity in content with Colorado grade K–4 benchmarks, especially when combining the number and operations standards. In this grade span, Colorado designates about the same number of benchmarks (4 or 5) to each standard, whereas the four referents emphasize most content areas differently. For example, Massachusetts designates the fewest number of its standards (about one-tenth) to its Data strand and the most (about one-fifth) to its Geometry strand. Virginia designates the fewest number of its standards (about one-tenth) to its Data strand and to

its Algebra strand, and about one-sixth of the Virginia standards are designated to the Geometry strand. Finland places about half the emphasis that Colorado places on Algebra or Data & Statistics, and about twice the emphasis on Geometry or Measurement. In the K–4 grade span, Singapore designates no subtopics to Algebra, and less than one-tenth to Data Analysis.

For all referents, there is a considerable amount of similarity in content with Colorado grades 5–8 benchmarks, especially when combining the number and operations standards. In this grade span, Colorado designates about the same number of benchmarks (5 to 7) to each of the other standards (2, 3, 4, and 5), whereas the referents emphasize these other standards differently. For example, Massachusetts designates the least amount (about one-tenth) to its Data strand, with Algebra and Geometry each containing about one-fifth of the standards. The Virginia standards put less emphasis on Algebra and Measurement than found in the MCS. Both Finland and Singapore designate about one-tenth of their subtopics to Data, which is about half of what Colorado designates.

In the 9–12 grade span, about one-fourth of the Colorado benchmarks address Data & Statistics, about one-fifth address Algebra, one-sixth address Geometry, and one-eighth address Measurement. Colorado deemphasizes number and operations, although together these standards represent about one-fourth of Colorado's 9–12 benchmarks. Again, there are differences in emphases with the referents. For example, in Massachusetts, the Number and Operations strand involves only about one-tenth of the standards, and Massachusetts puts less emphasis on Data & Statistics (about one-sixth) and Measurement (about one-tenth) than Colorado does. Several Virginia course-specific standards exceed Colorado's 9–12 benchmarks. Almost all of Colorado's 24 benchmarks contain content that corresponds to at least one core content topic in Finland grades 1–9. In this grade span, Singapore designates only three topics at each grade, by combining topics: Number & Algebra, Geometry & Measurement, and Statistics & Probability. The standards for this grade span are least similar in content emphasis to the Colorado MCS.

The following sections of the report compare each external referent with the relevant MCS documents. Additional detail is provided in the appendices.

Massachusetts

Both the Colorado and the Massachusetts documents have grade span articulation. Massachusetts provides seven 2-year grade spans for preK–12; whereas Colorado has three grade spans of 4 or 5 years each. Massachusetts also provides grade level standards for grades 3, 5, and 7, and single-year course standards for Algebra I, Geometry, Algebra II, and Precalculus, which are offered in grades 7 through 12.

For each of the five content strands in spans preK–12, Massachusetts has between 1 and 18 standards statements, while Colorado has 3–7 benchmark statements. For each Standard, Massachusetts also provides checklists of Exploratory Concepts and Skills, often followed by Selected Problems and Classroom Activities. Many of the Massachusetts course-specific standards are cross-referenced to the grade span standards. In grade spans preK–12, Massachusetts has many more standards than Colorado.

Massachusetts has 241 standards while Colorado has 86 standards that all students are expected to meet, with an additional 20 benchmarks for higher mathematics. In K–4, Massachusetts has 100 standards, whereas across K–4, Colorado has 28 benchmarks. In grades 5–8, Massachusetts has 82 standards compared to Colorado's 34 benchmarks, while in grades 9–12, Massachusetts has 59 standards compared to Colorado's 24 benchmarks. Massachusetts also has grade-specific standards for grades 3, 5, and 7, and in grades 9–12 has an additional 20 standards in Algebra I, Geometry, Algebra II, and Precalculus. It is important to note that although there is a great discrepancy in the number of Colorado benchmarks compared to the number of Massachusetts standards. Massachusetts provides a greater degree of specificity across more grade spans than Colorado. Colorado's benchmarks are typically broad and encompass the content of the Massachusetts standards in more than one grade span, often with similar emphases across Colorado's wider grade spans.

Massachusetts's standards statements are presented by strand for grades preK through 6 and by grade spans and course for grades 7 through 12. Colorado's benchmarks are arranged by standard, with benchmarks for each grade span. One advantage of the Massachusetts model is that a teacher using that document can easily see the standards for which students are responsible within a two-year span and also how the strands develop or progress across preK through grade 6. Course standards and grade-level standards for grades 3, 5, and 7 also are specified. Alternatively, a teacher using the Colorado document can readily see the progression of the standards, but must go to each standard and find the benchmarks for her grade span to see the content for which students are responsible.

In relation to content, Massachusetts combines Number and Operations into one strand. In both the Massachusetts and the Colorado standards, about one-sixth of the standards/benchmarks represent Number, with fairly heavy emphasis in grades K–8, and generally decreasing as grade spans increase. In the upper grade spans in Massachusetts, there is a sharper decrease in emphasis on Number than in Colorado; and Colorado places greater emphasis than Massachusetts on benchmarks 5 and 6 in grade span 5–8. Massachusetts specifies use of symbols for comparisons and includes decimals in the K–4 span, and continues with place value in the grade 5–8 span. Absolute value and scientific notation occur in Massachusetts grade 7–8 span, but not until 9–12 in Colorado.

For both Massachusetts and Colorado, emphasis on Algebra increases as the grade spans increase. Across the grades, about one-fourth of Massachusetts standards relate to Algebra, whereas about one-sixth of Colorado's benchmarks focus on Algebra. Massachusetts is more specific about inequalities and writing closed equations in the lower grades, in evaluating expressions and identifying properties (including identities) in the middle grades, and in simplifying and operations with polynomials in the upper grades. Overall, the emphasis of the standards seems more different than similar, given the specificity of the Massachusetts standards with concepts such as developing meaning for slope, zeros of a function, etc. Colorado's broader benchmarks likely include such concepts, but not based on this document alone.

In general, emphasis on Data and Statistics increases as the grade spans increase. Overall, Massachusetts places less emphasis on Data and Statistics than Colorado. For Colorado, benchmarks for this standard represent one-fifth of the standards, whereas for Massachusetts, the strand contains about one-eighth of their standards. Colorado develops concepts of measures of central tendency earlier than Massachusetts, as well as formulating hypotheses and making convincing arguments. Massachusetts places less emphasis on probability.

Across the grade spans, Massachusetts designates about one-fifth of its standards for Geometry, with increased emphasis in grades 9–10. Colorado also designates about the same amount of its benchmarks (about one-sixth) to Geometry at each grade span. In the middle grades, benchmark 5 (solving problems involving perimeter, area, surface area, and volume) is addressed in Massachusetts with measurement standards. Massachusetts also specifies perspective drawings and maps in its middle grade Geometry standards, as well as use of vectors in the upper grades.

Overall, both Massachusetts and Colorado designate about the same amount of their benchmarks (about one-sixth in Colorado and one-eighth in Massachusetts) to Measurement, with decreased emphasis at grades 9–12. Colorado students in grades K–4 spend more time developing sense of measurement using approximate measures of familiar objects; and middle grade students have more emphasis on reading and interpreting various scales. Massachusetts does not specify students learn to describe how a change in linear measurement affects its perimeter, area, or volume until grade span 9–10. Massachusetts also does not specify upper grade students determine the degree of accuracy of a measurement, and use of significant digits.

In both the Massachusetts and the Colorado sets of standards, about one-sixth of the Massachusetts standards and Colorado benchmarks represent Operations & Calculations, with heavy emphasis in grades K–8, and generally decreasing as grade spans increase. In the upper grade spans in Massachusetts, there is a sharper decrease in emphasis on Operations than in Colorado. Massachusetts is more specific with counting with money, skip counting, and using inverse relationships, properties of operations, order of operations and rules of powers and roots to solve problems. Colorado places greater emphasis than Massachusetts on using models to explain how ratios, proportions, and percents can be used to solve real-world problems, whereas Massachusetts seems more formal in the middle grades, and develops the concepts earlier.

Across the Colorado standards, there is a high degree of similarity in content with the three grade span benchmarks and Massachusetts standards, though the emphases vary. In grade span K–4, almost all of the 28 benchmarks contain content that corresponds to at least one Massachusetts standard statement in grade spans preK through 4. Combining Number and Operations, both Colorado and Massachusetts put the greatest emphasis (about two-fifths) on these concepts. In the K–4 grade span, Massachusetts designates the fewest number of its standards (about one-tenth) to its Data strand and the most (about one-fifth) to its Geometry strand, not including its Number and Operation strand.

In the grade 5–8 span, almost all of the 34 benchmarks contain content that corresponds to at least one Massachusetts standard statement. Both sets of standards put the greatest emphasis (about one-third) on concepts of Number and Operations. In this grade span, Massachusetts designates the least amount (about one-tenth) to its Data strand with Algebra and Geometry strands each containing about one-fifth of the standards.

Similarly, in the grade 9–12 grade span, almost all of the 24 benchmarks contain content that corresponds to at least one Massachusetts standard statement. Both Massachusetts and Colorado deemphasize Number and Operations in this span. However, in Massachusetts, the strand involves only about one-tenth of the standards, whereas in Colorado about one-fourth of the benchmarks address Number and Operations combined. In this grade span, about one-fourth of the Colorado benchmarks address Data and Statistics, about one-fifth address Algebra, one-sixth address Geometry, and one-eighth address Measurement. Massachusetts puts most emphasis on Algebra (over one-third) and on Geometry (over one-fourth). Massachusetts puts less emphasis on Data and Statistics (about one-sixth) and Measurement (about one-tenth). Of the three grade spans, there is least similarity in content emphasis with Colorado in grades 9–12.

Virginia

Virginia has standards for nine grades (K–8) and for 10 high school courses. Colorado's six standards correspond to Virginia's six content strands, which cross grades K–8. For each of the six content strands in grades K–8, Virginia has between one and ten statements describing what students should be able to do. Many of Virginia's standards statements are further detailed with between two and six statements including additional context or content. Though named differently—Colorado's Standards and Benchmarks corresponding to Virginia's Strands and Standards—the hierarchy of the standards is mostly similar.

Overall, Virginia has 249 standards that most students are expected to meet, with an additional 122 standards for higher mathematics courses. In K–4, Virginia has 112 standards, in grades 5–8, Virginia has 85 standards, and in grades 9–12, Virginia has 52 standards for courses, which most students are expected to take, with an additional 122 course-specific standards. As with Massachusetts, there is a great discrepancy in the number of Colorado benchmarks compared to the number of Virginia standards. Virginia provides a greater degree of specificity with their grade-level and course standards. Colorado's broader benchmarks typically encompass the content of the Virginia standards, often with similar emphases across Colorado's grade spans.

Like the Massachusetts documents, Virginia's standards statements are presented by grade level with strand names separating standards, whereas Colorado's benchmarks are arranged by standard, with benchmarks for each grade span. Virginia's grade level standards are much more specific and detailed than Colorado's benchmarks.

In relation to content, in grades K–8, reading, writing, and ordering of numbers are emphasized by both Virginia standards and Colorado benchmarks. In both sets of standards, about one-fifth of the Virginia standards and one-sixth of the Colorado

benchmarks represent Number, with fairly heavy emphasis in grades K–4, and generally decreasing as grade levels/spans increase. Across the grades, Virginia does not emphasize using number sense for estimation and justification. Virginia standards are more specific about finding equivalences, comparing numbers, and simplifying numerical expressions. Colorado benchmarks are more specific about applying concepts in problem-solving contexts.

Both documents focus on patterns, relationships, and functional relationships across grades K–8, designating about one-seventh to one-eighth of the total number of standards or benchmarks on algebraic content. Virginia has less emphasis in grades K–4 (about one-tenth) than does Colorado (about one-seventh), but increases in grades 5–8, (about one-fifth), whereas Colorado has about the same amount in grades 5–8 as in K–4. In grades 9–12, Algebra represents about one-fifth of the Colorado benchmarks whereas Virginia has two one-year courses specifically on Algebra, and additional coverage in the Precalculus course. Virginia is more explicit about evaluating and simplifying expressions, and using correct order of operations.

Overall, Virginia standards seem directly related to Colorado Data and Statistics benchmarks across the grades, with increasing emphasis as the grade spans/levels increase; though Virginia places less emphasis on Data and Statistics than Colorado. In grades K–8, Colorado designates about one fifth of its benchmarks to this standard, whereas Virginia designates about one-eighth of its standards to this strand. In grades 9–12, about one-fourth of the Colorado benchmarks address Data and Statistics, and Virginia offers a one-year course, with some data and statistics content also present in other courses. Colorado places more emphasis than Virginia on evaluating arguments based on statistical claims for erroneous conclusions or distortions.

Similarly, overall, Virginia standards seem directly related to Colorado Geometry benchmarks across the grades. Across the grades K–8, Virginia designates about one-seventh to one-sixth of its standards for geometry, with increased emphasis in grades 9–10. Colorado also designates about the same amount of its benchmarks to Geometry at each grade span. In grades K–8, Colorado puts more emphasis on recognizing geometry in the world and solving problems involving perimeter, area, surface area and volume. In grades 9–12, Geometry benchmarks continue representing about one-sixth of the Colorado content, whereas Virginia has a one-year Geometry course.

Across the grades, both documents emphasize knowing, using, describing and estimating measures, using both direct and indirect measurements, with each having about one-fifth of the standards/benchmarks dealing with Measurement. Across grades K–4, Virginia designates about one-fourth of its standards to Measurement, decreasing to just over one-sixth in grades 5–8, whereas Colorado has about one-fifth at both grade spans. In grades 9–12, Colorado designates about one-eighth of its benchmarks to measurement, which are only linked to once by Virginia's Geometry course standards. Virginia standards are more explicit about money, time (elapsed), and conversions within and between standard

and metric measures. Virginia high school courses show very little overlap with Colorado benchmarks.

Both documents specify fluency in basic operations across grades K–8, with Virginia being more detailed about various procedures. In grades K–4, Colorado designates about one-fifth of the benchmarks to operations, and decreases to about one-eighth in both grade spans 5–8 and in 9–12. Virginia designates about one-sixth of its standards across K–8. Only a few Virginia standards in Algebra I and Geometry address a Colorado benchmark. Problem solving context and reasonable answers are more explicit in the Colorado benchmarks, and also the use of algorithms. Colorado also puts more emphasis on estimation strategies and using estimation instead of an exact answer. Virginia is more specific about properties of operations and order of operations. Virginia high school courses show very little overlap with Colorado benchmarks.

Across the Colorado standards, there is a high degree of similarity in content with the three grade span benchmarks and Virginia standards. Almost all of the K–4 grade span 28 benchmarks contain content that corresponds to at least one Virginia standard statement in grades K through 4. Colorado's Number and Measurement benchmarks seem well represented by Virginia standards, which designate about one-fourth of the standards to each of these strands. In the K–4 grade span Virginia designates the fewest number of its standards (about one-tenth) to its Data strand and to its Algebra strand. About one-sixth of the Virginia standards are designated in the Operations strand and the Geometry strand. Not explicitly covered by Virginia standards is selecting algorithms for computing with whole numbers in problem solving situations. Of the three grade spans, K–4 benchmarks seem to have the strongest relationship to Virginia standards.

In the grade 5–8 grade span, almost all of the 34 benchmarks contain content that corresponds to at least one Virginia standard statement. In this grade span, Virginia designates about the same number of standards to each of the strands (from one-seventh to just over one-sixth), whereas Colorado designates the least, about one-eighth, to Operations and the most (about one-fifth) to Data and Statistics. The Virginia standards put less emphasis on Algebra and Measurement as described by Colorado benchmarks.

Almost all of Colorado's 24 benchmarks in grades 9–12 contain content that corresponds to at least one Virginia standard statement. There is a high degree of overlap with the Algebra benchmarks based on Virginia course standards for Algebra I and II, and also with Colorado's Data and Statistics benchmarks based on Virginia's Probability and Statistics course standards. Geometry benchmarks are also covered by course standards in Geometry. In this grade span, Virginia provides course-specific standards for several courses, which exceed Colorado's 9–12 benchmarks. There is less overlap in content between Virginia standards and Colorado's benchmarks for Number and Measurement. There is least overlap of Colorado benchmarks in this span with Virginia course standards for Algebra I, Geometry, Algebra II, and Probability and Statistics.

As stated in Virginia's foreword, "The standards are not intended to encompass the entire curriculum for a given grade level or course or to prescribe how the content should be

taught," which is similar to how the Colorado benchmarks are used. Virginia describes five goals for students: becoming mathematical problem solvers, communicating mathematically, reasoning mathematically, making mathematical connections, and using mathematical representations to model and interpret practical situations. Similarly, in the electronic version of their mathematics standards, Colorado describes six goals, the first four of which are the same as Virginia's. For both states, problem solving is woven throughout their standards.

Finland

Both Finland and Colorado articulate objectives/core content and benchmarks in three grade spans. Finland lists objectives, core content, and descriptions of good performance for three grade spans: grades 1–2; 3–5; and 6–9. Beyond 9th grade, Finland provides syllabi for courses in advanced mathematics (10 compulsory and 3 specialization courses) and in basic mathematics (6 compulsory and 2 specialization courses) listing Objectives and Core Content topics. The compulsory courses likely require one quarter or semester to be completed.

Colorado's six standards cross all grade spans and correspond to Finland's five content areas, which cross grades 1–9. Bullet points in Finland's Objectives and Core Content (and Descriptions of Good Performance in grades 1–9) correspond to Colorado's benchmarks. Finland's core content areas are labeled separately and grouped differently across the grade spans. For each core content area in grades 1–9, Finland has between 2 and 13 bulleted statements describing the curriculum that students will experience, but does not describe what students should be able to do.

Considering only the statements of Core Content in grades 1–9, and compulsory courses in Advanced Math (which generally subsume the content for compulsory Basic Math), Finland has 165 Core Content statements. An additional 19 Core Content statements describe Finland's 3 upper level specialization courses. Similar to Massachusetts and Virginia, Finland's Core Content statements are presented by grade span with content area names separating the bulleted statements. Finland prefaces the Core Content statements with bulleted Objectives and, in grades 1–9, the Core Content statements are followed by bulleted Descriptions of Good Performance at the end of each grade span. Finland's Core Content statements are more specific and detailed than Colorado's benchmarks, particularly in the high school content. However, Finland only lists the core content topics without detailing what it is the students are to do with the topics.

In relation to content, both Colorado and Finland place emphasis on Number in K–8 and grades 1–9, respectively, with decreasing emphasis as grade spans increase. Finland combines Number and Calculations under one category. In these grades, about one-sixth of both Colorado's benchmarks and Finland's core content topics address Number. Finland introduces multiplication and division concepts earlier than Colorado (as indicated in the grade 1–2 Core Content) and is more specific about using parentheses and simplifying expressions. In grades 10–12, none of Finland's core content topics in advanced or basic mathematics directly address any of Colorado's three grade 9–12 benchmarks. However, the first two of the three benchmarks are well represented in

Finland's grade 6–9 core content topics. Across the grades, Finland does not emphasize using number sense for estimation and justification, and Colorado benchmarks are more specific about applying concepts in problem-solving contexts.

In both sets of standards/core content, the emphasis on Algebra increases as grade spans increase. In grades 1–5, Finland designates about one-tenth of its core content to sequences, ratios and correlations, whereas Colorado, in grades K–4, designates more (about one-seventh) of its benchmarks to patterns and relationships. In the middle grades the emphasis reverses: In grades 6–9, Finland includes a content area of Functions in addition to the Algebra core content, together representing almost one-third of the core content in that span. However, in grades 5–8, Colorado continues to designate about one-seventh of its benchmarks to algebraic methods. Of Finland's core content statements in grade 10–12 courses that address Colorado 9–12 benchmarks, over one-half emphasize Algebra, whereas in Colorado, about one-fifth of the 9–12 benchmarks address Algebra. Finland is more explicit about content including exponential expressions, operations with polynomials, and solving incomplete quadratic equations. Colorado is more explicit about problem-solving contexts and distinguishing between linear and non-linear functions.

In the lower grades, both Finland and Colorado designate about one-seventh of their core content or benchmarks to Data and Statistics. In grades 9–12, Colorado designates about one-fourth of its benchmarks to Data and Statistics; and, of Finland's core content statements in grade 10–12 courses that address Colorado 9–12 benchmarks, over one-fifth emphasize this content. In the middle grades, Colorado increases its emphasis to about one-fifth, whereas Finland's emphasis decreases to about one-tenth of its core content. Also, Finland's emphasis changes somewhat as indicated by the labels across the grade spans: Finland labels this core content as Data Processing and Statistics in grades 1 and 2; labels it as Data Processing, Statistics, and Probability in grades 3–5; and it is labeled Probability and Statistics in grades 6–9. Colorado places more emphasis on evaluating arguments based on statistical claims in the middle grades and analyzing claims for erroneous conclusions or distortions in upper grades. Finland's core content also addresses storing data, which is more along the lines of data processing.

In grades 1–2, about one-fourth of Finland's core content represents Geometry; in grades 3–9, Geometry is combined with Measurement, which together represent between one-third and one-fourth of the core content, indicating that the emphasis on Geometry decreases as grades increase from grades 1–9. There is considerable overlap between Colorado grades 5–8 benchmarks and Finland's grade 6–9 core content. In grades 10–12, Finland designates about one-fifth of its core content to Geometry. In grades 1–2, Finland core content specifies basic Geometric concepts that include point, line segment, horizontal line, ray, straight line and angle; and by grade 5, core content includes rays, circles and their parts, parallel and perpendicular lines, and more about angles and Pythagorean theorem. These are concepts that either are not directly specified or come later in Colorado benchmarks. In grades 10–12, Finland provides core content for three Geometry-related courses: Geometry, Analytical Geometry, and Vectors.

Measurement represents about one-fifth of Finland's core content across grades 1–5, and one-sixth in grades 6–9, and is combined with Geometry in grades 3–9. This is similar to Colorado where one-fifth of the benchmarks address Measurement in K–8, and about one-eighth in 9–12. In grades 1–2, Finland core content specifies basic measurement concepts that include surface area, volume, and price, which could be addressed later in Colorado standards. In grades 3–5, Finland core content includes conversion of units of measurement, directly references circumference and circles, and specifies dilating and reducing figures by a given ratio. Colorado is more specific about reading and interpreting scales, and describing how a change in a linear dimension affects perimeter, area, and volume. In grades 9–12, only one of Colorado's three benchmarks seems directly related to specific core content in Finland's grades 6–9, or 10–12 syllabi.

In grades K–4, Colorado designates about one-fifth of the benchmarks to Operations, and decreases to about one-eighth in both grade spans 5–8 and in 9–12. Finland designates about one-eighth of the core content topics to Calculations in grades 1–9. Every Colorado benchmark in this standard is addressed by at least one core content topic in grades 1–9, although there seem to be no direct matches for Colorado 9–12 benchmarks with Finland grades 10–12 content. Finland's core content is more specific as to concepts such as time calculations and time intervals, reduction of expressions, order of operations and rounding. Colorado places more emphasis on estimation strategies and when to use estimation instead of an exact answer.

Across the Colorado standards, there is a fair amount of similarity in content with the K–4 grade span benchmarks and Finland's grades 1–2 and 3–5 core content topics. Most of the 28 benchmarks contain content that corresponds to at least one Finland core content topic listed in grades 1–5. Number and Operation are well represented by both Colorado and Finland. Finland puts about half the emphasis as Colorado does on Algebra and Statistics, and about twice the emphasis on Geometry and Measurement.

There is also a fair amount of similarity in content with the grade 5–8 span benchmarks and Finland's grades 3–5 and 6–9 spans. Most of the 34 benchmarks contain content that corresponds to at least one Finland core content topic listed in grades 3–9. The two documents also differ specifically in the 5–8 grade span, where Finland introduces a new topic: Thinking Skills and Methods, which contains seven core content subtopics. About half of these are included in Colorado's Data & Statistics standard, but subtopics such as history of mathematics, use of tools and drawings that assist thinking, and interpretation and production of mathematical texts are not specified in Colorado's benchmarks. Another new topic Finland includes is Functions, separate from Algebra. Combining these two topics, Finland designates about one-third of its core content to what best correlates to Colorado's Standard 2, and this is about twice what Colorado designates. Geometry and Measurement are combined in Finland at this span and represent about one-fourth of the core content, whereas in Colorado these two standards together represent over one-third of the benchmarks.

Almost all of Colorado's 24 benchmarks contain content that corresponds to at least one core content topic in Finland grades 1–9. There is a high degree of overlap with

Colorado's Algebra and Geometry benchmarks and some Finland grade 10–12 courses. There is limited overlap between Finland grade 10–12 courses and Colorado's Data and Measurement standards; and no overlap with Number and Operations.

Both Finland and Colorado emphasize problem solving, though Finland's documents are less specific in putting these in the core content statements themselves, wanting students to "derive satisfaction…solving problems" whereas Colorado states this in the text of each standard. Finland's documents suggest embedding their mathematics core content and syllabi within seven integration and cross-curricular themes. In K–8, most Colorado benchmarks seem related to at least one Finland core content topic in grades 1–9, and vice versa. In grades 9–12, there is less evidence of overlap or similar emphases in content.

Colorado's benchmarks provide verbs that specify what a student is to do with the content, whereas Finland's core contents consist of headings and lists of topics or content within the headings. The Finland document also provides greater detail as to specificity of concepts and the grade years these are introduced or learned.

Overall, Finland's core content was rated more different than similar to Colorado standards. Although, Finland and Colorado are most similar in content concerning number and data, in the other four standards content is considered more different than similar, based on content emphases as well as when content is introduced or learned. Also for each grade span, corresponding content is more different than alike. In K–4 there are differences in emphasis in algebra, data, geometry, and measurement. In 5–8 Finland introduces new topics and has different emphases in data, geometry, and measurement. In 9–12, there is less overlap in content, especially with Finland's grade 10–12 courses and in standards dealing with number, data, geometry, and measurement.

Singapore

Singapore has syllabi for eight grades (P1–P6, Secondary 1 and Secondary 2) and one grade span (Secondary 3/4). Also, Singapore provides additional syllabi for Foundations in P5 and P6, which contain more review of P1–P4. For secondary, syllabi are provided at three levels: O, N(A), and N(T); and Additional level O and level N(A) syllabi are provided for Secondary 3/4.

Colorado's six standards correspond somewhat to Singapore's Topics, although Topics change across the grades. Singapore lists from four to eight Topics in grades P1–P6, with from 10 to 20 subtopics at each grade. In secondary there are three topics in the syllabus for each grade, with from 11 to 16 subtopics at each grade. Each subtopic has between 1 and 18 content listings describing what content should be in the curricula, and many content bullets have further sub-bullets providing examples or specifics of content in more detail.

In P1–P6 and Level O Sec1, 2, and 3/4, Singapore lists 122 subtopics that students encounter, with an additional 11 subtopics in Level O Sec3/4+. In P1–P4, Singapore has 56 subtopics, in grades 5–8, Singapore has 50 subtopics, and in grades 9–10, Singapore

has 27 subtopics. For each grade, Singapore provides a table showing the Topic name. The names of Subtopics are then listed with the corresponding content bullets and are much more specific and detailed, based on the content bullets than Colorado's benchmarks.

In terms of content, Singapore combines both Number and Operations into six Topics in P1–P6: Whole Numbers, Fractions, Decimals, Percentage, Ratio, and Speed. In Sec1, 2, and 3/4, Number (including Operations) is combined with Algebra. In Sec3/4+ There is no mention of Number. In P1–P6, Number (including Operations) accounts for almost one-half of the subtopics. Due to the separation of types of numbers, it is apparent that P1–P5 place consistent emphasis on whole numbers, then P2–P6 include fractions, P4–P5 include decimals, P5–P6 include Percentage and Ratio; and P6 includes Speed. There is a sharp decrease in emphasis on Number (and Operations) after P6. Singapore P1–P4 content includes comparing and ordering fractions and knowing place value concepts for decimals. Across the grades, Singapore does not emphasize using number sense for estimation and justification, or developing and testing conjectures. Colorado benchmarks are more specific about applying concepts in problem-solving contexts.

As a Topic, Algebra does not appear in the Singapore course syllabi until P6, and is definitely an area of emphasis in Sec1, 2, and 3/4, where it is combined with Number as one of only three topics in those years. In Sec3/4+, Algebra is one of the three topics containing about two-thirds of the subtopics. In early grades, Colorado describes more experiences with patterns and solving problems with patterns. Singapore syllabi specify concepts such as polynomials, simultaneous equations, logarithms, and set notation.

Overall, Singapore places less emphasis on Data and Statistics than does Colorado. In Singapore the emphasis remains steady, involving about one-tenth of the subtopics at each grade P1–Sec1, and one-sixth to one-eighth at Sec2 and Sec3/4, respectively. Colorado develops concepts of measures of central tendency earlier than Singapore, as well as formulating hypotheses and making convincing arguments. In P1–P4, Singapore emphasizes only constructing and interpreting displays, with different types of displays emphasized each year. There is more overlap of content in the middle and upper grades, although Singapore does not emphasize probability as much as Colorado.

Across P1–P6, Singapore designates about one-fifth of its subtopics for Geometry, with increased emphasis in secondary. In the middle grades, Singapore combines Geometry and Measurement to be one of three topics, and Geometry is combined with Trigonometry in Sec 3/4+. Singapore emphasizes length and mass in early grades, and then brings in area. Singapore syllabi are more specific about lines and curves, and nets. Colorado specifies more with transformations earlier than Singapore, and indicates problem-solving settings more often.

In P1–P6, the content of almost one-fourth of Singapore's subtopics deals with Measurement. Measurement is combined with Geometry in Sec1, 2, and 3/4 as one of three topics at each year, together representing more than one-fourth of the subtopics. Colorado students in grades K–4 spend more time developing sense of measurement

using approximate measures of familiar objects, and middle grade students have more emphasis on reading and interpreting various scales, and describing how a change in linear measurement affects its perimeter, area, or volume; and upper grade students more specifically must measure with specified degrees of precision, accuracy, and error, and determine the degree of accuracy of a measurement, using significant digits.

There is a high degree of overlap of Singapore content with Colorado K–8 benchmarks in Operations and Calculations. In the upper level in Singapore, there is a sharper decrease in emphasis on Operations than in Colorado. Colorado places greater emphasis than Singapore on using models to explain how ratios, proportions, and percents can be used to solve real-world problems. None of Singapore's Sec3/4 content deals specifically with Operations, although content in Sec1 and Sec2 does overlap with two of the three Colorado benchmarks in grades 9–12.

Across the Colorado standards, there is a high degree of similarity in content with lower and middle grades benchmarks and Singapore subtopics and content bullets. Almost all of the 28 K–4 benchmarks contain content that corresponds to at least one Singapore subtopic in P1–4. Comparing Singapore's six Number topics, which include Operations, with Colorado, both put the greatest emphasis (about two-fifths to one half) on these concepts. In the K–4 grade span, Singapore designates no subtopics to Algebra, and less than one-tenth to Data Analysis, and about one-half to topics in Number and Operations.

There is also a high degree of similarity in content with the grade 5–8 benchmarks and Singapore subtopics. Almost all of the 34 benchmarks contain content that corresponds to content in at least one Singapore subtopic. Comparing Singapore's six Number topics including Operations with Colorado, both put the greatest emphasis on these concepts—about one-half of the content in Singapore's subtopics and about one-third of Colorado's benchmarks. In this grade span, Singapore designates the least amount (about one-tenth) to its Data strand. Some concepts possibly better covered, or at least specified, in Singapore subtopics include place value with decimals, set language and notation, Pythagorean theorem, order of operations, and simplifying numerical and variable expressions.

Across the Colorado standards, there is some similarity in content with the grade 9–12 benchmarks and content in the Singapore subtopics, particularly if content from Sec1 and Sec2 is considered. Almost all of the 24 benchmarks contain content that corresponds to at least one Singapore subtopic, with Number and Operations having the least amount of overlap. In the 9–12 grade span, Singapore designates only three topics at each grade, by combining topics named in P1–P6: Number & Algebra, Geometry & Measurement, and Statistics & Probability.

Review of Colorado's Mathematics Standards for 21st Century Skills and Abilities and Postsecondary and Workforce Readiness

As described in the Methodology section of this report, analysts analyzed Colorado's draft 21st Century Learning Skills and Abilities (21st Century Skills) and definition of Postsecondary and Workforce Readiness (PWR Skills) to determine the degree to which Colorado's MCS contain the skills described in those draft documents. Findings from those analyses are presented below.

Mathematics Model Content Standards and the 21st Century Skills and Abilities

Critical thinking and reasoning

Each of the mathematics standards ends with the phrase "in problem-solving situations and communicate the reasoning used in solving these problems" to emphasize the importance of problem solving to mathematics learning. As a result, many benchmarks across the standards and across the grade spans specify solving problems and/or involve critical thinking and reasoning to accomplish the benchmarks. The skills and abilities involved in critical thinking and reasoning were considered partially present across the grade spans for standard 5, involving measurement concepts, and fully present across the other five mathematics standards.

Information literacy

Aspects of information literacy appear in Standard 3, involving data and statistics, in all three grade spans, primarily in the areas of knowledge acquisition and source discernment, but perhaps not acquiring knowledge in the area of technology if that is the intent of this skill. It seems reasonable that this skill is not directly addressed in the other standards.

Collaboration

None of the mathematics standards or benchmarks specifically addresses collaboration. This seems to be more a curriculum issue that can be addressed by providing learning experiences that require student collaboration.

Self-direction

None of the mathematics standards or benchmarks specifically addresses self-direction. This seems to be more a by-product of various learning experiences in which the ability can be observed or inferred.

Invention

Several mathematics benchmarks across the standards indirectly promote invention or provide opportunities for students to display creativity and innovation. Most standards, however, received at least Partially present for invention in a grade span due to the need to integrate ideas in at least one benchmark. Benchmark 1.9–12.2 could be modified to address invention by expanding on how students might develop conjectures by integrating ideas, but generally don't seem to require innovation. In grades 4–8, Standard 2 benchmarks could involve integration of ideas, but it is not directly specified.

Overall, it seems that critical thinking and reasoning skills must be present whenever students demonstrate information literacy abilities or invention. Also, benchmarks relating to Invention typically were considered due to integration of ideas, which seems also to be a type of critical thinking and reasoning.

Mathematics Model Content Standards and the Postsecondary and Workforce Readiness Skills and Abilities

A rating of Fully present across the 9–12 grade span indicates that students likely receive opportunities to develop or access the skills and abilities in earlier grades and would demonstrate them in the 9–12 grade span.

Application of reading, writing, and computing skills with minimal remediation or training

Although computation occurs in many of the standards, it is the focus of mathematics standard 6.

Logical reasoning and argumentation abilities

Although logical reasoning occurs in many of the standards, it is most applicable for argumentation in mathematics standard 3.

Identification and solving of problems

Each of the mathematics standards ends with the phrase "in problem-solving situations and communicate the reasoning used in solving these problems" to emphasize the importance of problem solving to mathematics learning. As a result, many benchmarks across the standards specify solving problems to accomplish the benchmarks, and generating accurate solutions is a basic assumption. The skills and abilities involved in identifying and solving problems were considered fully present for standards 3 and 6, partially present for standards 1, 2, and 4, and not present for standard 5. For standard 1, if benchmarks 1 and 2 required students to use and "go beyond" the immediate application, the readiness requirement for would more likely be present. For standard 2, incorporating the phrase "in a problem-solving situation" in benchmarks 2, 4, and/or 5 would add emphasis. Likewise for standard 4, emphasis would be added by incorporating the phrase "in a problem-solving situation" in benchmark 2. Problem solving was considered not present in standard 5 because, although the language of the standard specifies that students are to apply their measurement results in problem solving situations, this is not reinforced in the benchmarks. Adding the phrase "required in a problem-solving situation" to benchmark 3 and/or adding "in a problem-solving situation" to benchmark 2 would help emphasize this skill.

Information management skills

Information management skills are not specified in the mathematics standards, although they could possibly be addressed when modeling real-world phenomena as an application in standard 2.

Human relation skills
Human relation skills are not specified in the mathematics standards, although they could occur in learning situations as part of students' learning experiences.

Analysis and interpretation skills
Analysis and interpretation skills are considered fully present in all the mathematics standards. Overall it seems analysis and interpretation skills must be present whenever students demonstrate logical reasoning and argumentation abilities and whenever identification and solving of problems is addressed.

Recommendations

This section contains specific recommendations from the WestEd reviews, organized by the components of the analysis.

Internal Quality Review of Colorado's Mathematics Model Content Standards

According to the front matter in the mathematics MCS, these standards were developed to reflect what mathematics every Colorado student should learn, and were intended to indicate the broad knowledge and skills that all Colorado students should acquire. The benchmarks serve to describe the knowledge and skills across certain grade spans, with further articulation of curriculum and instructional scope and sequence determined by local school districts. The CDE may want to consider implementing the following recommendations, where appropriate:

1. Provide documentation either within the standards and benchmarks or in companion documents that provides greater specification on where and when the existing content and any additional content should be mastered. Ancillary documents could also describe where and when the concepts should be introduced and how they might best be developed so that all students are prepared to show their mastery of the standards.
2. Consider combining standards 1 and 6 into a Number and Operations standard and standards 4 and 5 into a Geometry and Measurement standard in the 9–12 grade span, so that the benchmarks together represent a broader range for depth and rigor.

To clarify or modify existing benchmarks or standards:

- Reword benchmark 3.K–4.2 to "interpret data using concepts such as largest, smallest, most often, and middle."
- Modify benchmark 3.K–4.3 to have predictions in the 5–8 grade span by rewording to "generate and analyze data based on results obtained from surveys and chance devices," and expand 3.5–8.5 to "determine probabilities and make predictions based on experiments or simulations." Alternatively, in 3.K–4.3 provide examples of the types of predictions that can be expected using terms such as "possible," "impossible," "more likely," or "less likely."
- Provide examples in standard 5, grade span 5–8, for benchmarks 1, 2, and 3 that show such things as the complexity of the estimates and measures, the types of indirect measurements, and the complexity of the scales in order to better indicate the depth of the standard. Also, consider if benchmark 5 could be part of a less specific, more inclusive benchmark.
- Consider indicating that the benchmarks in the 9–12 grade span are not intended to have the same range or degree of depth as benchmarks in other spans, and/or that these benchmarks can be accomplished before 12th grade.
- Expand the "floor" for benchmark 2.K–4.4 by providing additional ways to show functions; for example, include equivalence trades with money (1 nickel is the same amount as 5 pennies, and 2 nickels are the same amount as 10 pennies).

- Expand benchmark 3.K–4.1 to include collecting, sorting, and/or organizing data and tallying results.
- Provide examples for benchmark 6.K–4.1 to include using objects or drawings to show fact families and/or relations between addition and subtraction, addition and multiplication, multiplication and division, division and subtraction.
- To increase rigor, consider identifying ways within existing or new benchmarks to specify that students apply skills such as justification and testing conjectures in more complex problem-solving situations.
- Consider expanding standard 6 to include operations with matrices, if that is considered essential for all students.

Consider specifying the following in the K–4 grade span:

- when/if students are comparing and/or using place value with rational numbers;
- where money is introduced—such as in measurement or as number, for decimals;
- whether/if skip counting is included in patterns (standard 2) or operations (standard 6);
- if geometry (standard 4) and/or measurement (standard 5) content includes circles, angles and/or parallel/perpendicular lines; and
- whether/if properties of operations are included (standard 6).

Consider specifying the following in the 5–8 grade span:

- when/if students are comparing and/or using place value with rational numbers, especially in problem-solving situations, beyond what is specified for the K–4 grade span;
- if rules of powers and roots are included;
- whether the types of problems referred to in benchmark 1.5–8.6 involve operations and would be a better fit in standard 6;
- if standard 2 (algebra) includes identity properties;
- if students are evaluating expressions by replacing variables and/or using order of operations in simplifying numerical and variable expressions;
- if Pythagorean theorem is introduced or used, and whether this would be in geometry (standard 4) or measurement (standard 5);
- if/where elapsed time and/or conversions with measures are included;
- if/where properties of operations are included, beyond what is specified for the K–4 grade span; and
- if benchmark 4.5–8.5 is more a measurement concept and could be included in 5.5–8.4.

Consider specifying the following in the 9–12 grade span:

- where/if operations with rational expressions and/or operations with polynomials or simplifying polynomials is included;
- whether informal solving of simultaneous equations is included; and
- whether the problems mentioned in 1.9–12.3 include operations, and would be a better fit in standard 6.

External Referent Review for Mathematics

Currently, the Colorado mathematics standards represent the essential knowledge and skills that all students should have. Thus, the enacted curriculum, which is determined locally, should go beyond what is articulated in the standards document. Assuming this continues to be the case, and depending upon the purpose of the standards and the audience the standards document is to reach, the CDE may want to consider the following recommendations:

- In grades K through 7/8, provide more detail about the content that should be learned each year. Consider topics that are assumed but not specified in the current standards, including those mentioned by referent documents, and decide where in the learning sequence the important topics should occur.
- If the six standards continue to be the focus of mathematics instruction, consider combining Number and Operations. Also, consider that different standards or combinations of standards can be emphasized in different grades, with non-emphasized content used as context for, or in connection with, new learning.
- Continue using action words that not only say what is to be learned, but also indicate the depth or level of learning. Be sure these statements represent learning for all and are measurable.
- Continue to include both conceptual knowledge/understanding and process/procedural skills in the standards/benchmarks.
- For coherence, consider having the document show both the vertical and horizontal development of content/topics.
- For secondary courses, provide course-specific standards. In addition or alternatively, for grades 8 or 9–10 articulate standards/benchmarks that are less grade-or course-specific, but that do emphasize Algebra and Geometry applications, in ways that support 21st Century Skills and Abilities and Postsecondary Workforce Readiness.

Suggestions for consideration of additional external referents

The *New England Common Assessment Program (NECAP) Mathematics Grade-level Expectations,* developed by the four New England Compact consortium states—Maine, New Hampshire, Rhode Island, and Vermont—provides a good example of vertical and horizontal alignment, and purposefully uses Webb's depth of knowledge categories. Nevada mathematics standards are useful as they are written to reflect developmental progression of content. West Virginia recently revised its standards to reflect 21st Century

Skills, and these could provide insights for states seeking to emphasize these skills within the content areas.

III-C. Science Findings and Recommendations

This section contains findings and recommendations related to the internal quality review, the external referent reviews, and the review of 21st Century Skills and PWR skills. Detailed review criteria can be found in the Methodology section of this report. A brief description of the criteria and guiding questions also are provided here for convenience.

Internal Quality Review

As described in the Methodology section of this report, the Colorado MCS were reviewed for their quality according to four criteria: depth; coherence; rigor; and breadth. The scale used for evaluating each criterion was as follows: Fully (F), Partially (P), No (N), or Insufficient information to determine (I). Findings from these analyses are presented below. Findings from these analyses are presented below.

Depth

Ratings for depth are assigned based on the questions below.

- Do the benchmarks describe content of sufficient and appropriate depth in the standard *within each grade span*? (For example, is the depth of content of the standard appropriate for a school year?)
- Do the benchmarks describe content of sufficient and appropriate depth in the standard *across the grade spans*?

The table below shows the ratings for depth in the Science standards, reported for each standard at each grade span, as well as across the grade spans. The across grade span ratings are holistic ratings of the depth of the standards in K–12.

Table 17. Ratings for Depth in the Science MCS

Standard	K–2	3–5	6–8	9–12	Across Grade Spans
1	F	F	P	F	F
2	F	F	F	P	F
3	F	F	F	F	F
4	F	P	F	F	F
5	F	P	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

As indicated by the ratings in the table, in all but a few standards/grade span combinations, the Science benchmarks Fully describe content of sufficient and appropriate depth. The following categories were given a rating of Partially because certain skills or concepts have not been included in the benchmarks. This content would have been necessary for the standards to Fully describe content of sufficient and appropriate depth. The missing content is also reflected in the subsequent ratings for Breadth in Table 22. A brief comment is provided below to explain each rating.

Standard 1, grade span 6–8 lacks content specific to designing and conducting investigations. This content is explicitly included in benchmark statements at the K–2, 3–5, and 9–12 grade spans, but is not included at 6–8.

Standard 2, grade span 9–12 lacks content specific to the types and characteristics of chemical bonds and chemical reactions.

Standard 4, grade span 3–5 lacks content specific to the composition and formation of rock types and soils. Content at the 6–8 grade span addresses the interrelationships between minerals, rocks, and soils, but the precedent understandings would typically be established in the 3–5 grade span. At the 3–5 grade span, the understandings addressing soils would typically cover soil formation (mechanical weathering of rock and decomposition of organic matter), soil composition (rock, clay, silt, sand, and humus), and may include soil properties (texture—size of particles, ability to retain water, nutrient levels—ability to support plant growth). The understandings addressing rocks would typically cover mineral properties, mineral tests, examples of common minerals, the mineral composition of rocks, rock types (igneous, sedimentary, and metamorphic), examples of common rocks of each type, and the processes that form each rock type (including the rock cycle).

Standard 5, grade span 3–5 lacks content specific to how scientific knowledge is acquired and changes over time. This content is explicitly included in benchmark statements at the subsequent 6–8 and 9–12 grade spans, but is not addressed at 3–5.

Standard 5, grade span 3–5 needs content specific to the interrelationships between science, technology, and society. This content is explicitly included in benchmark statements at the subsequent 6–8 and 9–12 grade spans, but should also be addressed at 3–5.

Coherence

Ratings for coherence are assigned based on the questions below.

- Are the benchmarks for each standard sequenced appropriately across the grade spans? (For example, do they scale or spiral appropriately across the grade spans?)
- Do the benchmarks begin and end at appropriate points in the content?

The tables below show the ratings for coherence for the Science standards, reported as appropriate sequence across the grade spans, and as appropriate beginning and endpoints for each standard at each grade span, as well as across the grade spans.

Table 18. Ratings for Coherence in the Science MCS

Standard	Appropriate Sequence Across Grade Spans
1	F
2	F
3	F
4	F
5	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Table 19. Ratings for Coherence in the Science MCS

	Appropriate Beginning and Endpoints				
Standard	**K–2**	**3–5**	**6–8**	**9–12**	**Across Grade Spans**
1	F	F	F	F	F
2	F	F	F	F	F
3	F	P	F	F	F
4	F	P	P	F	F
5	F	F	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

As indicated by the ratings in the table, in all but a few standard/grade span combinations, the science benchmarks are Fully (F) sequenced appropriately and begin and end at appropriate points. The following categories were given a P rating. A brief comment is provided below to explain each rating.

Standard 3, grade span 3–5 contains some examples in benchmark 3.3–5.4 that appear to exceed the grade span. One of the examples given is food webs. Food webs are most typically used beginning at the middle school grade span to represent the transfer of energy between multiple organisms across various trophic levels in an ecosystem. Linear food chains are more typically used at the upper elementary grade span to show more direct and less complicated paths of energy transfer.

Standard 4, grade span 3–5 contains some content in benchmark 4.3–5.4 that appears to exceed the grade span. Understanding the distinction between weather and climate requires comparing multiple short and long term conditions and understanding long term patterns that significantly exceed the frame of reference of upper elementary students. While weather conditions and factors are typically covered at the elementary grade spans, differentiating climate from weather is more appropriate at the middle school grade span.

Standard 4, grade span 6–8 contains content in benchmark 4.6–8.15 that appears to exceed the grade span. The vast number of objects in the universe (billions of galaxies each containing billions of stars) and the vast distances in the universe (measured in light years) require conceptual understandings that are more appropriate for the high school grade span.

Rigor

Ratings for rigor are assigned based on the questions below.

- Do the benchmarks describe content and skill expectations of a reasonable and appropriate level for this grade span? Do the standards and benchmarks communicate an appropriate level of rigor?

The table below shows the ratings for rigor in the Science standards, reported for each standard at each grade span, as well as across the grade spans.

Table 20. Ratings for Rigor in the Science MCS

Standard	K–2	3–5	6–8	9–12	Across Grade Spans
1	F	F	F	F	F
2	F	F	F	F	F
3	F	F	F	F	F
4	F	F	F	P	F
5	F	F	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

As indicated by the ratings in the table, in all but the following category, the science benchmarks Fully communicate an appropriate level of rigor. The brief comments provided below explain the P rating.

Standard 4, grade span 9–12 needs further definition of the content relating the composition and structure of Earth's interior and the transfer of energy to plate tectonics and changes on Earth's surface. The current benchmarks, 4.9–12.1 and 4.9–12.2, independently address the structure and composition of Earth's interior and the theory of plate tectonics, but do not directly relate the composition and structure of Earth's interior and the transfer of energy between Earth's layers to the motion and interaction of tectonic plates and the geologic events and features of Earth's surface that result from those interactions.

Standard 4, grade span 9–12 needs further definition of the content associated with the composition and structure of the universe. The content described above for the current middle school benchmark 4.6–8.15 would be more appropriate at the high school grade span. This content addresses the vast number of objects and the vast distances in the universe.

Breadth

Ratings for breadth are assigned based on the questions below, each of which is reported in a separate table.

- Do the benchmarks describe sufficient and appropriate breadth of content across standards *within each grade span*?
- Do the benchmarks contain the essential content for this subject *within and across grade spans*?
- Are the benchmarks free from extraneous content *within and across grade spans*? If not, what content is extraneous?

Each of the three aspects of breadth examined is reported in a separate table in order to distinguish between essential and extraneous content.

Breadth represents the sufficiency of content across the standards. The table below shows the ratings for overall breadth *across* the science standards within each grade span and across the grade spans.

Table 21. Ratings for Overall Breadth in the Science MCS

Grade Span	Across Standards
K–2	F
3–5	F
6–8	F
9–12	F
Across Grade Spans	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

As indicated by the ratings in the table, the Science benchmarks Fully describe sufficient and appropriate breadth of content across all standards within each grade span.

The table below shows the breadth ratings for essential content in the Science standards, reported for each standard at each grade span, as well as across the grade spans.

Table 22. Ratings for Breadth—Essential Content in the Science MCS

Grade Span	1	2	3	4	5	Across Standards
K–2	F	F	F	F	F	F
3–5	F	F	F	P	P	F
6–8	P	F	F	F	F	F
9–12	F	P	F	F	F	F
Across Grade Spans	F	F	F	F	P	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

As indicated by the ratings in the table, in all but a few standards/grade span combinations, the Science benchmarks Fully contain the essential content for this subject

within and across grade spans. The following categories were given a rating of Partially because specific essential content was not found in the standards within the grade span. The missing content is also reflected in the prior ratings for Depth in Table 17. A brief comment is provided below to explain each Partially rating.

Standard 1, grade span 6–8 lacks content specific to designing and conducting investigations. This content is explicitly included in benchmark statements at the K–2, 3–5, and 9–12 grade spans, but is not included at 6–8.

Standard 2, grade span 9–12 lacks content specific to the types and characteristics of chemical bonds and chemical reactions.

Standard 4, grade span 3–5 lacks content specific to the composition and formation of rock types and soils. Content at the 6–8 grade span addresses the interrelationships between minerals, rocks, and soils, but the precedent understandings need to be established in the 3–5 grade span for the interrelationships to be addressed in 6–8. At the 3–5 grade span, the understandings addressing soils would typically cover soil formation (mechanical weathering of rock and decomposition of organic matter), soil composition (rock, clay, silt, sand, and humus), and may include soil properties (texture—size of particles, ability to retain water, nutrient levels—ability to support plant growth). The understandings addressing rocks would typically cover mineral properties, mineral tests, examples of common minerals, the mineral composition of rocks, rock types (igneous, sedimentary, and metamorphic), examples of common rocks of each type, and the processes that form each rock type (including the rock cycle).

Standard 5, grade span 3–5 lacks content specific to how scientific knowledge is acquired and changes over time. This content is explicitly included in benchmark statements at the subsequent 6–8 and 9–12 grade ranges, but is not addressed at 3–5.

Standard 5, grade span 3–5 lacks content specific to the interrelationships between science, technology, and society. This content is explicitly included in benchmark statements at the subsequent 6–8 and 9–12 grade ranges, but is not addressed at 3–5.

For Standard 5, benchmarks 5.3–5.1 and 5.6–8.1 are more appropriately included as part of Standard 1 because both benchmarks relate directly to the results of investigations.

For Standard 5, at the middle school and high school grade spans, there is a need to address content related to the limitations of scientific understanding (e.g., questions of personal preference/value, questions of morality, questions of supernatural beliefs).

For Standard 5, at the middle school and high school grade spans, there is a need to address content related to ethical practice in conducting scientific investigations (e.g., knowledge and consent of human subjects, treatment of animals, accurate and complete reporting of results, minimizing conflict of interest).

The table below shows the breadth ratings for freedom from extraneous content, reported for each standard at each grade span, as well as across the grade spans.

Table 23. Ratings for Breadth—Free of Extraneous Content in the Science MCS

Grade Span	1	2	3	4	5	Across Standards
K–2	F	F	F	F	F	F
3–5	F	F	F	F	F	F
6–8	F	F	F	F	F	F
9–12	P	F	F	F	F	F
Across Grade Spans	F	F	F	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

As indicated by the ratings in the table, in all but the following category, the Science benchmarks are Fully free of extraneous content. A brief comment is provided below to explain the Partially rating.

Standard 1, grade span 9–12 contains content in benchmark 1.9–12.6 that is unclear. The current benchmark states that students should, "communicate and evaluate scientific thinking that leads to particular conclusions." Mixing communicating and evaluating in the same benchmark contributes to the lack of clarity. Since the prior benchmark, 1.9–12.5, already addresses constructing and revising scientific explanations, it may be best to focus 1.9–12.6 exclusively on evaluating conclusions (e.g., evaluate conclusions based on evidence including the results of scientific investigations).

External Referent Review

As described in the Methodology section of this report, analysts reviewed four sets of content standards to serve as an external referent comparison with Colorado's MCS in science. The following documents were used as external referent standards for the science review:

- Massachusetts Science and Technology/Engineering Curriculum Framework (October 2006)
- Science Standards of Learning for Virginia Public Schools (January 2003)
- National Core Curriculum for Basic Education 2004 (Finland)
- National Core Curriculum for Upper Secondary Schools 2003 (Finland)
- Science Syllabus Primary 2008 (Singapore)
- Science Syllabus Lower Secondary Normal (Technical) (Singapore, 2008)
- Science Syllabus Lower Secondary Express/Normal (Academic) (Singapore, 2008)

These external referent standards were reviewed for two broad criteria, organization/structure and content. Each criterion contained several subcategories about which analysts recorded observations before determining a final overall holistic rating of

mostly similar (Similar) or mostly different (Different). Findings from these analyses are presented below.

The table below summarizes the external referent standards in comparison with Colorado's MCS.

Table 24. Holistic Comparison Ratings for Science External Referents

Rating Category	Massachusetts	Virginia	Finland	Singapore
Organization/ Structure	Similar	Similar	Different	Different
Content	Similar	Similar	Different	Different

As indicated by the ratings in the table, Massachusetts and Virginia were determined to be more similar to Colorado in both Organization/Structure and Content, and Finland and Singapore were determined to be more different. The analyses below highlight various similarities and differences between the MCS and pertinent categories in each referent's documents. It is important to note that the referents have similarities and differences among one another, as well as with Colorado's MCS. However, no one approach is intended to be presented as necessarily more or less effective than another. Differences in structure or content of a state or country's standards may be qualitative, but may also be attributable to differences in history, purpose, and/or context. Thus, the implication is that a variety of approaches and combinations of approaches may be considered, should they be determined to be appropriate for Colorado.

Organization and Structure

This analysis focused on differences and similarities in four categories: grade articulation, hierarchy of standards, number of standards, and design/format of standards documents, and is summarized below. Colorado and three of the four external referents specify standards by grade level range (e.g., K–2, 3–5, 6–8). In contrast, Virginia specifies content standards by individual grade for kindergarten through grade six, and then by grade level range for middle school (7–8) and high school (9–12).

In contrast to Colorado, all four external referents organize the science content, at some level, by topical or thematic strands. For example, some of the Massachusetts topical strands include The Earth in the Solar System, Properties of Matter, and Motion and Forces. Some of the Singapore thematic strands include Cycles, Systems, and Interactions.

Content

Colorado and all four external referents cover the following three large domains of scientific understanding: scientific investigation (CO Standard 1), physical science (CO Standard 2), and life science (CO Standard 3). However, for the scientific investigation domain, the Singapore standards do not begin until the P5–P6 grade level range, and the

Massachusetts standards do not begin until the high school grade level range. For the physical science domain, Massachusetts, Virginia, and Finland specify separate content standards for physics and chemistry courses at the high school grade level range.

Colorado and two of the four external referents, Massachusetts and Virginia, cover the large domain for Earth and space science content (CO Standard 4). However, the Virginia Earth and space science coverage only extends through the middle school grade level range. For Finland, Earth and space science content is very limited and much less focused. In Singapore, most of the Earth and space science content in the Colorado benchmarks is not addressed at all.

Three of the four external referents, Massachusetts, Virginia, and Finland, do not directly address the large domain for Nature of Science (CO Standard 5).

Massachusetts

The organization and content of the Massachusetts Science and Technology/Engineering Curriculum Framework clearly reflect the intent to articulate the guidelines for learning, teaching, and assessment in science and technology/engineering.

To help articulate these guidelines, the Framework is an expansive document that includes "What it Looks Like in the Classroom" scenarios imbedded in the presentation of the learning standards. In addition, the Framework provides several appendices addressing related topics such as additional learning activities, safety practices, dissection, and curriculum review resources.

The Massachusetts framework presents the standards in table format. The table shows the learning standard and associated Ideas for Developing Investigations and Learning Experiences. In some cases, an additional column shows Suggested Extensions to Learning in Technology/Engineering.

Both Colorado and Massachusetts organize the standards by highly similar grade spans. At the highest level of organization for content, the Colorado and Massachusetts documents are very similar. Both cover the following three large domains of scientific understanding: physical science, life science, and Earth and space science. At all grade spans, Colorado includes two additional standards covering the large domains of scientific investigation and the nature of science.

At the high school grade span, Massachusetts divides the physical science domain into two distinct courses: Chemistry and Physics. Also at the high school grade span, Massachusetts defines a set of Mathematical Skills relevant to each science course and defines a common set of four Scientific Inquiry Skill Standards.

At all grade spans, Massachusetts includes an additional large domain covering Technology/Engineering. Massachusetts is the only entity in this study to include a large domain for Technology/Engineering. This reflects Massachusetts' understanding that

although science and technology/engineering have different goals, they are closely related in many fields.

Massachusetts divides each large domain into smaller subtopics at each grade span. In many cases, the subtopic titles are unique at each grade span, but reflect related content that is grade span appropriate. For example, in the physical sciences domain, at PreK–2 a subtopic is Observable Properties of Objects. At 3–5, the related subtopic is Properties of Objects and Materials. At 6–8 and at High School, the related subtopic is Properties of Matter.

Our comparison shows that the proper unit of analysis is between the Colorado benchmarks and the Massachusetts standards. In general, the individual Massachusetts standards tend to have greater specificity and detail than the individual Colorado benchmarks. A comparison between the number of Colorado benchmarks and the number of Massachusetts standards reflects the differences in specificity and detail. Colorado has 155 benchmarks across all grade spans. In contrast, Massachusetts has nearly twice that amount with 307 standards across all grade spans. To illustrate this difference, the examples below show the three Colorado Grades 3–5 benchmarks addressing energy, electricity, and forces. Also shown are the analogous Massachusetts standards addressing the same topics.

Colorado Grades 3–5 Physical Science Benchmarks

- 2.3–5.5 there are different types and sources of energy (for example: light, heat, motion)
- 2.3–5.6 electricity in circuits can produce light, heat, sound and magnetic effects
- 2.3–5.7 there are different types of forces (for example: gravity and magnetism)

Massachusetts Grades 3–5 Physical Science Standards

- Identify the basic forms of energy (light, sound, heat, electrical, and magnetic). Recognize that energy is the ability to cause motion or create change.
- Give examples of how energy can be transferred from one form to another.
- Recognize that electricity in circuits requires a complete loop through which an electrical current can pass, and that electricity can produce light, heat, and sound.
- Identify and classify objects and materials that conduct electricity and objects and materials that are insulators of electricity.
- Explain how electromagnets can be made, and give examples of how they can be used.
- Recognize that magnets have poles that repel and attract each other.
- Identify and classify objects and materials that a magnet will attract and objects and materials that a magnet will not attract.
- Recognize that sound is produced by vibrating objects and requires a medium through which to travel. Relate the rate of vibration to the pitch of the sound.
- Recognize that light travels in a straight line until it strikes an object or travels from one medium to another, and that light can be reflected, refracted, and absorbed.

The greatest difference between the number of Colorado benchmarks and the number of Massachusetts standards is at the high school grade span. Colorado has 57 benchmarks at the high school grade span while Massachusetts has nearly triple that amount with 166 standards. This difference tends to reflect differences in the depth and breadth of content coverage rather than in the specificity of the individual benchmark or standard statements. To illustrate this difference, the examples below show the Colorado High School Physical Science benchmark addressing wave properties and the analogous Massachusetts High School Physics standards addressing the same topic.

Colorado High School Physical Science Benchmark

- 2.9–12.7 light and sound waves have distinct properties; frequency, wavelengths and amplitude

Massachusetts High School Physics Standards

- Describe the measurable properties of waves (velocity, frequency, wavelength, amplitude, period) and explain the relationships among them. Recognize examples of simple harmonic motion.
- Distinguish between mechanical and electromagnetic waves.
- Distinguish between the two types of mechanical waves, transverse and longitudinal.
- Describe qualitatively the basic principles of reflection and refraction of waves.
- Recognize that mechanical waves generally move faster through a solid than through a liquid and faster through a liquid than through a gas.
- Describe the apparent change in frequency of waves due to the motion of a source or a receiver (the Doppler effect).

Virginia

The stated goal of the Science Standards of Learning for Virginia Public Schools is to identify the academic content for essential components of the science curriculum at different grade spans.

Colorado and Virginia cover the following four large domains of scientific understanding from kindergarten through the middle school grade span: scientific investigation, physical science, life science, and Earth and space science. At all grade spans, Colorado includes an additional standard covering the large domain of the nature of science. At the high school grade span, Virginia does not include the Earth and space science domain. Also at the high school grade span, Virginia divides the physical science domain into two distinct courses: Chemistry and Physics.

Of particular note is that Virginia is the only entity in this study to identify grade specific science standards. Virginia identifies specific standards for kindergarten through grade six. Colorado and Virginia organize the standards by similar grade spans for the middle school and high school grade spans. The middle school grade span is 6–8 for Colorado and 7–8 for Virginia.

At grades K–6, Virginia organizes the content by the following topical content strands, which provide a continuum through these grades and are intended to be represented indirectly throughout the middle school and high school grade spans:

- Scientific Investigation, Reasoning, and Logic
- Force, Motion, and Energy
- Matter
- Life Processes
- Living Systems
- Interrelationships in Earth/Space Systems
- Earth Patterns, Cycles, and Change
- Resources

Our comparison shows that the proper unit of analysis is between the Colorado benchmarks and the Virginia standards. Virginia presents each standard statement followed by a lettered list of key concepts. In general, the key concept statements for each Virginia standard tend to provide greater specificity than the analogous Colorado benchmarks. To illustrate this difference, the examples below show the Colorado Grades 6–8 benchmarks addressing atoms, elements, and compounds. Also shown are the analogous Virginia Grade 6 standard and key concepts from the strand Matter:

Colorado Grades 6–8 Physical Science Benchmarks

- 2.6–8.5 all matter is made up of atoms that are comprised of protons, neutrons and electrons and when a substance is made up of only one type of atom it is an element
- 2.6–8.6 when two or more elements are combined a compound is formed which is made up of molecules

Virginia Grade 6 Standard and Key Concepts

Matter

6.4 The student will investigate and understand that all matter is made up of atoms. Key concepts include
a) atoms are made up of electrons, protons, and neutrons;
b) atoms of any element are alike but are different from atoms of other elements;
c) elements may be represented by chemical symbols;
d) two or more atoms may be chemically combined;
e) compounds may be represented by chemical formulas;
f) chemical equations can be used to model chemical changes; and
g) a limited number of elements comprise the largest portion of the solid Earth, living matter, the oceans, and the atmosphere.

For the scientific investigation domain across all grade spans, Virginia tends to provide much greater specificity for the types of measurements to be made, the units of measure to be used, and the types of instruments to be used. For the physical science domain at

both the middle school and high school grade spans, Virginia includes content addressing the safe use of chemicals and equipment, which is not included in the Colorado standards.

Finland

The Finland National Core Curriculum for Basic Education covers science content through grade 9, and the National Core Curriculum for Upper Secondary School covers science content through the high school grade span. At grades 1–4, the science content is defined under the domain for Environmental and Natural Studies. At the 5–6, 7–9, and high school grade spans, the content is defined for the domains of Biology, Geography, Physics, and Chemistry (Biology and Geography and Physics and Chemistry are combined at the 5–6 grade span).

The stated objectives for instruction in biology and geography include emphasizing responsibility, the protection of nature, the preservation of living environments, and the student's growth as an active citizen committed to a sustainable lifestyle. The stated objectives for instruction in physics and chemistry include developing understandings that allow students to make everyday choices, particularly in matters related to the protection of the environment and the use of energy resources. To illustrate these objectives, the examples below show selected Finland objectives and core content statements from the Grades 7–9 Biology and Geography standards.

Finland Grades 7–9 Biology
Objectives

- come to understand the main objectives of environmental protection and the principles of sustainable consumption of natural resources

Core Content

- ecologically sustainable development and the substance and objectives of environmental protection
- investigating the status of, and changes in, one's living environment; examining measures to improve the status of one's immediate environment; weighing one's environmental behaviour

Finland Grades 7–9 Geography
Objectives

- understand and evaluate critically news information on such issues as global environmental and development questions, and learn to act in accordance with sustainable development themselves

Finland Grades 7–9 Geography
Core Content

- environmental and developmental questions, locally and globally; deliberation of possible solutions to problems

The Finland Core Curriculum focuses more directly on environmental topics (the content domain) and seeks to develop student attitudes that value environmental protection and

sustainable development (the affective domain). In comparison, the Colorado standards integrate content addressing environmental topics (the content domain) throughout the curriculum but with a less direct focus as uniquely environmental topics. For example, in the Colorado standards, ecological relationships and dependencies among the living organisms and non-living components of the environment are addressed throughout the grade spans. Similarly, the use, conservation, depletion, and recycling of natural resources are addressed throughout the grade spans. Also addressed at the middle school and high school grade spans are understandings of the composition, characteristics, and interactions of major parts of the biosphere (oceans, soils, atmosphere, chemical cycles, and energy transfer).

The Colorado standards also address the development of student attitudes and values (the affective domain), but again, with a less direct focus as uniquely environmental attitudes and values. For example, selected Colorado benchmarks in 6–8 and 9–12 in Nature of Science and 9–12 in Scientific Investigation directly relate to students' attitudes and values and can be applied to environmental issues.

The Finland Core Curriculum documents (Basic Education and Upper Secondary School) are expansive documents that cover subject areas besides science and address a number of related topics (e.g., Implementation of Instruction, Instruction of Pupils Needing Special Support, and Pupil Assessment).

Regarding content, the Finland curriculum has particular emphases on the ecosystems and adaptations of organisms found in Finland and the Nordic countries, human biology and health, and cultural geography.

At the highest level of organization for content, both Colorado and Finland cover the following three large domains of scientific understanding from grade 1 through the high school grade span: scientific investigation, life science, and physical science. At all grade spans, Colorado includes an additional standard covering the large domain of the nature of science. At the 7–9 and high school grade spans, Finland divides the physical science domain into two distinct courses—Chemistry and Physics.

At all grade spans, Finland divides each major topic or course into two sections: Objectives and Core Contents. Additionally, at grade spans 1–4 and 5–6, Finland defines a set of Descriptions of Good Performance. At the 7–9 grade span, Finland defines a set of Final Assessment Criteria. For Finland, the Core Contents and Descriptions for Good Performance/Final Assessment Criteria are organized by content strands (e.g., Organisms and living environments, Substances around us, Scales and structures, Motion and Force). The content strands are further defined by sets of bulleted statements. For making content comparisons, the Colorado benchmarks are somewhat similar to the Finland bulleted statements. However, the content specificity of the bulleted statements differs greatly across the Finland grade spans, so making direct comparisons to the Colorado benchmarks is somewhat limited.

For the physical science domain at the middle school grade span, the Finland curriculum places earlier and greater emphasis on chemical phenomena, including reactivity of elements, chemical bonds, and simple reaction equations. For the nature of science domain, both Colorado and Finland have similar emphases on the interaction of science, technology, and society throughout the grade ranges. However, the Colorado benchmarks addressing how scientific knowledge is acquired and modified are not directly covered in the Finland curriculum.

For the Earth and space science domain, the depth and breadth of the Colorado benchmarks are represented in a limited and much less focused way in the Finland curriculum throughout the grade spans. In the Finland curriculum, the most thorough coverage of the more traditional Earth and space science concepts is at the high school grade span in the Geography course where aspects of physical geography are addressed. In the Finland curriculum, some Earth and space science concepts are imbedded in various topics or courses throughout the grade spans. For example, the following bulleted statement is included in Physics and Chemistry at grades 5–6: "recognize phenomena caused by the motion of the earth and moon, such as times of the day, seasons, phases of the moon, and eclipses; know about the structure of the solar system; and be able to make observations of the night sky." The Finland curriculum has a very strong emphasis on physical and cultural geography (particularly for Finland and the Nordic countries) and on geographic skills, which are not addressed in the Colorado standards.

Singapore

The grade spans for Singapore are P3–P4 as the Primary Lower Block, P5–P6 as the Primary Upper Block, and the Lower Secondary grade span (covering the equivalent of the middle school and high school grade spans). At the Singapore Lower Secondary level, there are separate syllabi for Express/Normal (Academic) content and Normal (Technical) content. The Academic syllabus is more intended for preparation for university studies, while the Technical syllabus is more intended for technical-vocational studies. Singapore does not have a Science syllabus addressing the K–2 grade range.

The Academic syllabus contains most of the content in the Technical syllabus, but in much greater depth. The Technical syllabus has a somewhat greater emphasis on selected personal health issues (drug abuse, alcohol consumption, and tobacco use) and public health issues (air and water pollution).

Each Singapore syllabus is an expansive document that addresses a number of related topics (e.g., Teaching and Learning through Inquiry, Assessing Teaching and Learning) and includes a brief Glossary.

Singapore organizes the content by the following thematic strands which reflects an integrated perspective of science concepts and skills and, in large measure, provides a continuum through the grade spans:

P3–P4 and P5–P6 Grade Spans
- Diversity
- Cycles
- Systems
- Interactions

Lower Secondary Grade Span
- Science and Technology
- Measurement
- Diversity
- Models and Systems
- Energy
- Interactions

The thematic strands are further defined in the syllabi by the following three broad categories: 1) Knowledge, Understanding and Application; 2) Skills and Processes; and 3) Ethics and Attitudes. These three categories are further defined by specific bulleted statements as the expected learning outcomes. These categories reflect the overall emphases of the science curriculum in Singapore.

Both Colorado and Singapore cover the following three large domains of scientific understanding from approximately grade 3 through the high school grade span: scientific investigation, life science, and physical science. Coverage of the scientific investigation process does not begin in the Singapore Primary Syllabus until the P5–P6 grade range.

At all grade spans, Colorado includes a separate standard covering the large domain of the nature of science. Singapore integrates aspects of the nature of science domain into the three broad categories identified above. Both Colorado and Singapore have similar emphases on how scientific knowledge is acquired and modified, and on the interaction of science, technology, and society. Some aspects of the nature of science domain are addressed in the Singapore learning outcomes for Ethics and Attitudes (e.g., show an appreciation that scientific inquiry requires attitudes such as curiosity, creativity, integrity, open-mindedness and perseverance).

For the physical science domain, Singapore introduces some topics at an earlier grade span. These topics include heat and temperature at P3–P4, types of electrical circuits at P5–P6, and kinetic and potential energy at P5–P6. For the Earth and space science domain, most of the Colorado benchmarks are not addressed in the Singapore Science syllabi at any grade span. At the P5–P6 grade span, Singapore does include learning outcomes addressing the water cycle in the context of the states of matter of water and addressing air as a mixture of gases in the context of the respiration of gases in plants and animals.

Review of Colorado's Science Standards for 21st Century Skills and Abilities and Postsecondary and Workforce Readiness

As described in the Methodology section of this report, analysts analyzed Colorado's draft 21st Century Learning Skills and Abilities (21st Century Skills) and definition of Postsecondary and Workforce Readiness (PWR Skills) to determine the degree to which Colorado's MCS contain the skills described in those draft documents. Findings from those analyses are presented below.

In analyzing the Colorado Science Model Curriculum Standards relative to the Draft 21st Century Skills, an approach requiring minimal interpretation was used to ensure consistency and to make the results as meaningful as possible. A Fully Present rating was given only for standards with benchmarks, as currently written, that explicitly contain 21st Century Skills.

Critical thinking and reasoning

Standard 1 addressing scientific investigation was rated as Fully Present across all grade spans. All the benchmarks for Standard 1 are action statements beginning with a verb that explicitly state the skills required of the student. For example, the following Standard 1 benchmarks in the K–2 grade span are clearly the actions of the student and clearly provide a Fully Present match to critical thinking and reasoning:

K–2 Standard 1 Scientific Investigation

- use their senses to make and describe careful observations
- ask questions and make predictions
- conduct simple experiments using tools and technology
- record data, report on findings and explain with reasons

In contrast, Standards 2–5 were given a Partially Present rating at all grade spans because the match is not explicit to the skills required of the student. For Standards 2–5, the benchmarks are knowledge statements rather than the action statements used in Standard 1. While certain benchmarks may address content that could, or under certain circumstances would, require critical thinking skills and reasoning, it is not explicitly required of the student. The distinction between knowledge statements and action statements is not trivial for establishing the expectations of the student communicated in the standards.

For example, the following benchmarks are first shown as the current knowledge statement and then rewritten as an action statement to more fully identify the critical thinking and reasoning expected of the student. With this type of revision, all five standards would rate as a Fully Present match to critical thinking and reasoning.

Life Science 3–5

Knowledge	organisms interact with each other and with nonliving parts of their habitat to meet their basic needs (for example: food, water, air, shelter, space)
Action	describe ways that organisms interact with each other and with nonliving

parts of their habitat to meet their basic needs (e.g., food, water, air, shelter, space)

Physical Science 6–8

Knowledge	mixtures of substances can be separated based on their properties (for example: solubilities, boiling points, magnetic properties, densities and specific heat)
Action	describe how mixtures of substances can be separated based on their properties (e.g., solubility, boiling point, magnetic properties, density, specific heat)

Earth and Space Science 9–12

Knowledge	there are costs, benefits, and consequences of natural resource exploration, development, and consumption (for example: geosphere, biosphere, hydrosphere, atmosphere and greenhouse gas)
Action	analyze the costs, benefits, and consequences of natural resource exploration, development, and consumption (e.g., fossil fuels, renewable energy, water, metal ores, building materials)

Information literacy

Standard 1 addressing scientific investigation was rated as a Fully Present match across all grade spans. Using the minimal interpretation approach, Standards 2–4 were not an appropriate fit at any grade span. This circumstance most likely reflects the constraints of the language that can effectively be used in the individual benchmarks, since information literacy skills are certainly an integral part of the scientific enterprise.

Rather than adding more text and detail to the individual benchmarks, one recommendation for explicitly including these skills in the Colorado Model Curriculum Standards is to include a paragraph between the Standard and the benchmark statements that describes how information literacy skills should be incorporated in science education (e.g., relevant background material, reliable sources of data, scientific journals, data management, reporting results). It is also recommended that an expanded definition of information literacy be used that includes not only acquiring qualitative and quantitative information/data but also communicating qualitative and quantitative information/data.

Standard 5 addressing the nature of science was rated as a Partially Present match. Specific additions could be included at all grade spans that address the variety of types and sources of scientific information/data (e.g., text, numbers, graphics, measurements, observations, scientific literature, experimental data) and the recording and communicating of that information/data (e.g., organizing, reporting, presenting). These additions would provide a Fully Present match to information literacy for Standard 5.

Collaboration
Collaboration skills were not explicitly included in the current benchmarks except in Standard 5 addressing the nature of science at the 6–8 and 9–12 grade spans. As was stated above, this circumstance most likely reflects the constraints of the language of the individual benchmarks, since collaboration skills are an integral part of the scientific enterprise. One recommendation for explicitly including these skills in the Colorado Model Curriculum Standards is to include a paragraph between the Standard and the benchmark statements that describes how collaboration skills should be incorporated in science education (e.g., peer review, interdisciplinary research teams, methods of sharing information, interaction between scientists and engineers).

Self-direction
Standard 1 addressing scientific investigation was rated as a Fully Present match across all grade spans. Standards 2–5 were given a Not Present rating at all grade spans. As currently written, the benchmarks in these standards do not explicitly require self-direction skills. If selected benchmarks were rewritten as action statements as described above, many benchmarks would explicitly require self-direction. The benchmark below provides an example of how selected benchmarks could be rewritten to explicitly require self-direction on the part of the student.

Physical Science 3–5

Knowledge	measurable physical properties can be compared before and after effecting a change to verify a change has occurred and used to predict its outcome in similar circumstances
Action	measure and compare physical properties before and after effecting a change to verify that a change has occurred and to predict the outcome of similar changes

Invention
Standard 1 addressing scientific investigation was rated as a Fully Present match across all grade spans. Standards 2–5 were given a Not Present rating at all grade spans. As currently written, the benchmarks in these standards do not explicitly require invention skills. If selected benchmarks were rewritten as action statements as described above, many benchmarks would explicitly require invention. The example Physical Science benchmark above would require invention as well as self-direction on the part of the student. The processes of measuring, comparing, effecting a change, and then using what has been learned to make predictions requires the creativity, innovation, and integration of ideas that demonstrate invention on the part of the student.

Colorado Science Model Content Standards and the Postsecondary and Workforce Readiness Skills

The Postsecondary and Workforce Readiness ratings highly reflect the 21st Century Skills ratings due to the correlation between many of the skills described in each set. As with the draft 21st Century Skills ratings, an approach requiring minimal interpretation was used to ensure consistency and to make the results as meaningful as possible. A Fully

Present rating was given only for standards with benchmarks, as currently written, that explicitly contain Postsecondary and Workforce Readiness skills.

Application of reading, writing, and computing skills with minimal remediation or training
Standard 1 addressing scientific investigation was rated as a Fully Present match. Standards 2–4 were not an appropriate fit at any grade span. Standard 5 addressing the nature of science was rated as a Partially Present match.

Since reading, writing, and computing skills are an integral part of the scientific enterprise, one recommendation for explicitly including these skills is to include a paragraph between the Standard and the benchmark statements that describes how reading, writing, and computing skills should be incorporated in science education (e.g., gathering information through reading scientific journals and experimental results, recording accurate and detailed observations, reporting results, computing experimental results, using equations and formulae). It is also recommended that an expanded definition of reading and writing as part of scientific literacy include the reading and writing of text, graphics, and quantitative data.

Logical reasoning and argumentation abilities
Standard 1 addressing scientific investigation was rated as a Fully Present match across all grade spans. Standards 2–5 were given a Partially Present rating at all grade spans because the match is not explicit to the skills required of the student. If the benchmarks were rewritten as action statements explicitly describing the skills required of the student, all five standards would rate as a Fully Present match to logical reasoning and argumentation abilities.

Identification and solving of problems
Standard 1 addressing scientific investigation was rated as a Fully Present match across all grade spans. Standards 2–5 were given a Partially Present rating at all grade spans because the match is not explicit to the skills required of the student. If the benchmarks were rewritten as action statements explicitly describing the skills required of the student, all five standards would rate as a Fully Present match to identification and solving of problems.

Information management skills
Standard 1 addressing scientific investigation was rated as a Fully Present match. Standards 2–4 were not an appropriate fit at any grade span. Standard 5 addressing the nature of science was rated as a Partially Present match. Since information management skills are an integral part of the scientific enterprise, one recommendation for explicitly including these skills is to include a paragraph between the Standard and the benchmark statements that describes how information management skills should be incorporated in science education (e.g., developing classification schemes, organizing experimental data, using data analysis software). It is also recommended that an expanded definition of information be used that includes both qualitative and quantitative information/data.

Human relation skills
Standard 1 addressing scientific investigation was rated as a Fully Present match. Standards 2–4 were rated as Not Present at any grade span. Standard 5 addressing the nature of science was rated as a Partially Present match at the 6–8 and 9–12 grade spans.

Since human relation skills are an integral part of the scientific enterprise, one recommendation for explicitly including these skills is to include a paragraph between the Standard and the benchmark statements that describes how human relation skills should be incorporated in science education (e.g., peer review, interdisciplinary research teams, methods of sharing information, interaction between scientists and engineers, ethical practices, consideration of alternate explanations).

Analysis and interpretation skills
Standard 1 addressing scientific investigation was rated as a Fully Present match across all grade spans. Standards 2–5 were given a Partially Present rating at all grade spans because the match is not explicit to the skills required of the student. If the benchmarks were rewritten as action statements explicitly describing the skills required of the student, all five standards would rate as a Fully Present match to analysis and interpretation skills.

Recommendations

This section contains specific recommendations from the WestEd reviews, organized by the components of the analysis.

Internal Quality Review of Colorado's Science Model Content Standards

The comments for each Partially (P) rating shown in the tables above provide specific areas in the standards that would benefit from revision. The summarized recommendations that follow are intended to provide information regarding changes that would improve the depth, coherence, rigor, and breadth of those standards. The CDE may want to consider implementing the following recommendations, where appropriate:

Additional content needed

Standard 1, grade span 6–8 needs content specific to designing and conducting investigations. This content is explicitly included in benchmark statements at the K–2, 3–5, and 9–12 grade spans, but is missing at 6–8.

Standard 2, grade span 9–12 needs content specific to the types and characteristics of chemical bonds and chemical reactions.

Standard 4, grade span 3–5 needs content specific to the composition and formation of rock types and soils. Content at the 6–8 grade span addresses the interrelationships between minerals, rocks, and soils, but the precedent understandings need to be established in the 3–5 grade span. At the 3–5 grade span, the understandings addressing soils would typically cover soil formation (mechanical weathering of rock and decomposition of organic matter), soil composition (rock, clay, silt, sand, and humus), and may include soil properties (texture – size of particles, ability to retain water, nutrient levels – ability to support plant growth). The understandings addressing rocks would typically cover mineral properties, mineral tests, examples of common minerals, the mineral composition of rocks, rock types (igneous, sedimentary, and metamorphic), examples of common rocks of each type, and the processes that form each rock type (including the rock cycle).

Standard 5, grade span 3–5 needs content specific to how scientific knowledge is acquired and changes over time. This content is explicitly included in benchmark statements at the subsequent 6–8 and 9–12 grade spans, but should also be addressed at 3–5.

Standard 5, grade span 3–5 needs content specific to the interrelationships between science, technology, and society. This content is explicitly included in benchmark statements at the subsequent 6–8 and 9–12 grade spans, but should also be addressed at 3–5.

For Standard 5, at the middle school and high school grade spans, there is a need to address content related to the limitations of scientific understanding (e.g., questions of personal preference/value, questions of morality, questions of supernatural beliefs).

For Standard 5, at the middle school and high school grade spans, there is a need to address content related to ethical practice in conducting scientific investigations (e.g., knowledge and consent of human subjects, treatment of animals, accurate and complete reporting of results, minimizing conflict of interest).

Content exceeds grade span

Standard 3, grade span 3–5 contains some examples in benchmark 3.3–5.4 that may exceed the grade span. One of the examples given is food webs. Food webs are most typically used beginning at the middle school grade span to represent the transfer of energy between multiple organisms across various trophic levels in an ecosystem. Linear food chains are more typically used at the upper elementary grade span to show more direct and less complicated paths of energy transfer.

Standard 4, grade span 3–5 contains some content in benchmark 4.3–5.4 that exceeds the grade span. Understanding the distinction between weather and climate requires comparing multiple short- and long-term conditions and understanding long term patterns that significantly exceed the frame of reference of upper elementary students. While weather conditions and factors are typically covered at the elementary grade spans, differentiating climate from weather is best covered at the middle school grade span.

Standard 4, grade span 6–8 contains content in benchmark 4.6–8.15 that may exceed the grade span. The vast number of objects in the universe (billions of galaxies each containing billions of stars) and the vast distances in the universe (measured in light years) require conceptual understandings that are best suited for the high school grade span.

Further definition of content

Standard 4, grade span 9–12 needs further definition of the content relating the composition and structure of Earth's interior and the transfer of energy to plate tectonics and changes on Earth's surface. The current benchmarks, 4.9–12.1 and 4.9–12.2, independently address the structure and composition of Earth's interior and the theory of plate tectonics. The recommendation above is to have the benchmarks directly relate the composition and structure of Earth's interior and the transfer of energy between Earth's layers to the motion and interaction of tectonic plates and the geologic events and features of Earth's surface that result from those interactions.

Standard 4, grade span 9–12 needs further definition of the content associated with the composition and structure of the universe. The content described above for the current middle school benchmark 4.6–8.15 would be more appropriate at the high school grade span. This content addresses the vast number of objects and the vast distances in the universe.

Standard 1, grade span 9–12 contains content in benchmark 1.9–12.6 that is unclear. The current benchmark states that students should, "communicate and evaluate scientific thinking that leads to particular conclusions." Mixing communicating and evaluating in the same benchmark contributes to the lack of clarity. Since the prior benchmark, 1.9–

12.5, already addresses constructing and revising scientific explanations, it may be best to focus 1.9–12.6 exclusively on evaluating conclusions (e.g., evaluate conclusions based on evidence including the results of scientific investigations).

Reorganization of content
For Standard 5, benchmarks 5.3–5.1 and 5.6–8.1 are best included as part of Standard 1 because both benchmarks relate directly to the results of investigations.

External Referent Review for Science

Based on the review of the current Colorado Science Model Content Standards relative to the Massachusetts, Virginia, Finland, and Singapore science standards, the following recommendations are provided for consideration by the CDE:

Trade offs of articulation by grade span or grade level
Examine the advantages and disadvantages of defining the science standards by grade level spans (as currently done) or by specific grades for all or selected grades. Whether the state defines the content to be taught at each specific grade or the definitions are made at subsequent levels (district, school, or classroom), the primary challenge for science educators in making these definitions is the scarcity of empirical research, or body of evidence, that clearly define proper learning progressions, and relate those learning progressions to specific grades, for many of the strands of scientific understanding (e.g., energy transfer, structure and function of living systems, solar system and universe).

The primary advantage of the state defining standards by grade level spans is that this allows district flexibility in selecting and implementing curriculum at each specific grade. The primary disadvantage of this approach is that there may be significant differences between districts in the sequencing and spiraling of the content across the grades. Students transferring between districts within the state may experience a significant difference in the sequence of the content being instructed.

The primary advantage of the state defining standards by specific grades is that there is a much higher degree of uniformity in what is taught at each specific grade across districts. A second potential advantage is that the definitions of the standards for each specific grade can be the result of consensus decisions of science educators representing all the districts across the state.

Organization of science standards
The state would be justified in retaining the current five large domains of scientific understanding at all grade level ranges, based on the findings of the internal quality review and comparison to external referents. These five domains may be relabeled as Domains, rather than called standards as in the current structure. Under each domain would then be the specific standard statements, which are called benchmarks in the current structure. Under each standard would then be the benchmarks of that standard—the more specific statements of the content knowledge or skills that make up that standard. This approach has largely been incorporated in the current CSAP Assessment

Frameworks document as Assessment Objectives. However, the Assessment Frameworks are expressly limited to the content knowledge and skills that "can be assessed on the State's large-scale, paper and pencil, standardized assessment." The benchmarks in the revised Model Content Standards would not have this limitation. If there are benchmarks that are not intended to be part of the CSAP assessment, those could easily be identified by distinct formatting in the document (e.g., italicized, shaded).

Include content that addresses safety issues in conducting investigations, handling materials, following instructions, reporting accidents, etc.

In reference to wording and style, it is recommended that the revised standards use e.g., parenthetical lists for non-exclusive examples, and i.e., lists for exclusive examples. The use of each format would be described in the front matter of the new standards document.

Additional External Referents

The Colorado Department of Education may want to refer to the Utah Science Core Curriculum documents when developing the revised Model Content Standards. In particular, the Utah Core Curriculum contains many well crafted and concisely worded Objectives (analogous to the recommended standard level) and Indicators (analogous to the recommended benchmark level). The example below shows a Utah Science Grade 4 objective and associated indicators:

> **Objective 2:** Explain how the processes of weathering and erosion change and move materials that become soil.

a. Identify the processes of physical weathering that break down rocks at Earth's surface (i.e., water movement, freezing, plant growth, wind).
b. Distinguish between weathering (i.e., wearing down and breaking of rock surfaces) and erosion (i.e., the movement of materials).
c. Model erosion of Earth materials and collection of these materials as part of the process that leads to soil (e.g., water moving sand in a playground area and depositing this sand in another area).
d. Investigate layers of soil in the local area and predict the sources of the sand and rocks in the soil.

Recommendations from the Review of 21st Century Skills and Abilities and Postsecondary and Workforce Readiness

Because of the interconnectedness of the findings and recommendations related to the 21st Century Skills and Abilities and Postsecondary and Workforce Readiness definition, recommendations related to the 21st Century and PWR skills are presented together in the Findings section of this report.

III-D. Music Findings and Recommendations

This section contains findings and recommendations related to the internal quality review, the external referent reviews, and the review of 21st Century Skills and PWR skills. Detailed review criteria can be found in the Methodology section of this report. A brief description of the criteria and guiding questions also are provided here for convenience.

Internal Quality Review

As described in the Methodology section of this report, the Colorado MCS were reviewed for their quality according to four criteria: depth; coherence; rigor; and breadth. The scale used for evaluating each criterion was as follows: Fully (F), Partially (P), No (N), or Insufficient information to determine (I). Findings from these analyses are presented below.

Depth

Ratings for depth are assigned based on the questions below.

- Do the benchmarks describe content of sufficient and appropriate depth in the standard *within each grade span*? (For example, is the depth of content of the standard appropriate for a school year?)
- Do the benchmarks describe content of sufficient and appropriate depth in the standard *across the grade spans*?

The table below shows the ratings for depth in the Music standards, reported for each standard at each grade span, as well as across the grade spans. The across grade span ratings are holistic ratings of the depth of the standards in K–12.

Table 25. Ratings for Depth in the Music MCS

Standard	K–4	5–8	9–12	Across
1	I	I	I	I
2	F	F	P	F
3	I	I	P	I
4	P	P	P	P
5	P	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Ratings for the depth of Colorado's music standards include F, P, and I. Standards 2 and 5 received ratings of Fully across grade spans because, as written, these standards yielded an appropriate level of depth for the standards. For example, the first K–4 benchmark for standard 2 specifies "identifying whole, half, dotted half, quarter, eighth notes, and equivalent rests." The explicit specification of rhythmic values clarifies expectations and reflects sufficient and appropriate depth for this grade span. Standard 4 received ratings of P across all benchmarks because, although the standard was determined to yield an

appropriate level of depth for some benchmark statements, the depth of other benchmark statements in the standard was not clear. For example, the first bullet of K–4 and 5–8 focuses on "simple forms," but without more explicit specification of what this includes, the level of depth is not clear. It should be noted that in the Glossary section of the music standards, there is some guidance for interpreting "simple forms" but not at a sufficient level of detail to modify the P rating. Standards 1 and 3 received ratings of I across the grade spans because, as written, these standards do not convey clear levels of depth for the content. For example, in standard 1, depth is not determinable with such broad descriptions as "with appropriate technique," "an expanding repertoire," or "musically and culturally diverse literature." The addition of more definition to these types of phrases would lead to more clarity in terms of the required depth for the content.

Coherence

Ratings for coherence are assigned based on the questions below.

- Are the benchmarks for each standard sequenced appropriately across the grade spans? (For example, do they scale or spiral appropriately across the grade spans?)
- Do the benchmarks begin and end at appropriate points in the content?

The tables below show the ratings for coherence in the music standards, reported as appropriate sequence across the grade spans, and as appropriate beginning and endpoints for each standard at each grade span, as well as across the grade spans.

Table 26. Ratings for Coherence in the Music MCS

Standard	Appropriate Sequence Across Grade Spans
1	F
2	F
3	F
4	F
5	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Table 27. Ratings for Coherence in the Music MCS

Standard	Appropriate Beginning and Endpoints			
	K–4	5–8	9–12	Across Grade Spans
1	P	F	F	F
2	F	F	F	F
3	F	F	F	F
4	P	F	F	F
5	P	P	P	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

For appropriate sequence across the grade spans, all of Colorado's music standards received an overall rating of F. A particularly clear example of Colorado's spiraling of content across grade spans can be seen in the 9–12 benchmarks for standard 4: identifying forms at 5–8 becomes "describing and comparing forms" at 9–12; "identifying contrasts in meter, rhythm, melody and timbre" at 5–8 becomes "describing and evaluating music performance using musical terminology" at 9–12; and "identifying and examining criteria for evaluating music performances and compositions" at 5–8 becomes "explaining characteristics that distinguish musical styles" at 9–12. For these three benchmark statements at 9–12, the content is not only prepared at 5–8, but there is also a clear continuation as well as an appropriate extension of the content at the higher level.

In three of the five K–4 standards, the content was determined to begin at inappropriate points, or there was a lack of appropriate content for the lower part of the K–4 span. Such benchmarks were rated P. For example, the benchmark expectations of standard 1 at K–4 are very similar to those for 5–8, with the exception of one additional benchmark at K–4 on "responding to music through movement," which is appropriate for the lower end of the span (and, possibly, could be spiraled through the higher grade spans). As written, however, there is little to distinguish the other benchmarks at K–4 from those at 5–8. Presumably, the intention of the first K–4 benchmark "singing or playing music, with appropriate technique, in rhythm, in tempo, and on pitch" is that the music is a single part.[4] Even if a single part is implied at K–4, this skill may be neither a realizable nor practical expectation for kindergarten and first grade. Similarly with standard 4, the first bullet at K–4, "listening to and identifying simple forms," is very similar to the corresponding bullet at 5–8—"identifying and describing simple forms." As noted above, the Glossary offers some guidance on determining what is meant by "simple forms"; however, for the lower part of the K–4 span, even the simpler forms mentioned in the Glossary, such as AB and ABA, may not be appropriate for kindergarten and first grade. A few examples of more appropriate beginning points may include identifying and distinguishing between repetition, between similarity and difference (possible at various levels: rhythm, pitch, phrase).[5]

Across all grade spans, standard 5 was rated P for the category of appropriate beginning and endpoints. At K–4, there is a lack of appropriate beginning points for the lower part of the span (other appropriate beginning points for the lower part of the span could include the function or use of certain types of music). At 5–8, aside from the example, it is not clear how the first bullet in K–4 ("identifying how elements of music are used in examples from various cultures") is distinct from the first bullet in 5–8 ("describing how distinguishing elements of music are used in examples from various cultures"). Nor do the examples provide clarification (at K–4, the example reads "rhythms found in the music of Africa and rap music from America show commonalities"; at 5–8, the example

[4] This presumption is based on the corresponding benchmark at 5–8, which specifies "music written in two or more parts."

[5] For the third K–4 bullet of standard 4—"identifying elements and/or expressive qualities in music"—a more appropriate starting point for the lower grades of the K–4 span may include connecting ideas with non-musical ideas/emotions.

reads "The rhythms present in many examples of Latin American music are derived from dance rhythms. Dance is an integral part of that culture"). Additional guidance on application of this benchmark content to the lower part of the K–4 span would be helpful.

At 9–12, the first bullet of standard 5 focuses, appropriately, on the historical and cultural context of musical works. (The second bullet continues a strand introduced at earlier benchmarks.) Colorado may wish, however, to extend this content down at least through the previous benchmark (5–8). Although there is a bullet at 5–8 addressing the role of musicians in history, the *historical context* of musical works does not appear until 9–12, yet it would be appropriate for inclusion at 5–8.

More broadly, the presentation of standard 5 is inconsistent with that of Colorado's other music standards. Very broad statements (for example, at 9–12, "identifying and explaining the features of a given musical work in its historical or cultural context") are followed by very specific examples (for the same 9–12 benchmark, "many African songs are constructed in the call and response form because they originally functioned as work songs. It was not necessary to read musical notation to learn, sing or enjoy this type of music"). Application and interpretation of the standard outside of the example provided could pose instructional challenges. Colorado could improve the overall coherence of its music standards by ensuring that the content is appropriate for all grades within a span (or target grade-specific content), that there are sufficient beginning points especially for the lower grades, and that content is spiraled appropriately, whenever desirable. Independent of the concern for appropriate beginnings, the current content for standard 5 *does* sequence content appropriately through the different grade spans. Therefore, this standard received the rating of F for appropriate sequence across the grade spans.

Rigor

Ratings for rigor are assigned based on the question below.

- Do the benchmarks describe content and skill expectations of a reasonable and appropriate level for this grade span? Do the standards and benchmarks communicate an appropriate level of rigor?

The table below shows the ratings for rigor in the music standards, reported for each standard at each grade span, as well as across the grade spans.

Table 28. Ratings for Rigor in the Music MCS

Standard	K–4	5–8	9–12	Across
1	F	F	F	F
2	F	F	P	F
3	I	P	P	P
4	F	F	F	F
5	P	F	F	P

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Ratings for the rigor of Colorado's music standards include F, P, and I. Standards 1, 2, and 4 received across ratings of F because, as written, these standards yielded a reasonable and appropriate level of rigor. In standard 1, for example, the first bullet at 5–8 specifies "singing or playing, with appropriate technique, music written in two or more parts, in rhythm and in tempo, blending voices or instruments, and matching dynamic levels." At this grade span (5–8), it is reasonable and appropriate to expect students to be able to perform music in parts and focus on ensemble skills, such as blending and matching others in the group.

Standards 3 and 5 received across span ratings of P because, although these standards did contain some evidence of appropriate rigor, there were other factors that prevented an F rating. For standard 3, it was not possible to determine the expected level of rigor at K–4. The inclusion of such words as "simple" and "selections" do somewhat differentiate the K–4 benchmarks for this standard from the corresponding benchmarks at 5–8 (which do not contain "simple" and "selections"); however, these were deemed insufficient for determining the appropriateness of the rigor. At 5–8, the addition of harmonic patterns does add an appropriately higher level of rigor to this grade span, but since the expectation of rigor, as distinguished from the previous benchmark, is still somewhat ambiguous, this benchmark was rated P. Similarly, for 9–12, the addition of improvisation over a chord progression adds an appropriately higher level of rigor to this grade span, but since the expectation of rigor, as distinguished from the previous benchmarks, remains somewhat ambiguous, this benchmark was rated P.

For standard 5, the first two bullets of K–4, as written, may be too rigorous for the lower part of this grade span. For example, without additional guidance or elaboration, the skill of identifying how elements of music are used in examples from various cultures may be too advanced for Kindergarten or grade 1. Given the few bullets for this standard, the lack of appropriate rigor at K–4 lowered the overall across rating of this standard to P.

Breadth

Ratings for breadth are assigned based on the questions below, each of which is reported in a separate table.

- Do the benchmarks describe sufficient and appropriate breadth of content across standards *within each grade span*?
- Do the benchmarks contain the essential content for this subject *within and across grade spans*?
- Are the benchmarks free from extraneous content *within and across grade spans*? If not, what content is extraneous?

Each of the three aspects of breadth examined is reported in a separate table in order to distinguish between essential and extraneous content.

Breadth represents the sufficiency of content across the standards. The table below shows the ratings for overall breadth *across* the music standards within each grade span and across the grade spans.

Table 29. Ratings for Overall Breadth in the Music MCS

Grade Span	Across Standards
K–4	F
5–8	F
9–12	F
Across	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Holistically, Colorado's music standards were determined to contain sufficient and appropriate breadth within the grade spans.

The table below shows the breadth ratings for essential content in the Music standards, reported for each standard at each grade span, as well as across the grade spans.

Table 30. Ratings for Breadth—Essential Content in the Music MCS

Grade Span	1	2	3	4	5	Across Standards
K–4	F	F	F	F	P	F
5–8	F	F	F	F	P	F
9–12	F	F	F	P	F	F
Across	F	F	F	F	P	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

Most of Colorado's music standards were determined to contain essential content. In a few cases, the benchmarks were rated P. In standard 5, for example, given that the first two bullets may be inappropriate for the lower grades of the K–4 span (discussed above), there may not be sufficient coverage to capture the historical and cultural part of this standard's rationale. To fill this gap, Colorado should include statements relating to the identification of music from specific historical and/or cultural traditions or to the use of music in specific historical and/or cultural traditions. To facilitate a realizable and practical application of the culture/history strand, some states have opted to focus certain grades on certain cultures/historical periods.[6] As mentioned above, the breadth of standard 5 could be improved at 5–8 by including coverage to capture the historical context of musical works, as it appears in the 9–12 benchmarks.

Usually, aesthetics and interpretation are a part of music standards. These would seem appropriate, for example, to be included in standard 4, at the 9–12 grade span, should Colorado wish to include either or both of these. The inclusion of aesthetics and/or

[6] In Kentucky, for example, the culture/history portion of their arts and humanities standards was intentionally designed to cover the same cultures and periods as their social studies standards at the corresponding grades, thereby distributing the content across different grade levels and coordinating it with the social studies curriculum.

interpretation would be consistent with the goal of the standard to analyze and evaluate music. Holistically, all music standards were consistently rated F in the across ratings for breadth.

For standard 3, the concept of improvisation currently appears only at 9–12; yet Colorado should incorporate this concept at lower grade spans, as this is an important concept and would represent an appropriate spiraling of the content.

The table below shows the breadth ratings for freedom from extraneous content, reported for each standard at each grade span, as well as across the grade spans.

The table below shows the breadth ratings for freedom from extraneous content in the Music standards, reported for each standard at each grade span, as well as across the grade spans.

Table 31. Ratings for Breadth—Free of Extraneous Content in the Music MCS

Grade Span	1	2	3	4	5	Across Standards
K–4	F	F	F	F	F	F
5–8	F	F	F	F	F	F
9–12	F	F	F	F	F	F
Across	F	F	F	F	F	F

(F= Fully; P=Partially; N=No; I=Insufficient Information)

All of Colorado's music standards were determined to be free of extraneous content.

External Referent Review

As described in the Methodology section of this report, analysts reviewed four sets of content standards to serve as an external referent comparison with Colorado's MCS in Music. The external referent standards documents reviewed for Music were:

- Massachusetts Arts Curriculum Framework (November 1999)
- Music Standards of Learning for Virginia Public Schools (April 2006)
- National Core Curriculum for Basic Education 2004 (Finland)
- National Core Curriculum for Upper Secondary Schools 2003 (Finland)
- 2008 Syllabus General Music Programme Primary/Secondary (Singapore)

The external referent standards were reviewed for two broad criteria, organization/structure and content. Each criterion contained several subcategories about which analysts recorded observations before determining a final overall holistic rating of mostly similar (Similar) or mostly different (Different). Findings from these analyses are presented below.

The table below summarizes the external referent standards in comparison with Colorado's MCS for music.

Table 32. Holistic Comparison Ratings for Music External Referents

Rating Category	Massachusetts	Virginia	Finland	Singapore
Organization/ Structure	Similar	Different	Different	Different
Content	Similar	Similar	Similar	Similar

The analyses below highlight various similarities and differences between the MCS and pertinent categories in each referent's documents. It is important to note that the referents have similarities and differences among one another, as well as with Colorado's MCS. However, no one approach is intended to be presented as necessarily more or less effective than another. Differences in structure or content of a state or country's standards may be qualitative, but may also be attributable to differences in history, purpose, and/or context. Thus, the implication is that a variety of approaches and combinations of approaches may be considered, should they be determined to be appropriate for Colorado.

Organization and Structure

This analysis focused on differences and similarities in four categories: grade articulation, hierarchy of standards, number of standards, and design/format of standards documents. For organization and structure, Colorado's MCS for music is holistically similar to Massachusetts' Learning Standards for music. Significant similarities include the division of standards into five broad topics, presentation of standards into three grade clusters, once at elementary, middle, and high school, and the inclusion of a glossary of content terms. Despite the overall similarity in organization and structure, a few differences were noted. Particularly, Massachusetts' standards also include an additional five standards in the Connections Strand, including such topics as purposes and meanings in the arts; roles of artists in communities; concepts of style, influence, and stylistic change; inventions, technologies, and the arts; and interdisciplinary connections. Many of the topics in the Connections Strand are present in Colorado's MCS; however, inventions, technologies, and the arts and interdisciplinary connections receive little attention in the MCS.

Virginia's Music Standards of Learning, Finland's National Core Curriculum for Basic Education in Music, and Singapore's General Music Programme are holistically different from Colorado's MCS in organization and structure. Substantive differences pertain to grade articulation, number of standards, and design/format in comparison to Colorado's MCS. In terms of grade articulation, Colorado's articulation of standards at the grade spans of K–4, 5–8, and 9–12 are somewhat similar to Finland's articulation at grades 1–4 and 5–9; at upper secondary, however, Finland articulates compulsory and specialization courses to further the study of music. The MCS differs, markedly, from Singapore's articulation at different developmental stages (stages 1–5), from Virginia's articulation at every grade from kindergarten through grade 5, and from Virginia's articulation of the

vocal/choral and instrumental music standards at developmental levels, such as Beginning, Intermediate, Advanced, and Artist.

In terms of number of standards, Colorado has a total of 44 benchmark statements. Two external referents—Massachusetts and Virginia—have considerably more statements (84 and 259, respectively); one external referent—Finland—has far fewer comparable statements (20).[7] In the presentation and organization of the standards, notable differences include Virginia's hierarchical organization into categories of music (general), vocal/choral music, and instrumental music; and Finland's organization of content around broader concepts rather than around topics that appear at each level. Singapore's program, also, appears stylistically different from Colorado's standards, presenting the Learning Outcomes by developmental stage. However, Singapore's program is based on broad topics that appear across all stages, similar to Colorado's standards. Detailed comments can be found in the Appendix to this report.

Content

For music content, Colorado's MCS is holistically similar to the comparable documents for Massachusetts, Virginia, Finland, and Singapore. The rating of similar was determined on the basis that all (or nearly all, in the case of Finland) music content in Colorado's MCS can be found in each of the external referents and that each of the external referents focused on the same five strands. These strands include performance, notation, composition, analysis, and historical context, albeit not all identified as such and with some nuances in the treatment of the content.

For the performance strand, Virginia, Finland, and Singapore treat vocal and instrumental performance, singing and playing instruments, together in one standard, similar to Colorado's MCS; Massachusetts, however, treats these as two separate standards. In content coverage, both Massachusetts and Virginia offer detail on concepts related to sound production and technical skills of singing and playing (e.g., diction, posture, breath control, playing position, intonation; playing specific scales and arpeggios within specified ranges on different instruments).

For the notation strand, both Massachusetts and Virginia reflect Colorado's emphasis on making sense of music symbols, identifying specific rhythmic values (depending on grade span), and notation of pitch and rhythm. Not only do Massachusetts' and Virginia's standards on notation encompass Colorado's coverage for this topic, but they also delve deeper into the content. Massachusetts incorporates some basic theory and musicianship skills (e.g., intervals, inversions, triads, seventh chords and their inversions; sight reading; transpositions). Virginia specifies notation from dictation and notation via technology. It is important to note that Virginia also provides a higher level of detail on this standard (e.g., division of music into measures; specification of reading music in treble staff; movement by step/leap; use of syllable, number, letter system to read and write simple pitch notation in appropriate clef).

[7] Due to the significant difference in Singapore's presentation of music content, it was not possible to determine the specific number of comparable statements for the external referent; however, given the content, this was rated to be very similar.

For the composition strand, all external referents place an emphasis on creating and improvising music, similar to Colorado. All external referents include the concept of improvisation at elementary school; it does not appear until high school in Colorado's MCS. All external referents also include the concept of arranging music, which currently does not have a place in the MCS.

For the analysis strand, nearly all of the external referents focus, like Colorado, on the identification and evaluation of music elements (especially form, timbre, melody, rhythm, style, and expressive qualities). Massachusetts, Virginia, and Singapore venture beyond this. Virginia and Singapore specify visual and aural music skills, usually using the terms "sight and sound" (e.g., identifying instruments and instrument families by both sight and sound). These distinctions do not currently appear in the MCS. Massachusetts and Virginia both provide a more robust treatment of musical style at every level (in Colorado, style currently appears only at high school). Virginia, for example, specifies placing musical examples in categories of style; recognizing composers and music compositions from different periods of music history; and investigating music sounds, forms, styles, genres through listening, discussing, writing and performing. Virginia also offers more specificity (e.g., like and unlike phrases, ABC, rondo, theme and variations; identify function of top and bottom number of meter signature; distinguish between major and minor; demonstrate contour of phrase and describe how pitches move up, down, stay the same). In this strand, Singapore's focus on modes and organization of pitch provides exposure to music theory.

For the history and culture strand, the external referents are similar to Colorado's MCS in their focus on how elements of music are used in different cultures (Massachusetts, Virginia, Singapore, and Finland), audience protocol (Massachusetts, Virginia, and Finland), and the role of musicians (Massachusetts, Virginia, and Singapore). On each of the topics, however, the external referents usually go beyond what is specified in the MCS. For example, the use of music elements in different cultures (in Colorado) is expanded to include analyzing characteristic features of works from various periods, cultures, genres (in Massachusetts); associating aural examples with a variety of cultures, styles, historical periods (in Virginia); and the focus on national music (in Finland and Singapore).

As detailed above, the rating of similar content for all external referents was based on the observation that all of Colorado's standards are present in each of the external referents' comparable documents. In different ways, however, the external referents go beyond Colorado's standards, in terms of the level of detail (Massachusetts, Virginia, and Singapore), the range of content (Massachusetts, Virginia, and Singapore), the level of rigor (Massachusetts), the consistency with which content is sequenced through all levels (Massachusetts), and the presence of appropriate beginning points (Finland). Three referents (Massachusetts, Virginia, and Finland) include an additional dimension—interdisciplinary connections.

In each external referent, these differences were not substantial enough to change the overall holistic content rating of similar; however, some differences were determined to contribute to the overall strength of the external referent. In addition to presenting substantial similarities and differences between Colorado and the external referents, this summary will identify those aspects of the external referents that contribute to their strength and, thus, may be of particular interest to Colorado as the state considers revisions to its own standards. Detailed comments can be found in the Appendices to this report.

Massachusetts

The concept underlying Massachusetts' Learning Standards for music is literacy in the arts. The arts are viewed as essential for expressing ideas and emotions that cannot be expressed through words alone and are a necessary component in understanding the "range and depth of the human imagination."

> Through music education students become fluent in the language of music as artistic, intellectual, and cultural expression. Performing, creating, and responding to music provide means for development and growth. Learning to read and notate music opens for students the limitless body of musical styles, forms, and repertoire, and allows them to see what they hear and hear what they see. Fluency in music brings understanding of contemporary and historical cultures, as well as self-knowledge. (p. 32)

Massachusetts has two broad categories of standards in music: the PreK–12 Standards for Music Strand and the Connections Strand. The PreK–12 standards are specific to the discipline of music and include five main standards: singing, reading and notation, playing instruments, improvisation and composition, and critical response; the Connections standards are applicable to all of the art disciplines (music, dance, theatre, visual arts) and include five main standards: purposes and meanings in the arts; roles of artists in communities; concepts of style, influence, and stylistic change; inventions, technologies, and the arts; and interdisciplinary connections. For the purposes of this review, both sets of standards were considered; the main focus, however, was on the PreK–12 standards.

Massachusetts' Learning Standards in music were found to be holistically similar to Colorado's MCS in music for both organization/structure and content. Like Colorado, Massachusetts' standards are articulated once per grade span,[8] based on five standards, presented in grade clusters, supplemented by a glossary, and based largely on the same content coverage.

Despite these similarities, there are some important differences that set Massachusetts' standards apart from Colorado's standards. These differences represent important considerations to use for strengthening the MCS, should the CDE determine that standards revision is warranted. They include the following:

[8] Massachusetts' standards, however, articulate *endpoints* only—the goals and expectations for the end of grade 4, end of grade 8, and end of basic and extended study in high school.

- *Level of detail/granularity* – Overall, both Colorado's and Massachusetts' standards include a comparable level of detail. In fact, their first standard is worded nearly identically. For example, Colorado's standard 1 (students sing or play on instruments a varied repertoire of music, alone or with others) is very close to Massachusetts' standard 1 (students will sing, alone and with others, a varied repertoire of music). Another point of similarity between Colorado and Massachusetts' standard is the use of the phrase "with appropriate technique" in Colorado and "with technical accuracy" in Massachusetts. In most instances, the wording/specificity in Massachusetts is very similar to that in Colorado. Massachusetts' standards occasionally have more specificity. This is noted in Massachusetts' larger number of benchmark statements (84 in comparison to Colorado's 44), which yield content with more specificity. Examples of this can be seen in Massachusetts' inclusion of the definition and expected level of difficulty for each grade cluster; the specification to sing ostinatos, to use a system (syllables, numbers, letters) to read and sing at sight, etc. (Additional examples of higher level of detail can also be seen in some of the descriptions below on breadth and rigor.)

- *Breadth* – Massachusetts' standards include a broader range of content than Colorado's. Some examples of this can be seen in Massachusetts' treatment of sound production (diction, posture, playing position, intonation, breath control, vocal range), manners of performing (with/without accompaniment, small ensembles with one on a part, large ensembles, from memory and written notation), music theory (intervals, triads, and seventh chords and inversions); concepts of style (stylistically appropriate composition and improvisation, stylistic influence and change via analysis of works from various periods, cultures, genres); and music communities (artists, patrons, cultural organizations, art institutions).

- *Rigor* – In a few cases, Massachusetts' standards expect more challenging or higher-level skills than Colorado's standards. Examples of these include the expectation to play by ear, sing at sight, read full instrumental or vocal scores by describing how elements are used, explain transpositions and clefs, and perform independent instrumental parts while others sing or play contrasting parts. Massachusetts' standards also tend to reflect development of more diverse cognitive skills, as noted in their use of the following: perceive; analyze; demonstrate ability to perceive, remember, and describe; compare and contrast; and demonstrate imagination and technical skill in applying principles of composition. These higher-level skills may be appropriate for some of Colorado's high school standards.

- *Coherence* – In a few instances, Massachusetts' standards spiral content through all grade clusters. A few noteworthy examples of this include the following at each grade cluster: improvisation, style/genre/culture, and appropriate audience

protocol. The examples mentioned are not currently spiraled in Colorado's MCS but could be.

- *Interdisciplinary approach* – Although nearly all of Colorado's standards map clearly to Massachusetts' standards, Massachusetts' approach ventures beyond the discipline of music and into connections between music and other disciplines, such as the integration of music, dance, theatre, and visual arts; knowledge of cultural institutions and resources in the arts; and the application of music to English language arts, foreign languages, health, mathematics, science, and technology and engineering. The focus on interrelationships of the arts provides an area of focus that students are likely already experiencing in their daily lives through the community, the media, and potentially school activities.

As noted above, since all of Colorado's standards are included in Massachusetts' standards, Colorado's MCS was found to be similar in content as well as similar in organization and structure.

Virginia

Although the basis for Virginia's Music Standards of Learning (SOL) is not explicitly stated, a review of their music standards yields the following observations regarding the ideology and design of their standards: the standards provide a practical and realizable basis for instructional strategies, particularly at the more challenging lower grade levels; the standards provide links to other disciplines and, more broadly, to life outside of music; the standards capture both the broad view as well as the more detailed view (e.g., specific technical expectations for particular instruments); the standards offer consistency in spiraling of similar content through nearly all levels; the standards provide a fairly comprehensive treatment of music generally and of performing specifically vocal/choral music and instrumental music. Their standards identify essential content and skills required in the music curriculum. They do not intend to be comprehensive, and Virginia encourages their teachers to go beyond the standards.

Colorado's music standards were found to be holistically different from Virginia's Music SOL in organization and structure and holistically similar in content. Differences in organization and structure are due to the following: articulation of standards at individual grades in kindergarten through grade 5, broader subdivision of standards into categories based on music, vocal/choral music, and instrumental music; and a significantly larger number of standards (259 total statements across the music, vocal/choral music, and instrumental music standards). Virginia's standards include four strands—performance and production, cultural context and music theory, judgment and criticism, and aesthetics—most of which have a direct parallel in Colorado's standards. The only strand that does not have a direct parallel in Colorado's benchmarks is aesthetics, which, in Virginia's standards, pertains mostly to the relationship between music and other disciplines.

Also, Virginia's vocal/choral and instrumental standards are articulated at developmental levels, such as beginning, intermediate, advanced, and artist. Specification of standards by developmental stages can be useful as a realistic application based on an individual student's starting point irrespective of grade level. However, organization of standards based on developmental stages may not be consistent with the goal of state standards and could be impractical. The value of such specification lies mainly in the practical level of detail that it can offer and such information may be communicated via supplemental documents.

At each grade span, all of Colorado's benchmark statements are covered in some form in Virginia's standards. For this reason, there is an overall similarity in content between Virginia and Colorado, despite some differences in the treatment of each standard. These differences represent important considerations to use for strengthening the MCS, should the CDE determine that standards revision is warranted. Specifically, these differences include a higher level of detail, a wider range of content, and connections to other disciplines in Virginia's standards, as summarized below.

- *Level of detail/granularity* – Virginia's standards tend to be very precise in wording and specific to different areas in music (e.g., using pitch and non-pitched instruments, using sight and sound, traditional and nontraditional sound sources, notate via dictation; identifying and performing sets of beats grouped in twos and threes, using terminology to identify strong and weak beats). This inclusion of a higher level of detail—realized as specific direction, specific tasks, expected technical skills on instruments—ultimately, provides tangible starting points for instruction that could facilitate classroom instruction. Inclusion of a higher level of detail (greater specification) leaves less room for interpretation and would also likely result in consistency in instruction across different learning environments.

- *Breadth* – Virginia's standards tend to cover a wider range of content. This is especially notable for musical notation, which specifies division of music into measures, specification of treble staff; movement by step/leap; use of syllable, number, letter system to read and write in appropriate clefs. Also, for musical style, Virginia's standards specify placing musical examples in categories of style; recognizing composer and compositions from different periods of history; and investigating sounds, forms, styles, genres through listening, discussing, writing and performing. For culture and history, Virginia's standards specify exploring music of world cultures through song, dance, and movement; comparing and contrasting materials in its historical and cultural context; associating aural examples with a variety of cultures, styles, historical periods; and identifying and analyzing cultures, styles, composers, and historical periods.

- *Interdisciplinary approach* – Virginia's music standards provide a strong and consistent link to other disciplines and areas. This is apparent through the following content: compare and contrast relationships between music and other disciplines; identify how characteristics of sound, visual stimuli, other stimuli, movement, and human interrelationships can influence the fine arts; investigate

> the role of music in the human experience; and discuss musical performance and its value to the community.

Again, since all of Colorado's standards appear in Virginia's standards, Colorado's MCS was found to be similar in content despite a different organization and structure. That Virginia's standards offer more in terms of detail, breadth, and interdisciplinary approach contributes to the strength of the standards but does not contradict the overall rating of similar content.

Finland

As a national curriculum, Finland's Core Curriculum for Basic Education (CCBE) takes a much broader approach than Colorado's MCS. For example, the following values are articulated for secondary instruction: respect for life and human rights; pursuit of truth, humaneness, and justice; knowledge of conflicts between stated values and reality and critical evaluation of the disadvantages/opportunities of Finnish society. The CCBE was designed to enable students to acquire extensive all-round learning and form a structured world view; to strengthen students' self-esteem and recognize personal uniqueness; to stimulate students to engage in artistic activities; to participate in artistic and cultural life, and to adopt lifestyles that promote health and well-being. The following goals for music instruction guide the curriculum: to help pupils find their objects of interest in music; to encourage pupils to engage in musical activity; to give pupils means of expressing themselves musically; to support overall growth; and to help pupils understand that music is tied to time and situation.

Finland's curriculum in music was found to be holistically different from Colorado's MCS in music for organization/structure and similar in content. Like Colorado's standards, the curriculum is intended to serve as the basis for formulating local curriculum. Finland's music curriculum is not organized around set topics that are spiraled across different levels. Instead, the focus of the objectives for grades 1–4 is on creativity (i.e., development of musical expression through playful and integrating activity, encouragement of expression and giving form to ideas). The focus of the objectives for grades 5–9 is on analysis and integrating knowledge with practice. At upper secondary, students are provided the opportunity to pursue individual interests via courses.[9]

Despite these structural differences, Finland's content for music was found to be holistically more similar to Colorado's content than different. Despite similar content, there are some important differences that set Finland's curriculum apart from Colorado's standards. These differences represent important considerations to use for strengthening the MCS, should the CDE determine that standards revision is warranted. They include the following:

[9] The following courses are articulated in the curriculum: *Music and Me* (compulsory), *Polyphonic Finland* (compulsory), *Open up to Music* (specialization), *Music's Message and Influence* (specialization), and *Music Project* (specialization). See Appendix V for more details on these courses.

- *Coherence* – In terms of appropriate beginnings for the content, Finland specifies slightly more content that is applicable to the lower levels, such as exercises using the voice by speaking, talking nonsense, and singing; age-appropriate song games; exercises that prepare skills for playing instruments together; singing exercises that prepare the pupils for singing in parts; using their bodies as instruments; and listening to and observing the sound environment actively and intently. Specification of content for the lower grades is very useful in that it provides age-appropriate content not likely to be present in or deduced from standards at higher-grades.

- *Interdisciplinary approach* – Finland's upper secondary curriculum is based on notions of integration and cross-curricular themes that are common to all content areas, such as active citizenship, safety and well-being, sustainable development; cultural identify and knowledge of cultures, technology and society, and communication and media competence. Application of music to other fields is both practical and lends a contemporary relevance to the standards.

Unlike the other three external referents, Finland's curriculum takes a significantly broader approach in content than Colorado's MCS; however, the content emphasis is similar to that of the MCS despite a different organization and structure. That Finland's curriculum offers more in terms of coherence and interdisciplinary approach contributes to the strength of the curriculum but does not contradict the overall rating of similar content.

Singapore

Singapore's General Music Programme is based on the concept that music education is part of a holistic education, which nurtures students to become informed audiences for the arts. It enriches the social, cultural, and historical awareness of students. It also leads to creative expression and enables students to respond to and engage with music throughout their lives.

The General Music Programme is organized around the following six objectives: sing and play melodic and rhythmic instruments individually and in groups; create and improvise music; describe and evaluate music through listening; develop understanding of music elements/concepts; discern and understand music from various cultures and of various genres; and understand the role of music in daily living. Overall, Colorado's standards cover all of the above objectives except the last (understand the role of music in daily living). For organization/structure, Singapore's General Music Programme was found to be holistically different from Colorado's MCS and similar in content. In design, Singapore includes sections on Music Elements/Concepts, Music Instruments, and Repertoire at the end of the learning outcomes, which work to effectively define the scope of the content. The amount of information and various levels of information (broad vs. specific) could lead to greater understanding by educators and consistency in implementation.

Despite these structural differences, Singapore's content for music was found to be holistically more similar to Colorado's content than different. Despite similar content, there are some important differences that set Singapore's treatment of music apart from Colorado's standards. These differences represent important considerations to use for strengthening the MCS, should the CDE determine that standards revision is warranted. They include the following:

- *Level of detail/granularity* – Some parts of Singapore's objectives provide a level of specificity comparable to Colorado's standards. For Singapore, however, the higher level of detail is realized through the combination of the Music Elements/Concepts sections and objectives that often specify tasks or activities. The specification of tasks could be useful for informing instructional activities and determining stage-appropriate lesson plans. Overall, these components create a sufficiently comprehensive picture of instruction and instructional activities. Whether they are part of the standards or a separate support document, additional information—in the form of identifying specific content or specific activities that can be easily implemented in the classroom without any significant new resources—would provide additional support and result in greater consistency in instruction.

- *Breadth* – Overall, Singapore's program offers a broader range of content. Notable instances of this include exposure to music theory (modes, chords/harmony, and organization of pitch), technology and contemporary music (electronic, synthesized sounds), and the role of music in daily life.

Since all of Colorado's standards appear in Singapore's program, Colorado's MCS was found to be similar in content despite a different organization and structure. That Singapore's program occasionally offers more in terms of detail and range of content contributes to the strength of the program but does not contradict the overall rating of similar content.

Review of Colorado's 21st Century Skills & Postsecondary and Workforce Readiness

As described in the Methodology section of this report, analysts analyzed Colorado's draft 21st Century Learning Skills and Abilities (21st Century Skills) and definition of Postsecondary and Workforce Readiness (PWR Skills) to determine the degree to which Colorado's MCS contain the skills described in those draft documents. Findings from those analyses are presented below.

Music Model Content Standards and the 21st Century Skills and Abilities

Critical thinking and reasoning
Critical thinking and reasoning skills are fully present at each standard level across all grade spans. Specifically, the skill of critical thinking and reasoning is contained within "singing or playing music, with appropriate technique, in rhythm, in tempo, and on pitch" (improving blend and matching dynamic levels at higher benchmarks). Regardless of the level, knowing how to perform music in rhythm, in tempo, and on pitch demands a thought process that involves reasoning and being able to assess cause and effect.

Information literacy
Information literacy skills are fully present in Standards 2 and 4 across all the grade spans. It seems reasonable that this skill is not directly addressed in the other standards.

Collaboration
Collaboration skills are fully present in Standard 1 across all the grade spans. Standard 3 ("students will create music") received an N rating for collaboration because it is currently not in the standard; however, it would be an appropriate addition to the standard, and could be done with minor adjustments (e.g., add a phrase similar to "alone or with others"—the phrase used in standard 1).

Self-direction
Self-direction skills are fully present in Standards 1 and 3 across all the grade spans. The skill is partially present in Standard 5 at grade span K–4. Self-direction could be incorporated into standard 5. One way would be to expand or extend the bullet on appropriate audience behavior to higher benchmarks; it currently appears only at K–4. It seems reasonable that this skill is not directly addressed in Standards 2 and 4.

Both collaboration and self-direction are modes of working and, as such, are on a slightly different plane from the other three 21st Century Skills and Abilities. Outside of the performance context (solo and ensemble), however, Collaboration and Self-direction could probably be worked into the other standards. If this is done, care should be taken so as not to dilute the content of the actual standard. Alternatively, the skills and abilities can be presented as tiers, with collaboration and self-direction as a separate level that can be generally applied to all content areas and all/most standards.

Invention
Invention skills are fully present in Standard 3 across all the grade spans. Invention is partially present in Standard 1: performing music (even the music of others) is not just

playing the notes on the page; performing music is *making* music, requiring creativity and innovation (e.g., making decisions regarding dynamics, phrasing, expression, etc.; interpreting and realizing musical ideas). However, given the wording of standard 1 in relation to standard 3 ("students will create music"), standard 1 was given a partial rating, reserving the full rating for standard 3, where invention is more explicit and maps more clearly and directly to the draft definition of this skill. It seems reasonable that this skill is not directly addressed in the other standards.

Music Model Content Standards and the Postsecondary and Workforce Readiness Skills and Abilities

Application of reading, writing, and computing skills with minimal remediation or training
This skill is fully present in Standard 2 across all grade spans.

Logical reasoning and argumentation abilities
This skill is fully present in Standards 4 and 5 across all grade spans and is partially present in Standard 3. For Standard 3 ("students will create music"), the process of creating rhythmic and melodic patterns would involve reasoning and communication via musical language. However, because this skill is indirectly linked to the actual wording of the standard, it received a partial rating.

Identification and solving of problems
This skill is fully present in Standard 3 across all grade spans.

Information management skills
Information management skills are fully present in Standard 1 and are not present in Standards 2, 3, and 4. For the draft PWR skills, three instances were found in which the current wording of the standards does not contain a specific skill, but the standard would be a reasonable and appropriate place to include the skill (N). Standards 2, 3, and 4 do not currently contain information management skills as the skill is defined (system thinking competencies, financial awareness, increasing productivity and adapting to new information). However, for standard 2, musical notation is a system and, as such, requires decoding. Broadening the PWR skill of information management (or the accompanying examples), would make it more inclusive of the skills in the standards.

Human relation skills
Human relation skills are fully present in Standard 1 across all grade spans.

Analysis and interpretation skills
Analysis and interpretation skills are fully present in Standards 1, 4, and 5 across all grade spans.

Recommendations

This section contains specific recommendations from the WestEd reviews, organized by the components of the analysis.

Internal Quality Review of Colorado's Music Model Content Standards

The CDE may want to consider implementing the following recommendations, where appropriate:

- *Depth* – Provide more substantive clarification of overly broad phrases (e.g., with appropriate technique, an expanding repertoire, short selections, simple forms) for standards 1, 3, and 4 at different benchmarks to clarify expectations at different grade spans.
- *Coherence* – Ensure benchmarks contain sufficient and appropriate starting points for all grades within the specified range, paying particular attention to the lower grades. In particular, possible places for improvements were noted for the K–4 span of standards 1, 4, and 5. If desirable, ensure continuity (sequencing/spiraling of material) across the different benchmarks. Examples of where this is possible are in standard 1 (responding to music through movement), standard 3 (improvisation), and standard 5 (historical context and appropriate audience protocol).
- *Rigor* – Colorado could improve the overall rigor of its music standards by supplementing or replacing some of the broad statements with more specific statements that would communicate clear expectations. Also, Colorado could ensure that benchmarks contain appropriate levels of rigor for all grades to which their standards pertain, paying particular attention to the lowest part of the span. Possible places for improvement were noted in standards 3 and 5. (The rigor rating on these standards is related to the issues raised above with depth and coherence.)
- *Breadth* – Ensure that benchmarks within standard 5 sufficiently treat culture and history in a manner that is appropriate for the intended grade range and that interpretation of the benchmarks is possible without reliance on a limited number of specific examples.

External Referent Review

To improve overall organization/structure:

- Consider articulating standards at grade level for the lowest grades, where there is likely to be significant differences in age-appropriate content and activities. Alternatively, consider articulating standards based on developmental stages in a supplemental document (not the actual standards document). Developmental stages can be useful as a realistic application based on an individual student's starting point irrespective of grade level, and can provide an additional level of information to form a more comprehensive view of expectations.

- Consider adopting a system for identifying specific bullets of the standard to facilitate use of and reference to the document.

To improve overall content:

- *Higher level of detail/granularity* – Although broad statements offer flexibility and room for interpretation, as standards, a balance between broad concepts and specific content to be mastered is more likely to lead to acquisition of specific knowledge and skills than broad statements would. Providing specificity is also more likely to yield overall consistency in how the standards are applied. Some ways in which these have been done in the external referents are summarized below:
    - Overall inclusion of more detail (greater specification) would leave less room for interpretation and would promote consistent standards-based instruction across different learning environments.
    - Specification of tasks or activities could inform instructional activities and be helpful in determining level-appropriate lesson plans and tangible starting points. These can be accomplished as part of the standards or in a separate support document.
    - Defining difficulty levels could be helpful in interpreting standards and would promote consistency in interpretation.
    - Hierarchical separation of standards based on broad categories could yield both broad and specific scopes of learning.

- *Greater breadth* – For benchmarks that may be thin in content, Colorado may want to consider possible ways to broaden the range of content. Particularly noteworthy examples in the external referents included more robust treatments of history, culture, style, music theory, and sound production, and technology. Should any new content be added, the state will need to ensure that all required content can be taught within the time allotted for instruction.

- *More rigorous* – Particularly strong examples of rigor in the external referents included higher-level performance expectations, such as playing by ear and sight-reading. Another method for achieving rigor is through specification of the cognitive skill, usually indicated through the verb (analyze, compare and contrast, etc.).

- *Interdisciplinary strands* – Connecting music standards to either the art disciplines or to other content areas are effective methods for coordinating music content with other content areas or art disciplines, which is both practical and desirable. Noteworthy examples of this in the external referents include connections to ELA, languages, mathematics, science, technology; interrelationship among the arts, the role of music in daily life, and cultural identity.

- *Greater coherence* – Some topics in Colorado's standards noted as potential candidates for spiraling content include historical context, improvisation, style, culture, and audience protocol. An additional improvement to Colorado's

coherence would include sufficient and appropriate beginnings for the lowest part of the grade span.

Additional External Referents

California's Visual and Performing Arts: Music Content Standards are noteworthy for their organization/structure; specific grade-level guidance, especially at the lowest level (prekindergarten/K); and thoughtful identification and classification of five strands that are both broad but offer appropriate and specific guidance at individual grade levels through grade 8. California's standards in music at all benchmarks are organized around the following five strands:

1. Artistic Perception – processing, analyzing, and responding to sensory information through the language and skills unique to music
2. Creative Expression – creating, performing, and participating in music
3. Historical and Cultural Context – understanding the historical contributions and cultural dimensions of music
4. Aesthetic Valuing – responding to, analyzing, and making judgments about works of music
5. Connections, Relationships, Applications – connecting and applying what is learned in music to learning in other art forms subject areas and to careers

The content of California's music standards are consistent with some of the strengths of the external referents discussed above.

Recommendations from the Review of 21st Century Skills and Abilities and Postsecondary and Workforce Readiness

Because of the interconnectedness of the findings and recommendations related to the 21st Century Skills and Abilities and Postsecondary and Workforce Readiness definition, recommendations related to the 21st Century and PWR skills are presented together in the Findings section of this report.

IV. REFERENCES AND EXTERNAL REFERENTS

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English Language Arts External Referents

Massachusetts English Language Arts Curriculum Framework (June 2001)
Supplement to the Massachusetts English Language Arts Curriculum Framework (May 2004)
English Standards of Learning for Virginia Public Schools (November 2002)
National Core Curriculum for Basic Education 2004 (Finland)
National Core Curriculum for Upper Secondary Schools 2003 (Finland)
English Language Syllabus 2001 For Primary and Secondary Schools (Singapore)

Mathematics External Referents

Massachusetts Mathematics Curriculum Framework (November 2000)
Supplement to Massachusetts Mathematics Curriculum Framework (May 2004)
Mathematics Standards of Learning for Virginia Public Schools (October 2001)
National Core Curriculum for Basic Education 2004 (Finland)
National Core Curriculum for Upper Secondary Schools 2003 (Finland)
Mathematics Syllabus Primary (Singapore, 2006)
Secondary Mathematics Syllabuses (Singapore, 2006)

Science External Referents

Massachusetts Science and Technology/Engineering Curriculum Framework (October 2006)
Science Standards of Learning for Virginia Public Schools (January 2003)
National Core Curriculum for Basic Education 2004 (Finland)
National Core Curriculum for Upper Secondary Schools 2003 (Finland)
Science Syllabus Primary 2008 (Singapore)
Science Syllabus Lower Secondary Normal (Technical) (Singapore, 2008)
Science Syllabus Lower Secondary Express/Normal (Academic) (Singapore, 2008)

Music External Referents

Massachusetts Arts Curriculum Framework (November 1999)
Music Standards of Learning for Virginia Public Schools (April 2006)
National Core Curriculum for Basic Education 2004 (Finland)
National Core Curriculum for Upper Secondary Schools 2003 (Finland)
2008 Syllabus General Music Programme Primary/Secondary (Singapore)

The contents of this report were developed under a grant from the Department of Education. However, those contents do not necessarily represent the policy of the Department of Education, and you should not assume endorsement by the Federal Government.

V. APPENDICES

Appendix A. Reading and Writing: Internal Quality Review

Depth

Standard	Grade Span	Within span	Across span	Comments
1	K-4	N		The bulleted statements under the standard describe a fairly comprehensive set of reading comprehension skills and strategies while the benchmarks for the grade span describe the types of reading material to which students in this span apply these skills. What's missing is a description of the kinds of tasks and activities, which would illustrate the depth of reading comprehension skill expected for students in this span. Students' ability to apply comprehension skills (such as inferring or comparing and contrasting) to text does not remain static across grades and grade spans. For example, students in the K-4 span may be able to determine the main idea when it is directly stated in an informational text; they may not be able to infer a main idea when it is implicit. They may be able to compare and contrast the actions of two characters in a story but not to compare and contrast the motivations of those characters. To provide sufficient depth of content for this grade span, the benchmarks would need to 1) define the types of applications of reading comprehension skills expected and 3) identify the level of skills to be demonstrated within this span. In addition, both the standard and the benchmarks provide limited reference to foundational skills developed in K-2 (phonemic awareness; decoding; comprehension of oral language and literature).
1	5-8	N		To provide sufficient depth of content for this span, the benchmarks would need to define the types of applications of reading comprehension skills expected within this span.
1	9-12	N		To provide sufficient depth of content for this span, the benchmarks would need to define the types of applications of reading comprehension skills expected within this span. For example, students in this span might be expected to synthesize ideas and information from multiple texts or to consider the contribution of irony to theme in a literary text.
1	Across		N	Across all spans, the benchmarks provide insufficient depth of content. The standard as amplified in its bulleted statements suggests depth through its list of reading comprehension skills and strategies; however, these are not "translated" into specific types and levels of performance within the grade spans. The standard and benchmarks also under-emphasize some skills related to the acquisition of reading in K-2, and those related to the comprehension of literature across all spans (i.e. applying knowledge of plot structure, point-of-view, etc.).
2	K-4	P		Types of writing and speaking activities appear as examples in the benchmark referring to "generating topics and developing ideas for a variety of writing and speaking purposes;" however, the benchmarks do not directly describe the types or level of writing and speaking performances expected for this span. For example, are students expected to write or present informational reports, responses to literature, narratives and stories? Is their writing expected to demonstrate a clear organizing idea, the use of paragraphs with topic sentences, and support through details or examples? Skills used for "generating topics and developing ideas"

Standard	Grade Span	Within span	Across span	Comments
				are also not specified (participation in class or small group discussion, prewriting, etc).
2	5-8	P		The benchmarks make limited reference to specific skills in using the elements of composition (pre-writing, focus, organization, development, sentence structure, point-of-view, etc.) or the elements of fiction (plot, setting, character, dialogue, etc.) in writing stories. "Applying skills in analysis, synthesis, evaluation, and explanation" suggests depth but these skills are not tied to specific types of writing and speaking, such as persuasion or response to literature. Aside from the use of "greater detail and supporting material," it is difficult to determine what level of writing performance is expected for students in this span. The benchmarks also provide few indicators for the expected level and types of speaking skills.
2	9-12	P		The benchmarks for this span include more examples of types of writing but make limited reference to developing skills in using the elements of writing (organization, development, sentence structure, point-of-view, etc.) and the writing process (for, example, choosing an organizational structure based on audience and purpose). Some types of writing included (persuasion) would also be appropriate for students in 5-8; some benchmarks included as "beyond" the standard may be appropriate for all students. The benchmarks refer to some types of speaking (persuasive) but do not define specific speaking skills.
2	Across		P	Across the spans, the depth of content is limited by the lack of specificity in the benchmarks, in terms of types of writing and of the level of skill expected in using the elements of writing and speaking.
3	K-4	P		Depth is limited by the lack of application of the designated skills to speaking and writing. Especially at grades 3-4, one would expect to see some reference to using these conventions in students' writing and speaking. For grades 3-4, one would also expect to see reference to students' use of simple and compound sentences in writing.
3	5-8	F		
3	9-12	F		
3	Across		F	
4	K-4	F		
4	5-8	F		
4	9-12	F		
4	Across		F	
5	K-4	P		Benchmarks do not include the use of information to create a written or oral report (or other product). Since the benchmarks for the other two spans do include the use of information to produce a product, the omission for this span appears to imply less depth.
5	5-8	F		
5	9-12	F		Note: Incorporating some of the "beyond the standards" benchmarks would increase depth.
5	Across		F	
6	K-4	P		

Standard	Grade Span	Within span	Across span	Comments
6	5-8	P		
6	9-12	P		
6	Across		P	Across all spans, the benchmarks focus on broad topics approached through literature ("the American experience," for example) but do not require students to demonstrate skills in interpreting, analyzing, or evaluating individual works of literature or an author's use of particular literary elements (such as dialogue, symbolism, point-of-view). Depth is limited by the lack of analytic skills and attention to the literary characteristics of individual works, authors, or genres.

Reading and Writing: Internal Quality Review

Coherence

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
1	K-4		N	Within the span, the benchmarks provide limited reference to the acquisition of reading skills in K-2. They also provide no indication of the level of reading comprehension skills expected for this span.
1	5-8		N	The benchmarks provide no indication of the level of reading comprehension skills expected for this level.
1	9-12		N	The benchmarks provide no indication of the level of reading comprehension skills expected for this span.
1	Across	N	N	Progression within and across spans is defined by types of reading material encountered, not by growth in comprehension skills. One would expect to see some progression in sophistication and range of skills across the spans. In addition, it's not clear why some types of reading material included in 9-12 (i.e. speeches, autobiographies) are not appropriate for students in lower grade spans.
2	K-4		P	Foundational skills in K-2 (learning to write) are not clearly represented in the benchmarks. Types of writing and level of skill in using elements of writing are not clearly specified within the span.
2	5-8		P	Within the span, the benchmarks do not provide a clear picture of the expected growth in specific writing skills (control of elements such as focus, organization, development, sentence structure, tone, etc.). Types of writing listed include "stories, letters, and reports;" it's unclear whether students in these grades are expected to produce other types of writing (persuasive essays, response to literature) as well. The benchmarks do not describe growth in skills specific to speaking (volume, pace, gesture, use of visuals, etc.).
2	9-12		P	Expected growth in specific writing skills (control of elements such as organization, development, sentence structure, tone, etc.) and in use of the writing process (selecting a focus and structure based on audience and purpose) could be more fully articulated. Some benchmarks for the 9-12 span ("selecting a focused topic," "supporting an opinion") would also be appropriate for students in earlier grade spans. The benchmarks do not describe growth in skills specific to speaking (volume, pace, gesture, use of visuals, etc.).
2	Across	P	P	Across all spans, one would expect to see a more clearly delineated progression of specific speaking skills, writing skills, and of the types of writing students are expected to produce at each span.
3	K-4		P	Within the K-4 span, the benchmarks provide limited reference to the early development of skills

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
				in K-2. Unlike the benchmarks for the other grade spans, the K-4 benchmarks do not describe the application of knowledge and skills "in writing and speaking." There is little sense of a developmental progression within the span. Defining the expected skills in more specific terms could clarify the expectations for this span. For example, what kinds of punctuation are students expected to know and use? What kinds of modifiers?
3	5-8		F	However, some skills included in the benchmarks for 5-8 are appropriate for students in earlier grades (i.e. use of simple and compound sentences; use of modifiers).
3	9-12		F	
3	Across	F	F	
4	K-4		F	
4	5-8		F	
4	9-12		F	
4	Across	F	F	
5	K-4		F	
5	5-8		F	
5	9-12		F	
5	Across	F	F	
6	K-4		P	In the K-4 span, one would expect to see the foundations for literary analysis and interpretation. The benchmarks refer to the use of "literary terminology such as setting, plot, character," etc. but it's unclear how students use these terms--whether they're expected to identify elements of plot in a story, for example, or to describe the traits of a main character, or begin to express an opinion about a work, as in an oral or written book review, for example. The primary activities included in the benchmarks, "reading, responding to, and discussing," are very broad, making it difficult to determine what degree of knowledge and skill is expected.
6	5-8		P	As in the K-4 span, the 5-8 benchmarks do not describe specific analytic or interpretive skills or clarify how students use the literary terminology for this span, making it difficult to determine the degree of knowledge and skill expected. One would expect students in this span to be able to develop and support a thesis about the meaning or theme of a particular work, or about the effect of the author's use of elements such as figurative language.
6	9-12		P	The benchmarks describe few specific analytic or interpretive skills. One would expect to see students in this span demonstrate their understanding of the impact of elements such as "diction, idiom, perspective," etc. in particular works of literature. However, the language of "reading, responding, and discussing" (the same at all spans) is too broad to convey a clear sense of the

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
				progression of students' knowledge and skills. "Identifying recurrent themes in United States literature" is also somewhat vague; it's not clear whether this activity would include analysis. The activity of "developing and supporting a thesis about the craft and significance" of particular works is more specific and appropriate for this span; describing other skills and activities in more specific terms would help clarify the sequential progression within the span.
6	Across	P	P	Across spans, describing the skills and knowledge expected in more specific terms would help clarify the progression of students' knowledge and skills.

Reading and Writing: Internal Quality Review

Rigor

Standard	Grade Span	Rigor	Comments
1	K-4	N	The development of literacy (including decoding and the foundational role of oral language skills) is under-emphasized in the standard and benchmarks. It is also difficult to determine whether the benchmarks represent an appropriate degree of rigor without more information about the level of skill and types of applications expected for the span.
1	5-8	N	To represent an appropriate degree of rigor, the benchmarks need to describe the level of reading comprehension skills and types of applications of those skills expected for the span.
1	9-12	N	To represent an appropriate degree of rigor, the benchmarks need to describe the level of reading comprehension skills and types of applications of those skills expected for the span.
1	Across	N	To represent an appropriate degree of rigor, the benchmarks need to describe the level of reading comprehension skills and types of applications of those skills expected for the span.
2	K-4	P	The benchmarks do not describe specific types of writing or speaking activities expected of students in these grades. Writing skills are described in very broad terms; it's not clear, for example, what types of organizational strategies students in this span would be expected to employ, or how their skills in "organizing their speaking and writing" or in "revising and editing" would be different from those of students in higher grade spans.
2	5-8	P	It's unclear if "stories, letters, and reports" represents the full range of types of writing expected of students in this span. One would expect to see other types of writing (descriptive, persuasive, analytic, etc.) specified. The benchmarks do not emphasize growth in students' control of specific elements of writing such as focus, organization, sentence structure, etc. An appropriate degree of rigor would include a benchmark for the level of performance expected for writing and speaking.
2	9-12	P	Growth in students' control of specific elements of writing could be more clearly defined. For example, are students in this grade span expected to draw on a wider range of organizational strategies? Or to revise for appropriateness of tone and voice for the intended audience? Some benchmarks described as appropriate for students "extending their English/Language Arts education beyond these standards" may be appropriate for all students, perhaps with some modification (for example, "using rubrics to become self-evaluators of their writing" or "making oral presentations for audiences within the school using a variety of media."
2	Across	P	Across the spans, the standards lack specificity in describing students' developing skills in the use of specific writing and speaking strategies and in describing the types of writing appropriate for each span.
3	K-4	P	An appropriate degree of rigor would include application of the specified knowledge and skills to writing and speaking activities.
3	5-8	F	
3	9-12	F	
3	Across	F	
4	K-4	F	

Standard	Grade Span	Rigor	Comments
4	5-8	F	
4	9-12	F	
4	Across	F	
5	K-4	P	An appropriate degree of rigor for students in the upper range of this span (grades 3-4) would include using information to create a simple product.
5	5-8	F	
5	9-12	F	Note: Some benchmarks "beyond the standards" may be appropriate for all students.
5	Across	F	
6	K-4	P	Appropriate rigor would include foundational skills in the analysis, interpretation, and evaluation of works of literature.
6	5-8	P	Appropriate rigor would include some specific skills in the analysis, interpretation, and evaluation of works of literature.
6	9-12	P	Appropriate rigor would include skills in the analysis, interpretation, and evaluation of works of literature.
6	Across	P	Appropriate rigor would include skills in the analysis, interpretation, and evaluation of works of literature.

Reading and Writing: Internal Quality Review

Breadth

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
Across	K-4	P	P	F	Some elements under-emphasized include the acquisition of reading skills in K-2; creation of specific types of writing; the foundations of literary analysis and interpretation.
1	K-4		N	F	Early acquisition of reading skills is under-emphasized; the benchmarks also do not indicate the types of activities students are expected to perform to demonstrate an appropriate range and level of reading comprehension skills.
2	K-4		P	F	Does not include types of writing expected for this span; does not describe specific writing skills and strategies.
3	K-4		P	F	Does not include application of skills to speaking and writing; does not include use of simple sentences.
4	K-4		F	F	
5	K-4		P	F	Does not include use of information to create a product--written or oral reports, summaries, etc.
6	K-4		P	P	There is ample breadth in the types of reading material encountered. However, the benchmarks do not include the expected breadth of interpretive and analytic skills or knowledge of literary elements. Re extraneous content: Using new vocabulary from literature in other contexts is a benefit of studying literature, not intrinsic to the study of literature itself.
Across	5-8	P	P	F	Some under-represented elements include specific types of writing and speaking expected for the span; and a range of analytic skills related to the interpretation and evaluation of literary works.
1	5-8		N	F	The benchmarks do not indicate the types of activities students are expected to perform to demonstrate an appropriate range and level of reading comprehension skills.

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
2	5-8		P	F	Benchmarks do not describe a full range of types of writing and speaking (narrative, descriptive, persuasive, etc) expected for students; they also do not contain the expected breadth of skills in the use of the elements of writing and speaking.
3	5-8		F	F	
4	5-8		F	F	
5	5-8		F	F	
6	5-8		P	P	Benchmarks do not contain the expected breadth of interpretive and analytic skills. For example, the benchmarks do not include the interpretation of theme or character in a literary work or the analysis of an author's use of figurative language or setting. Use of new vocabulary from literature in other contexts is extraneous to the study of literature.
Across	9-12	P	P	F	
1	9-12		N	F	The benchmarks do not describe the types of activities students are expected to perform to demonstrate an appropriate range and level of reading comprehension skills.
2	9-12		F	F	
3	9-12		F	F	
4	9-12		F	F	
5	9-12		F	F	Note: Some or all benchmarks for students "extending their English/Language Arts education beyond the standards" may be appropriate for all students. For example, all students should be able to use "information from various resources . . . as a vehicle for expressing their own thoughts, impressions, and ideas."

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
6	9-12		P	P	Benchmarks do not provide the expected breadth of interpretive and analytic skills. The comprehension and analysis of literary elements such as "theme, mood, diction," etc is implied by the reference to "using literary terminology accurately;" however, these skills are not described. Use of new vocabulary from literature in other context is extraneous to the study of literature.
Across	Across	P	P	F	
1	Across		N	F	The K-4 span under-emphasizes the acquisition of reading skills in K-2. Across all spans, the benchmarks do not provide any specific description of the kinds of activities and tasks students are expected to perform to demonstrate their reading comprehension skills.
2	Across		P	F	Across spans, the benchmarks under-emphasize some specific skills in using writing and speaking strategies; the variety of types of writing and speaking expected for each span could be more clearly and fully specified.
3	Across		F	F	However, benchmarks for K-4 do not include the application of skills to writing and speaking. They also do not reflect a clear progression of developing skills within the span.
4	Across		F	F	
5	Across		F	F	
6	Across		P	P	Across all spans, the benchmarks do not include the expected breadth of interpretive and analytic skills related to the study of literature, including the analysis of specific works, authors, and genres. For example, the benchmarks do not include the interpretation of theme or character in a literary work, or the analysis of an author's use of sound and rhythm in a poem. Use of new vocabulary from literature in other contexts is extraneous to the study of literature.

Appendix B. Reading and Writing: External Referent Review—Massachusetts
External Referent: English Language Arts Curriculum Framework (June 2001) and Supplement to the Massachusetts English Language Arts Curriculum Framework (May 2004)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	CO has six broad standards that cross all grade spans. MA has 27 broad "General Standards" that also cross all grade spans. Both states organize their standards by grade span rather than by grade level (with a few exceptions in Massachusetts.). Both states articulate more specific expectations for each grade span through benchmarks (CO) and "learning standards" (MA).	CO's standards are organized by two four-year and one five-year grade spans (K-4, 5-8, 9-12). MA's standards are organized by five two-year and one three-year grade spans: PreK-2, 3-4, 5-6, 7-8, 9-10, 11-12. General Standards for vocabulary, reading and composition are further subdivided into Pre-K and 1-2 clusters.	Overall, the organization of MA's standards by two-year spans (and for some strands and grades, by grade level) rather than broader four-year grade spans is a significant difference, giving greater definition to the specific skills and capacities expected for each two-year span and to the incremental growth of skills from span to span, and in some cases, from year to year. MA added grade level standards in reading and vocabulary for grades 3, 5, and 7 in order to comply with the federal NCLB Act, requiring annual testing in every grade, 3-8. When combined with the grade span standards for reading and vocabulary, MA has articulated grade level reading and vocabulary standards for these six grades.
Hierarchy of Standards	Both CO and MA have a broad set of standards, articulated by more specific benchmarks or learning standards for each grade span.	MA standards are organized by strand, general standard, and learning standard. The four strands in MA standards are Reading and Literature, Language (includes oral language, vocabulary, and the structure/origins of English), Composition and Media. CO standards are organized by standard and benchmark. CO standards are not organized by strand. On the contrary, a number of CO standards describe knowledge and skills across reading, writing, speaking, and listening.	Both strands and general standards play a key role in MA standards, providing an overarching structure within each grade span or grade as well as continuity across all grades. CO's six standards provide the overarching structure for their standards document.

Subcategory	Similarities	Differences	Comments
Number of Standards		With 27 "General Standards," MA has a much larger number of cross-grade standards compared to CO's six. (One MA standard, for "Beginning Reading," only applies to PreK-4). As the numbers would suggest, MA has chosen to differentiate its standards to a much greater extent than CO. For example, MA has three standards for oral language, ten standards that address literature (separate standards for theme, genre, dramatic literature, poetry, fiction, etc.), and seven standards that address different aspects of writing. CO has no separate standards for oral language, three standards that address literature, and three standards that address writing. Of the latter CO standards, all but two are broad standards covering knowledge and skills applied across broad strands of reading (literature and nonfiction), writing, speaking, and listening. All MA standards are separated by strand as well as by more specific subtopics within strands.	As an example of differences at the level of a single grade span, MA has 26 general standards and 52 learning standards for the 5-6 grade span; CO has 6 standards and 33 benchmarks for the 5-8 span. It is worth noting, however, that the greater differentiation of MA standards leads to some duplication of content. This is particularly true of MA standard 8 ("Understanding a Text"), which includes some of the same learning standards as MA standards 12 ("Fiction"), 13 ("Non-fiction"), and 14 ("Style and Language"). The repetition of content in MA learning standards also reflects the overlapping categories of content in their general standards (i.e. fiction and theme).
Design/Format	Both MA and CO organize their standards vertically, presenting each broad standard one at a time across all grade spans. Both follow the standard with a brief rationale. Both also elaborate their standards through the more specific knowledge and skills described in benchmarks or learning standards for each grade span.	MA also organizes its standards by strands and identifies both general standards and more specific learning standards by number. Learning standards are numbered sequentially across all grade spans. General Standard 4, for example, has 27 learning standards, 4.1-4.27, from PreK-2 to 11-12. The strand, standard number, and standard statement are repeated at the top of each page for all of the grade spans and learning standards, making it easy to quickly identify the content of any page.	At the beginning of the list of learning standards for each grade span, MA includes the following statement: "Continue to address earlier standards as needed," and, for some standards, "as they apply to more difficult texts." This statement makes explicit the understanding that knowledge and skills addressed in earlier grades may need ongoing reinforcement or opportunities to grow as they are applied to new material. CO does not refer to continuing to address earlier standards as needed.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)		CO standards are identified by number (1-6). Each one-sentence standard is developed through bulleted statements describing more specific knowledge and skills included in the standard. Often, the standard with its bulleted statements takes up most or even all of a page. The standard is not repeated on subsequent pages containing the grade span benchmarks, and the bulleted benchmarks are not identified by number or letter. This can make it a little more difficult to quickly identify the context of a given page of benchmarks, or to refer quickly to any specific benchmark.	MA includes both brief examples and more extended "learning scenarios" showing how particular learning standards might be addressed in the classroom. These are interspersed throughout the MA standards document. CO does not include such examples. At the high school level, CO includes some benchmarks "for students extending their English Language Arts education beyond the standards." MA does not describe any skills beyond the standards.

External Referent: English Language Arts Curriculum (Framework 2001) and Supplement to the Massachusetts English Language Arts Curriculum Framework (May 2004)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	Nearly all of the content of CO's standard 1 ("Students read and understand a variety of materials"), including the content of its bulleted statements describing specific reading skills and strategies, can be found in MA's reading and literature standards (not necessarily at any one MA grade span or in any one standard). MA's standard 8, "Understanding a Text," is the most similar in content to CO standard 1.	CO standard 1 lists many reading skills/strategies in its bulleted statements under the standard but has only one benchmark per grade span, describing the types of material students read in that span. MA reading standards include all of the content of the CO standard but emphasize the progression of specific reading skills in much more detail within and across grade levels and spans. MA also has many more general standards for reading and literature than CO, with separate standards for nonfiction, fiction, poetry, genre, etc. For example, CO standard 1 includes "applying knowledge of foreshadowing, metaphor, simile, symbolism, and other figures of speech." MA general standard 14 ("Poetry") includes learning standards addressing the analysis of figurative language in poetry at every grade span; general standard 15 ("Style and Language") addresses the analysis of figurative language and diction in texts; general standard 12 ("Fiction") includes learning standards focused on different elements of fiction, including plot elements, etc.	There is substantial similarity in the skills identified in CO standard 1 and those in MA's related reading and vocabulary standards. However, CO's standard 1 is very broad in scope, with little differentiation across grade spans. MA gives the cluster of skills and knowledge summarized in CO 1 far more specific elaboration through a greater number of separate standards addressing reading and vocabulary, and through many more specific learning standards articulating grade span/level expectations. Overall, MA reading and vocabulary standards describe a greater depth and breadth of content than CO.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2	Nearly all of the content of CO standard 2 ("Students write and speak for a variety of purposes and audiences") can be found in MA writing and oral language standards (not all in one standard or at every grade level). Both states emphasize writing and speaking for a variety of purposes and audiences, and drafting, revising, and editing written communications.	MA standards separate oral language skills from writing skills and address oral language in three standards in their "Language" strand. MA also emphasizes a wider range of oral language skills, including formal oral presentations, participation in small group activities and discussions, and the analysis/evaluation of oral presentations by others. MA writing and oral language standards also place greater emphasis on (or articulate more fully) the early development of foundational writing and speaking skills in K-4. (For example, PreK-K-19.1: "Draw pictures and/or use letters or phonetically spelled words to tell a story.")	There is considerable similarity between the content of CO standard 2 and that of MA writing standards. As with reading in standard 1, CO "bundles" a cluster of writing skills and strategies into one broad standard, while MA differentiates its writing standards to a much greater extent, with separate general standards addressing audience and purpose (20), revising (21), organizing (23), etc. At the level of benchmarks or learning standards for each span, MA also describes more specific expectations for each span. For example, a K-4 benchmark for CO standard 2 is "organizing their speaking and writing." A MA learning standard for the grade 3-4 span is "Write stories that have a beginning, middle, and end and contain details of content."
Standard 3	All of the content of CO standard 3 ("Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling") can be found in standards in MA Composition and Language strands 5 and 22.	MA has two different standards addressing grammar and conventions. One (22) is a standard in the Composition strand ("Standard English Conventions") focused on students' use of conventions in "writing, revising, and editing." There are more specific learning standards in the primary grade spans, when students are learning to "separate words with spaces" or to "write legibly in cursive" than in the higher grade spans, where the learning standards are more global ("Use all conventions of standard English when writing and revising" for grades 11-12). MA has another standard (5) in its Language strand ("Structure and Origins of Modern English) focused on the understanding and analysis of grammatical structures. Much of the	Overall, there is substantial similarity in the content of CO standard 1 and MA standards 5 and 22. MA standard 5, in particular, describes more specific learning standards for each grade span than CO benchmarks. For example, an MA learning standard for the PreK-2 grade span requires students to "identify correct capitalization for names and places" while a CO benchmark for the K-4 span calls for students to use "correct capitalization." MA standard 5 also includes more learning standards focused on understanding and analyzing grammatical structures (i.e. "analyze the structure of a sentence"). MA standard 5, in particular, describes more depth and breadth of content than CO standard 3.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 3 (Continued)		specific content of CO standard 3 addressing grammar is covered by this MA standard.	
Standard 4	Nearly all of the content of CO standard 4 ("Students apply thinking skills to their reading, writing, speaking, listening, and viewing"), including the skills described in the bulleted statements under the standard, can be found in MA reading, writing, and oral language standards and indicators.	The content of CO standard 4 is represented in a number of different MA general standards, particularly in standards 8 ("Understanding a Text"), 13 ("Nonfiction"), 2 ("Questioning, Listening, and Contributing") and 3 ("Oral presentations"). MA's grade span learning standards for these general standards are more specific than the comparable CO benchmarks: "making predictions" in CO's 5-8 span vs. "Make predictions . . . using prior knowledge and text features" in MA's 1-2 grade span. Overall, the content of MA standards elaborates the knowledge and skills of CO standard 4 in more specific detail and with a greater degree of differentiation by grade span.	MA's approach embeds the thinking skills described in CO's standard 4 in the standards for individual strands, particularly in standards in the reading and literature strand. The cross-strand structure of CO's standard emphasizes the importance of thinking skills across all strands of the language arts. MA describes greater breadth and depth of content through its differentiation of content in multiple strands and standards and its more specific development of learning standards for each grade span. As noted above, there is some duplication of content in the MA learning standards (notably for general standards 8 and 13). There is also some degree of repetition in CO standards 4 and 1 (bulleted statements).
Standard 5	All of the content of CO standard 5 ("Students read to locate, select, and make use of relevant information . . .") can be found in MA reading (13) and research (24) standards. The greatest similarity is between CO standard 5 and MA standard 24 ("Research").	The benchmarks for CO standard 5 emphasize knowledge/skills used to locate information using the organizational features of both printed and electronic texts. CO standard 5 also refers to using research to create a product but does not elaborate the steps involved. MA includes skills related to using organizational features of printed (not electronic) text in its standard 13 ("Nonfiction"). MA standard 24 emphasizes research as a complete process, with multiple steps, from generating questions for research to evaluating "the research project as a whole." Its learning standards show a progression of knowledge and skills across grade spans in	There is substantial similarity in the content of CO standard 5 and related MA standards. In its emphasis on the research process and the use and evaluation of research at all grade spans, MA describes greater breadth and depth of content. However, MA standard 24 does not describe specific skills related to using the organizational features of electronic resources. In this area, CO standard 5 provides more breadth of content.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 5 (Continued)		planning, carrying out, evaluating, and reporting research.	
Standard 6	Some of the content of CO standard 6 ("Students read and recognize literature as a record of human experience") can be found in MA reading and literature standards.	CO standard 6 focuses primarily on the study of literature for its cultural and historical significance. The bulleted statements in the standard refer to literature as a way for students to explore "the uniqueness and integrity of the American experience," and "ethnic traditions from around the world." Although the benchmarks for CO grade spans include some skills related to the accurate use of terminology and the understanding of elements of literary "classics," the primary emphasis of standard 6 and its benchmarks is on literature as "a record of human experience." Including standard 8, which clusters skills for understanding literary text separately from those for nonfiction, MA has a total of ten different general standards addressing the understanding, analysis, and performance (dramatic) of literature. No single MA standard focuses primarily on the historical and cultural dimension of literature. Instead, MA standards give considerably more emphasis to specific elements of literature (theme, style and language) and to the in-depth understanding and analysis of specific genres (fiction, poetry, drama, myth, etc).	CO standard 6 has depth within the dimension of literature that it addresses, that is, literary works as a source of insight into human experience, culture, and history. Related MA standards, however, address a greater depth and breadth of skills and knowledge related to the understanding, analysis, interpretation, and evaluation of specific works, elements of literary works, and genres, as well as standards addressing the interactions of literature, history, and culture.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades K–4	The distribution of related content in CO standards and benchmarks for the K-4 span and in MA general standards and learning standards for grades K-4 is similar.	CO standards and benchmarks for the K-4 span do not appear to be designed to describe a sequence of grade-by-grade student learning within the span. For example, CO standard 1 ("read and understand") does not describe a learning progression through which students in the K-4 span learn to read. In contrast, MA includes a PreK-4 standard (7) for "Beginning Reading," which describes the acquisition of foundational skills, such as developing concepts of print, phonemic and phonological awareness, decoding, and fluency. For this standard, MA further subdivides the PreK-2 span into PreK-K and 1-2, describing a more specific differentiation of knowledge and skills by level. Standard 7 has no learning standards for grades 5-12 "as the majority of students will have met this standard by the end of grade 4." MA has also articulated separate grade level reading standards for grades 3 and 4.	MA has included learning standards for the PreK-2 and 3-4 spans that more fully describe the foundational stages of students' growth in all strands of the language arts. For example, for general standard 11 ("Theme"), students in the PreK-2 span are expected to "relate themes in works of fiction and nonfiction to real life." Students in the 3-4 span "identify themes as lessons in folktales, fables, and Greek myths for children." CO standard 6 refers to students in the K-4 span "reading, responding to, and discussing a variety of literature such as folk tales, legends, myth, etc." This broad CO benchmark can apply equally to students in kindergarten or grade four; it does not differentiate levels of skill or understanding within the span. Overall, MA standards for grades PreK-4 describe a more differentiated sequence of student learning from one two-year span to the next (and in some cases, from one year to the next).
Grades 5–8	The distribution of related content in CO standards for the 5-8 span and in MA standards for the 5-6, 7-8 grade spans is similar.	CO standards and benchmarks for the 5-8 span do not identify a sequence of student learning from one grade to the next within the span. MA standards for its two-year spans (5-6, 7-8) show a more differentiated, sequential progression of student learning from one span to the next. In addition, MA has articulated separate grade level standards for Vocabulary, reading, and literature for grades 3-8. For example, two learning standards for MA standard 8 ("Understanding a Text") show a progression from accurate recall at grade 3 to higher order thinking in grade 5:	CO grade span standards do not describe a progression of student learning within the span but typically articulate broader, cross-span goals (i.e. "reading, responding to, and discussing a wide range of literature," or "distinguishing the elements that define and characterize a literary classic").

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 5–8 (Continued)		Grade 3: "Retell the events of a story in sequence." Grade 5: Identify and analyze main ideas and supporting details."	
Grades 9–12	The distribution of related content in CO 9-12 standards and benchmarks and in MA standards and learning standards is similar.	The benchmarks for CO 9-12 span typically describe broader, cross-grade goals ("incorporating material from a wider range of sources"), or in some cases, goals that may typically be addressed by students in the upper range of the span ("experimenting with stylistic elements such as voice, tone, and style"). MA standards and learning standards for grade spans 9-10 and 11-12 describe a sequence of student learning from one two-year span to the next. For example, two nonfiction standards for grades 9-10 and 11-12: 9-10: "Analyze the logic and use of evidence in an author's argument." 11: "Analyze and *evaluate* the logic and use of evidence in an author's argument."	The differences in the sequencing of content in CO's standards/benchmarks and in MA's general standards and learning standards are consistent across all grade spans. Overall, the smaller two-year grade spans in MA standards (and the addition of some grade level standards) compared to CO's four-year spans, allows for a finer gradation of the growth in students' knowledge and skills from one level to the next.
Across All Grades	The distribution of related content across CO four-year grade span standards and MA two-year grade span standards is similar. Both sets of standards also describe a progression of student learning across all spans.	One key difference in both distribution and sequencing of content is seen in MA's detailed description of the gradual acquisition of foundational knowledge and skills in grades K-4. This difference is evident across all standards and content.	The sequencing of the benchmarks in CO's three grade spans shows a progression in student learning from span to span that is largely consistent with the progression across comparable MA grade span learning standards.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity	The language in both CO's and VA's standards and benchmarks/indicators is fairly concise and accessible, with few lengthy, overly abstract or complex sentences. Both sets of standards and benchmarks/indicators are characterized by the use of verbs or verb forms, emphasizing student performance.	The language of MA general standards and learning standards is typically more specific and more concise than that of CO standards and benchmarks. All of MA's 27 general standards are expressed in single sentences with active verbs and specific nouns. CO's six standards are also expressed in single sentences with active verbs but the language is less specific, reflecting the broader scope of the standards. MA standard 8: "Students will understand the basic facts and main ideas in a text and use them as a basis for interpretation." CO standard 1: "Students read and understand a variety of materials." In addition, each CO standard also includes a bulleted list of statements describing more specific knowledge and skills included in the standard; this makes each standard considerably longer and more complex.	CO benchmarks are fairly concise but the use of gerund phrases rather than single sentences with active verbs makes them slightly less energetic than MA learning standards. In addition, the language of some benchmarks for CO's broader standards (1, 2, 4, 6) is also fairly broad and general ("using fictional, dramatic, and poetic techniques in writing" or "applying skills in analysis, evaluation, and explanation to their writing and speaking"). Overall, MA's approach of differentiating content into more specific standards and learning standards lends itself to language that is more concise and specific.

Appendix C. Reading and Writing: External Referent Review—Virginia
External Referent: English Standards of Learning for Virginia Public Schools (November 2002)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	CO's six standards cross all grade spans. Although VA's standards are grade level specific, there is still considerable continuity across grades in the core skills addressed by most of the VA standards, and in the language of the standards. Both states articulate more specific expectations for each grade span or level through benchmarks (CO) or indicators (VA). For example, the VA standard, "Students will read and demonstrate comprehension of non-fiction" recurs across grades 1-8 with some variations by grade level (fiction/non-fiction combined in grades 1-2); in grades 9-12, the word "analyze" replaces "demonstrate comprehension."	CO's standards are organized by three grade spans (K-4, 5-8, 9-12). Virginia's standards are organized by grade level. In addition, VA's K-8 standards are organized by three strands - Oral Language, Reading, and Writing - and their 9-12 standards are organized by four strands: Oral Language, Reading Analysis, Writing, and Research. CO's standards document is subtitled "Reading and Writing" but the six standards themselves do not appear to be organized by these content strands (CO standard 4 incorporates both reading and writing, for example).	Overall, the organization of VA's standards by grade levels rather than grade spans is a significant difference, giving greater definition to the specific skills and capacities expected for each grade level and to the incremental growth of skills from year to year. The gradual acquisition of reading skills in the primary grades, for example, is elaborated in far more detail in VA's K-4 standards than in CO's K-4 span standard.
Hierarchy of Standards	Both CO and VA have a set of broader standards, elaborated by more specific benchmarks or indicators for each grade or grade span.	VA's standards are organized by strand, standard, and indicator (comparable in structure to CO's benchmarks). As noted above, CO's standards are not organized by content strand; rather, CO's six standards describe knowledge and skills applied across multiple strands.	Strands play a key role in VA's standards, providing an overarching structure within each grade level set of standards as well as continuity across all grades. CO's six standards provide the overarching structure for their standards, with each standard elaborated by benchmarks for each grade span.
Number of Standards	CO has six standards repeated across all grade spans. VA has a much larger total number of grade level standards; however, its average number of standards per individual grade level is nine, approximately one-third more than CO's six. There is also	CO's six standards run across all grade spans. Typically, VA has nine standards per grade level, but, in total, VA has 126 standards across all grade levels. In addition, in VA, even closely related standards across grade levels are often	At individual grade levels, VA has a higher number of standards (an average of 12 per grade) in K-3 and slightly fewer, an average of 9 per grade, for 4-12. VA's higher total number (126) reflects both the choice to organize standards by grade level and the

Subcategory	Similarities	Differences	Comments
Number of Standards (Continued)	considerable continuity in the language and core content of most of the VA standards across the grade levels.	differentiated by grade level. For example, Reading standard 11.3 focuses on "relationships among American literature, history, and culture" while Reading standard 12.3 focuses on "the development of British literature." Other VA standards, such as the two Oral Language standards (7.3 and 8.3) addressing the analysis of non-print media, are unique to just a few specific grades.	strategy of making individual standards more specific in scope than CO's. For example, VA has separate standards for oral language while CO has combined speaking with writing. At many grade levels, VA has separate standards addressing vocabulary skills while CO incorporates vocabulary in a more global standard, "Students read and understand a variety of materials."
Design/Format	Both CO and VA have broad standard statements elaborated by benchmarks/indicators describing more specific skills for each grade level or span.	VA organizes its standards horizontally, providing a unified picture of all the strands, standards, and indicators for each level. CO organizes its standards vertically, presenting each of the six standards one at a time across all grade spans, K-12. VA's format emphasizes grade level goals, but there is sufficient cross grade repetition to indicate the continuity of the standards. CO's format places the emphasis on broader goals across all grades. CO's six standards are elaborated through bulleted statements under each standard, describing key skills and knowledge included in the standard. For example, CO's standard 1 includes 5 bulleted statements listing a wide array of specific reading comprehension skills and strategies such as "previewing, predicting, inferring," the use of "word recognition skills," and of "reading strategies for different purposes." These bulleted statements under the standard are distinct from the grade span benchmarks.	VA identifies the indicators for each standard by letter (standard K-8, indicators a-f) while CO's benchmarks (their indicators) are bulleted w/o letters or numerals. The alphabetic ordering of VA's indicators makes it easier to refer to an individual indicator w/o having to quote the content. The relationship between the bulleted statements under each of CO's standards and the grade span benchmarks for the standard can be confusing at times. It is not always clear whether and to what extent all of the content of the bulleted standard statements apply at each grade span.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)		VA's standards, in contrast, are each composed of a single statement, elaborated through grade level indicators for the specific knowledge and skills expected at each grade. VA also integrates its LEP standards into the larger standards document. The language and content of the LEP standards have been closely aligned with those of the English standards, although indicators differ to reflect the development of proficiency in English. The integration and alignment of the LEP standards makes it easy to see their relationship to the English standards.	In the case of CO standard 1, for example, the bulleted portion of the standard is more specific in its description of reading comprehension skills than the benchmarks for each grade span. At the high school level, CO includes some benchmarks "for students extending their English Language Arts education beyond the standards." VA does not include any indicators describing skills beyond the standards.

External Referent: English Standards of Learning for Virginia Public Schools (November 2002)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	Nearly all of the content of CO's standard 1 ("Students read and understand a variety of materials"), including the content of its bulleted statements describing specific reading skills and strategies, can be found in VA's reading standards (not necessarily at any one VA grade level or in any one standard).	CO's standard 1 has only one benchmark per grade span, referring to the types of material students read in that span. VA's reading standards emphasize the progression of specific reading skills across grade levels. For example, VA's K-3 standards emphasize the acquisition of foundational skills, such as developing concepts of print, phonemic and phonological awareness, decoding, and fluency. In grades 9-12, VA's reading standards shift from a focus on comprehension to a focus on analysis. VA's reading standards are also differentiated by types of reading material, with separate standards at most grade levels for the comprehension and analysis of informational and literary texts.	There is substantial similarity in the skills identified in CO's standard 1 and those in VA's related reading standards and indicators. However, CO's standard 1 is very broad in scope, with little differentiation across grade spans. The skills it describes are more specifically articulated in VA's reading standards, which also show a clear progression of increasing depth and complexity of skills across grades. Overall, the greater specificity, variety, and progression of VA's grade level reading standards and indicators convey a more complete description of the breadth and depth of content.
Standard 2	Nearly all of the content of CO's standard 2 ("Students write and speak for a variety of purposes and audiences") can be found in VA's writing and speaking standards (not all in one standard or at every grade level). Both states emphasize writing and speaking for a variety of purposes and audiences, and drafting, revising, and editing written communications.	VA's standards separate oral language skills from writing skills and emphasize a wider range of oral language skills, including formal oral presentations, dramatic readings, participation in small group activities and discussions, and the analysis/evaluation of oral presentations by others. VA's writing and oral language standards also place greater emphasis on (or articulate more fully) the early development of foundational writing and speaking skills in K-3. (For	Overall, there is considerable similarity between the content of CO's standard 2 and VA's writing standards. However, VA's K-3 writing standards address the early development of writing skills in more breadth and depth. VA's oral language standards and indicators also describe greater breadth and depth of oral language skills and knowledge at all grade levels.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2 (Continued)		example, K-11b: "Draw pictures and/or use letters and phonetically spelled words to write about experiences, stories, people, objects, or events.")	
Standard 3	All of the content of CO's standard 3 ("Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling") can be found in VA's writing and oral language standards. Like CO, VA has a broad standard addressing the use of conventions at nearly every grade level (2-11).	As noted above, VA addresses oral language skills (including the use of correct grammar in speaking) in separate standards rather than in a combined writing and speaking standard. VA's grade level standards and indicators also differentiate specific skills and knowledge to be mastered at each grade. VA's K-3 standards and indicators, for example, address the early development of skills in using conventions in more specific detail (i.e. 1.11b: "Space words and sentences." or 2.2a: "Recognize and use complete sentences.") than CO's parallel standard and benchmarks for K-4.	Overall, the content emphasized in CO's standard 3 is also emphasized in VA's writing and speaking standards at all grade levels. The greatest difference between the two lies in VA's more specific elaboration of the skills and knowledge to be mastered at each grade. Particularly in the primary grades, VA's standards for the use of writing conventions describe a greater breadth of content.
Standard 4	Nearly all of the content of CO's standard 4 ("Students apply thinking skills to their reading, writing, speaking, listening, and viewing"), including the skills described in the bulleted statements under the standard, can be found in VA's reading, writing, and oral language standards and indicators.	CO's standard 4 addresses thinking skills across multiple strands (reading, writing, speaking, listening, and viewing). VA, with standards organized by strand, has no comparable single standard covering thinking skills across multiple strands.	VA's approach embeds the thinking skills described in CO's standard 4 in the standards and indicators for individual strands. The cross-strand structure of CO's standard emphasizes the importance of thinking skills across all strands of the language arts. Since the skills described in CO's standard 4 also have applications within other CO standards, there is a potential to either repeat skills in multiple standards (CO's standard 1, for example, repeats some content of standard 4) or to omit skills from the standards that would typically be included

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 4 (Continued)			there (CO's standard 4 addresses the analysis of literary quality while its standard 6, focused on literature, does not.).
Standard 5		CO's standard 5 describes skills used to find, organize, evaluate, and use information for "reading, writing, and speaking purposes." The benchmarks for this standard across the three grade spans place the greatest emphasis on skills and strategies used to locate information in a wide range of both written and electronic resources. VA's standards for K-8 embed these skills in standards within the strands of reading (primarily) and, to a lesser extent, in writing. At the high school level (9-12), VA makes research its own strand, with standards and indicators focused primarily on putting research to use in writing but with some application to oral presentations as well.	Overall, CO's standard 5 emphasizes the cohesiveness of research skills applied across strands. Compared to VA, CO places less emphasis on the specific skills and strategies for putting research to use. The emphasis in VA's standards tends to shift from skills used to locate, comprehend, and summarize information in grades 1-6 to an increasing emphasis in grades 8-12 on analyzing, evaluating, synthesizing, and integrating information in carefully documented reports/presentations. Particularly at these grade levels, VA's standards appear to have greater breadth and depth.
Standard 6	Some of the content of CO's standard 6 ("Students read and recognize literature as a record of human experience") can be found in VA's reading standards, primarily in standards at the high school level.	CO's standard 6 focuses primarily on the study of literature for its cultural and historical significance. The bulleted statements in the standard refer to literature as a way for students to explore "common issues," "the uniqueness and integrity of the American experience," and "ethnic traditions from around the world." Although the benchmarks for CO grade spans include some skills related to the accurate use of terminology and the	CO's standard 6 has depth within the dimension of literature that it addresses, that is, literary works as a source of insight into human experience, culture, and history. VA's related standards however, address a greater depth and breadth of skills and knowledge related to the understanding, analysis, interpretation, and evaluation of specific works, elements of literary works, and genres, as well as standards (primarily in grades 9-12) addressing the interactions

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 6 (Continued)		understanding of elements of literary "classics," the primary emphasis of CO's standard 6 and its benchmarks is on literature as "a record of human experience." In contrast, VA's standards for the comprehension and analysis of literature focus much more attention on the skills students use to understand and analyze specific literary works and elements of texts, such as plot, character, theme, diction, imagery, etc and of genres, such as poetry, drama, and fiction.	of literature, history, and culture. At grade 11, for example, VA has three standards addressing literature, one (11.3) asking students to "analyze relationships among American literature, history, and culture," one (11.5) asking students to "critique a variety of poetry," and one (11.6) asking students to "critique a variety of dramatic selections."
Grades K–4	The distribution of related content in CO's standards and benchmarks for the K-4 span and in VA's grade level standards and indicators for grades K-4 is similar.	CO's standards and benchmarks for the K-4 span do not appear to be designed to describe a sequence of grade-by-grade student learning within the span. Rather, CO's K-4 standards and benchmarks typically describe skills broad enough to apply to all five grades within the span or skills representing goals for students in the upper range of that span. For example, students at all grade levels of CO's K-4 span can participate with varying degrees of skill in "generating topics and developing ideas for a variety of writing and speaking purposes" (a K-4 benchmark for standard 2). However, "knowing and using subject/verb agreement," (a K-4 benchmark for standard 3) is an ability typically addressed at the higher levels (grades 3-4) of the span.	VA has included a greater number of standards and indicators in grades K-3, in particular, to more fully describe the foundational stages of students' growth in all strands of the language arts. For example, the following two benchmarks for VA writing standards show a progression of skills from Kindergarten to grade one: K.11a) "Draw pictures and/or use letters and phonetically spelled words to write about experiences, stories, people, objects, or events. 1.12.c): "Use descriptive words when writing about people, places, things, and events."

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades K–4 (Continued)		In contrast, VA's standards and indicators for grades K-4 describe a sequence of student learning from one grade to the next, particularly emphasizing the acquisition of foundational knowledge and skills in reading, writing, and oral language in the primary grades.	CO's grade span approach gives more flexibility and responsibility to districts, schools, and teachers to determine the grade-by-grade curriculum and instructional program.
Grades 5–8	The distribution of related content in CO's standards for the 5-8 span and in VA's grade level standards for grades 5-8 is similar.	CO's standards and benchmarks for the 5-8 span do not identify a sequence of student learning from one grade to the next within the span. VA's standards and indicators for grades 5-8 do suggest a sequential progression of student learning from one grade to the next. For example, one benchmark for CO's standard 4 refers to students "making predictions, drawing conclusions, and analyzing what they read, hear, and view," a goal broad enough to apply to all grades across the span. VA's related standards for the comprehension of nonfiction include an indicator at grade five (5.6a) referring to the use of text organizers "to predict and categorize information." A grade six indicator for the same standard (6.4f) states, "Use information stated explicitly in the text to draw conclusions." An indicator requiring students to "analyze the author's credentials, viewpoint, and impact" in informational texts is found in grade eight (8.6b).	CO's grade span standards do not identify a sequence of student learning within the span but typically articulate broader, cross-span goals or, in some cases, goals for the upper range of the span, as in another 5-8 benchmark for standard 4 ("determining literary quality based on the author's use of vocabulary, character development, plot development, description of setting, and realism of dialogue."). VA's grade level standards and indicators provide greater clarity about the distribution and sequencing of student learning from one grade to the next.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 9–12		The benchmarks for CO's 9-12 span typically describe broader, cross-grade goals ("incorporating material from a wider range of sources"), or in some cases, goals that may typically be addressed by students in the upper range of the span ("experimenting with stylistic elements such as voice, tone, and style"). VA's standards and indicators for grades 9-12 describe a sequence of student learning from one grade to the next. For example, two writing standards for grades 9 and 11: 9.6: "Students will develop narrative, expository, and informational writing . . ." 11: "The student will write in a variety of forms, with an emphasis on persuasion."	The differences in the sequencing of content in CO's grade span standards/benchmarks and in VA's grade level standards/indicators is consistent across grade levels and spans. See comments above.
Across All Grades	The distribution of related content across CO's grade span standards and VA's grade level standards is similar across grades and grade spans. Both sets of standards also describe a progression of student learning across all grades or spans.	CO's six standards repeat across all grade spans. However, the grade span benchmarks for each standard describe a sequence of student learning from one span to the next. In some cases, the language used in 5-8 or 9-12 benchmarks is comparative, clearly differentiating the content from that of the span below ("incorporating material from a *wider* range of sources"). In other cases, the benchmarks for a standard add new content at each span. For example, a 5-8 benchmark for standard 4 refers to "recognizing an author's or speaker's point-of-view and purpose" while the related 9-12 benchmark adds "recognizing an author's . . . historical and cultural context."	The sequencing of the benchmarks in CO's three grade spans shows a progression in student learning from span to span that is largely consistent with the progression across comparable grade level indicators in VA's standards. Since CO's six standards remain constant across all spans, all differentiation between spans is articulated through the benchmarks. For some standards (CO standard 1, for example) and for some standards at given grade spans (CO standard 2, K-4) there are relatively few specific benchmarks, and the differentiation between the spans remains quite broad.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades (Continued)		VA's grade level standards and indicators show considerable continuity in language and content across grades but also describe a sequence of student learning from one grade to the next, across all grades. The most pronounced difference in both distribution and sequencing of content is seen in VA's detailed description of the gradual acquisition of foundational knowledge and skills in grades K-3. These grades have the greatest number of standards and indicators per grade of all grades, K-12, in VA's standards.	VA's standards show considerable continuity in language and content across grades, but also show a pattern of progressive differentiation across grade levels. For example, VA's reading standards combine the comprehension of fiction and the comprehension of nonfiction into one standard at grades K-2, and starting at grade three, separate them into two distinct standards for fiction and nonfiction. At the high school level, these standards are further differentiated, with separate standards for literature, drama, poetry, and informational materials.
Wording/Specificity		Another small difference results from the combination of oral language with reading and writing in a number of CO's standards, which requires many coordinate constructions within benchmarks ("in written and spoken forms," "orally and in writing," "as a reader, listener, and articulate speaker." etc.). Overall, the VA standards and indicators also tend to use language that is simpler and more concrete than that of CO's. This is most likely because VA is spreading its content over more standards and grade level indicators while CO is compressing more of its content into fewer standards and benchmarks.	

Appendix D. Reading and Writing: External Referent Review—Finland
External Referent: National Core Curriculum for Basic Education 2004 (Finland) and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	CO has six broad standards that cross all grade spans, K–12. Finland has four broad, overarching "objectives" that are closely parallel in content for the three grade spans in their "primary grades," 1–9. (For Finland's grade 1–2 span, two of the four objectives are combined, for a total of three overarching objectives).	CO's language arts standards are organized by three grade spans: K–4, 5–8, and 9–12. Finland organizes their "Mother Tongue and Literature" objectives by three grade spans within their nine-year primary or "comprehensive" schools: grades 1–2, 3–5, and 6–9. Finland's voluntary three-year "upper secondary" schools (roughly equivalent to 10–12 in American schools) are non-graded and have language and literature objectives organized by courses. Finland's "pre-primary" education (the equivalent of kindergarten) has its own separate curriculum and objectives. Students in FI begin first grade at age seven, so Finnish students are always one year older than American students in the corresponding grades.	Within their primary education system, Finland's grade spans and the ages of students within those spans differ significantly from CO's. Finland's grade spans 1–2 and 3–5, for example, both overlap with CO's K–4 and 5–8, making comparisons more challenging. Finland's upper secondary education, for students aged 16–19, is not organized by grade levels. A set of broad objectives describes overall goals for instruction in language and literature. In addition, all students take six "compulsory" courses and a selection of "specialization" (elective) courses; each course has its own objectives and core content. The objectives and core content for the six required courses provide the closest parallel to CO's standards and benchmarks for the 9–12 span.
Hierarchy of Standards	Both CO and FI have a set of broader standards or objectives, elaborated by more specific benchmarks or core content for each grade span. CO elaborates its six broad cross-span standards in two ways: 1) bulleted statements included under each standard describe more specific knowledge and skills *included* in the standard across all grade spans and 2) benchmarks for each grade span describe the more specific level of knowledge and skills expected for that span.	In contrast to CO's cross-grade standards (including bulleted elaborations), Finland's broad objectives (and bulleted statements) do vary by grade span. For example, the grade 1–2 objective, "The pupils' relationship with language and literature will take shape" evolves into "The pupils' relationship with language, literature, and other cultures will deepen" at grades 3–5. The more specific bulleted statements elaborating those objectives also show a developmental progression across grade spans.	Finland's description of end-of-span student performance at the end of grades two, five, and nine provide a culminating set of grade-level 'benchmarks' to define the level of attainment at the completion of each span. CO does not define end-of-span or grade-level benchmarks. Finland's "core contents" elaborating the objectives within each grade span emphasize specific skills (i.e., "distinguishing main Issues from secondary ones") but also

Subcategory	Similarities	Differences	Comments
Hierarchy of Standards (Continued)	Finland's broad objectives for their primary (1-9) grades are also elaborated in two ways at each grade span: bulleted statements under each broad objective describe more specific skills *included* in the objectives for that span. The objectives are further elucidated by descriptions of the "core contents" (similar to CO benchmarks) describing the knowledge and skills to be mastered for each objective within each grade span.	Despite the similarities noted, the two sets of standards are not entirely parallel in structure. At the broadest level, Finland's four overarching objectives are more comprehensive than CO's standards; similar to strands, they refer to broad dimensions of the language arts, such as communication ("interaction," particularly oral), and reading comprehension ("interpreting and utilizing texts"). At the most specific level, Finland's end-of-span performance descriptions define more concrete learning goals for students at the end of grades two, five, and nine. For example, each Finland grade span includes a broad objective for "interaction skills" (i.e. grades 1–2, "The pupils' interaction skills will increase"). This broad goal is elaborated through a set of more specific oral language communication objectives, (the bulleted statements under the "interaction" objective): i.e. at grades 1–2: "The pupils will learn to ask and answer questions." The core contents for "interaction skills" describe activities through which students build and demonstrate their skills and knowledge, such as participation in "one-on-one, small group and class discussions." The end-of-span descriptions provide a more precise and detailed picture of what students will be able to do by the end of the span: "they will follow the teacher's and other pupils' oral narration and discussion, strive for reciprocity when speaking, and in discussion, react to what they have heard with their own thoughts and questions."	include some curriculum content to be mastered (i.e. "fundamentals of spelling"). CO's grade span benchmarks focus primarily on skills, such as "differentiating between fact and opinion." Overall, while there is not an exact correspondence between their organizing structures, there is enough similarity between the two sets of standards to allow for meaningful comparison. Finland's objectives (both the overarching statement and the more specific, bulleted content) are comparable to CO's six standards, with their bulleted content. Both Finland's "core contents" (describing cross-span knowledge and skills) and their end-of-span performance descriptions should be considered in relation to CO's grade span benchmarks. *For the purpose of comparison, Finland's end-of-span performance descriptions will be included in all future references to "core contents" for a grade span.* At the upper secondary level, Finland describes a set of course-specific objectives and core contents. These can also be compared to CO's 9-12 standards and benchmarks. Finland does not provide end-of-span student performance descriptions at the upper secondary level.

Subcategory	Similarities	Differences	Comments
Number of Standards	The overall number of standards in CO and Finland is similar when the bulleted statements under CO's standards and Finland's objectives are taken into account. CO has six standards repeated across all grade spans. However, the three-four bulleted statements under each CO standard add considerable content. Finland has four broad objectives for grades 3–9 (three objectives at grades 1–2), each elaborated through four-six more specific goals for each span. At the upper secondary level, Finland has 10 overarching objectives for the language and literature curriculum as a whole, and 26 course-specific objectives for its six required courses.	CO includes a total of 27 bulleted statements under its six broad standards. These statements appear to articulate essential skills and knowledge included in the standards and they apply across all grade spans. Finland includes a range of 12–16 specific objectives per grade span elaborating the broad objectives for each span.	The overall number of benchmarks is also similar in Finland and CO. At the span level, Finland has 26 total benchmarks (performance descriptions) for describing student performance at the end of grade five. CO has a total of 33 benchmarks for its 5–8 span. At the upper secondary level, Finland has 26 course-specific objectives; CO has 26 benchmarks for its 9–12 span.
Design/Format	Both CO and FI have broad standard or objective statements, elaborated by benchmarks or core contents describing more specific skills and knowledge for each grade level or span.	Finland's objectives and core contents are organized horizontally, presenting a unified picture of all objectives, core content, and end-of-span performance descriptions for each grade span. CO organizes its standards vertically, presenting each of the six standards one at a time across all grade spans, K-12. Finland's format emphasizes grade span goals, but there is sufficient cross span repetition to indicate the continuity of objectives for grades 1-9. CO's format places the emphasis on broader goals across all grades.	

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)	Both CO and Finland have bulleted content that is not organized by numerical or alphabetical markers. CO's standards are numbered but include bulleted statements that are not. CO's benchmarks are not numbered. Finland does not use numbers to identify their objectives, core contents, or end-of-span performance descriptions.	At the upper secondary level, Finland's objectives and core contents are organized very differently than in the primary grades. Each course is presented one at a time, with its corresponding objectives and core contents. There are no individual grade levels in the upper secondary. Some other differences in format: Finland provides a two paragraph overview of the goals of language and literature instruction at the beginning of each grade span set of objectives and core contents. CO provides a one paragraph "rationale" for each standard, referring to goals for all students at all levels. Finland's approach helps create a picture of the emphasis within each span. CO's approach emphasizes continuity of goals across spans.	There is a much more pronounced differentiation between the objectives and core content for Finland's primary grades and those for their upper secondary schools compared to CO's standards and benchmarks for all grade spans K-12. Finland's descriptions of student performance at the end of each grade span (1-9) are slightly longer and typically more detailed and specific in content than either the objectives or the core contents for each span. They also tend to be more detailed and specific than CO's benchmarks. The descriptions clearly refer back to the knowledge and skills described in the objectives and core content and are meant to provide a clear picture of students' level of attainment at the end of each span.

External Referent: National Core Curriculum for Basic Education 2004 (Finland) and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	The content of CO's standard 1 ("Students read and understand a variety of materials"), including the content of its bulleted statements describing specific reading skills and strategies, can be found in Finland's objectives, core contents, and end-of-span performance descriptions.	CO's standard 1 has only one benchmark per grade span, referring to the types of material students read in that span. Finland's objectives and core contents show a progression of reading comprehension and interpretation skills across grade spans. For example, Finland's 1–2 objectives/core contents emphasize the acquisition of "the basic techniques of reading," such as "breaking down speech into words, syllables, and sounds" or "gradually shifting from reading aloud to reading silently. In its 6–9 span, Finland emphasizes "interpretive and evaluative reading." At the upper secondary level, all of Finland's courses are highly integrative: "reading, writing, oral communication, language, literature and the media will be linked to the objectives and contents of each course." These courses are organized by central themes or concepts. For example, "Texts and Influence" focuses on texts, both those students read and those they create, from the perspective of "exercising influence." Every course includes some objectives related to understanding and interpreting texts.	There is an emphasis throughout Finland's reading objectives and core contents on the importance of interaction and relationship, including the student's interaction with self (self-awareness). At all grade spans, Finland emphasizes the goal of students' becoming accustomed to "observing and evaluating themselves as readers" (grades 3–5). Students in the 6–9 span are expected to "know how to hold a discussion with a variety of texts—to ask questions, summarize, comment, disagree, etc." "Building bridges between the text and the recipient" and "sharing reading experiences" with others are also emphasized at all spans. At the upper secondary level, one required course focuses on "Language, texts, and interaction." Overall, all of the content in CO's standard 1 can be found in Finland's objectives and core contents but Finland describes additional breadth and depth of content. At the upper secondary level, objectives and core contents for reading emphasize in-depth analysis and interpretation over comprehension, including analysis of the student's own "reading habits" and the factors "steering their interpretation of texts."

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2	All of the content of CO's standard 2 ("Students write and speak for a variety of purposes and audiences") can be found in Finland's writing (or "producing texts") and "interaction" objectives/core contents. Both CO and Finland emphasize writing and speaking for a variety of purposes and audiences, and drafting, revising, and editing written communications. In addition, both CO and Finland integrate writing and speaking, CO in standard 2, and Finland in their objectives/core contents related to the production of texts.	Finland's objectives also address oral language communication skills separately from writing skills in their "interaction" objectives/core contents. These objectives focus on students' skills in communicating in a variety of classroom contexts, including discussion, dialogue, giving and receiving feedback, self-expression, conflict resolution, and more. Compared to CO's K–4 writing benchmarks, Finland's writing objectives and core contents for the 1–2 span articulate more fully the early development of foundational writing skills. For example, students learn to use "spacing between words" and "word division between lines." By the end of grade two, they are able to "write simple and familiar words almost without error and have begun to use terminal punctuation."	As with reading, Finland's objectives/core contents for writing at all levels emphasize the importance of students learning to "observe and evaluate" their own writing and to "accept feedback and make use of it in developing their skills" (grades 6–9). CO includes a benchmark for students in grades 9–12 to become "self-evaluators" of their writing but as it is included under the conventions standard, it's unclear whether it refers to elements beyond spelling, grammar, etc. Finland's objectives/core contents emphasize the goal of students becoming increasingly self-motivated and independent as writers. Students in the 1–2 span write texts based on their "own observations, everyday experiences, opinions and imagination, with an emphasis on the joy of creating." Students at the end of grade five are able to plan and construct texts based on "experience and imagination" in which "the writer's own voice" is evident, and students in the 6-9 span are expected to become "versatile and independent creators of texts." In the upper secondary school, the goal is for students to "be capable of carrying through an independent writing process from choice of a subject to . . . drawing up their own reflective text" (reflecting on the process). Overall, Finland's objectives and core contents describe a greater breadth and depth of content for both writing and oral language.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 3	Most of the content of CO's standard 3 ("Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling") can be found in Finland's writing and language objectives/core contents.	FI integrates the knowledge and use of conventions in its core contents for writing ("producing texts") at all grade spans. After the 1–2 grade span, however, there are typically no more than one or two specific goals for conventions (primarily spelling and punctuation) in the writing core contents. Finland's objectives and core contents for "language, literature, and culture" focus on a more in-depth understanding of the "Mother Tongue" and its "structure, variations, and changes." By the end of grade nine, students "know how to talk about the phonetic, formal, and sentence structure of language," know "the parts of speech and the key parts of a sentence," and "the main distinguishing features" of their language.	CO's standard 3 and its grade span benchmarks describe a somewhat greater breadth of content, with benchmarks describing a wider range of specific knowledge and skills related to conventions. Finland's objectives for "language, literature and culture" describe a greater depth of content, with knowledge of grammar and sentence structure integrated into an in-depth knowledge and analysis of language structures.
Standard 4	Nearly all of the content of CO's standard 4 ("Students apply thinking skills to their reading, writing, speaking, listening, and viewing"), including the skills described in the bulleted statements under the standard, can be found in Finland's related reading, writing, and oral language objectives and core contents.	CO's standard 4 addresses thinking skills across multiple strands of the language arts (reading, writing, speaking, listening, and viewing). Finland has no comparable broad objective addressing thinking skills. Instead, the skills described in CO's standard and grade span benchmarks are integrated into Finland's objectives/core contents for reading, writing, oral language, and literature. For example, a CO Standard 4 benchmark for K–4 refers to "making predictions, drawing conclusions, and analyzing what they read, hear, and view."	Although Finland does not have a separate objective for thinking skills, it does share with CO the close linking of reading/listening and writing/speaking. Finland's objectives define written, multi-media, and oral communications as "texts" and therefore integrate writing and speaking in "producing texts" and reading/listening /viewing in "interpreting texts." At the upper secondary level, Finland courses integrate all strands of the language arts in the exploration of broad themes and concepts.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 4 (Continued)		Finland places this content differently. Core contents for reading in Finland's 3–5 span include "anticipating the content and structure of texts" and "drawing conclusions and evaluating things read and heard."	The contents of CO's standard 4 and its grade span benchmarks are comparable in breadth and depth to that of related content in Finland's objectives/core contents. The cross-strand structure of CO's standard emphasizes the importance of thinking skills across all strands of the language arts. Finland's approach embeds related thinking skills in objectives organized by more traditional categories of reading, writing, oral language, and literature.
Standard 5	The content of CO's standard 5 ("Students read to locate, select, and make use of relevant information from a variety of media, reference, and technological sources") can be found in Finland's related objectives and core contents.	CO's standard 5 describes skills used to find, organize, evaluate, and use information for "reading, writing, and speaking purposes." The benchmarks for this standard across the three grade spans emphasize skills and strategies used to locate information in a wide range of both written and electronic resources. Finland includes comparable content in two of its broad objectives and their core contents: reading and writing (at grades 1–2) or "interpreting and utilizing texts" and "producing texts" for grades 3–9. For the latter grades (3–9) research skill are given their own heading in the core contents as "Information management skills."	Overall, the content of CO's standard 5 is comparable in depth and breadth to related content in Finland's objectives and core contents for grades 1–9. At the upper secondary level, one course ("Structures and meanings of texts") has a related objective: "learn information acquisition strategies, use printed and electronic sources and find useful and reliable information for use in their essays and oral presentations." Another course ("Texts and influence") focuses on the analysis and interpretation of "media texts." Some of the content of CO's benchmarks for students extending "beyond the standards" for standard 5 is found in the core contents of Finland's upper secondary objectives/core contents. At this level, Finland's objectives appear to describe greater depth of content.
Standard 6	Some of the content of CO's standard 6 ("Students read and recognize literature as a record of human experience") can be found in Finland's objectives and core content for "Language, literature, and culture" in grades 1–9 and for the "Language, literature and identity" course in the upper secondary	CO's standard 6 focuses primarily on the study of literature for its cultural and historical significance. The bulleted statements in the standard refer to literature as a way for students to explore "common issues," "the uniqueness and integrity of the American experience," and "ethnic	CO's standard 6 has depth within the dimension of literature that it addresses, that is, literary works as a source of insight into human experience, culture, and history. Finland's related objectives address a greater depth and breadth of skills and knowledge related to the understanding,

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 6 (Continued)	school. Some of the content of CO's standard 6 is also found in Finland's objectives/core contents for "interpreting texts" in the 3–5 and 6–9 grade spans.	traditions from around the world." Some benchmarks for the CO grade spans also include skills related to the accurate use of literary terminology and the understanding of literary "classics." Finland's related objectives and core contents for grades 1–9 emphasize a thorough grounding in Finnish literature as well as "other countries' classics" and a range of knowledge and skills related to literary analysis. By the end of grade nine, students are expected to know all the major genres and subgenres of literature, some literary classics representing different eras, and basic distinctions between the styles of "romantic, realist, and modernist texts (6-9)." Overall, the cultural and historical significance of literature is addressed in Finland's objectives but does not appear to receive the same degree of emphasis as in CO's standard 6.	analysis, and interpretation of specific works, genres, and literary elements as well as objectives addressing the interactions of literature, history, and culture. At the upper secondary level, the objectives and core contents for "Devices and interpretation of literature" focus almost entirely on the analysis and interpretation of individual works and genres (i.e. students "develop in the analysis of fictional texts" or "learn to justify their interpretation of texts"). A course in "Language, literature, and identity" focuses on "key works and themes in Finnish literature" and requires students to assess these in relation to both "cultural and individual identity." Overall, Finland's objectives and core contents related to literature describe a greater breadth and depth of content.
Grades K–4	The distribution of related content in CO's standards and benchmarks for the K–4 span and in Finland's objectives and core contents for the 1–2 and 3–5 spans is mostly similar. Overall, neither CO nor FI attempts to describe a grade-by-grade sequence of learning within their grade span standards.	CO's K-4 standards and benchmarks typically describe skills broad enough to apply to all five grades within the span or skills representing goals for students in the upper range of that span.	Finland does give more emphasis to the progression in students' mastery of the "basic techniques of reading and writing" in grades 1–2. They also define objectives for students' oral communication skills, use of media, and knowledge of conventions by the end of grade two. CO's benchmarks do not differentiate the levels of skill and knowledge expected of first and second grade students from those in third and fourth grade.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades K–4 (Continued)		Finland's objectives and core contexts for grades 1-4 are organized into two separate grade spans, 1–2 and 3–5. (Kindergarten is not included in the primary school). The 1–2 grade span is Finland's smallest; compared to CO's broader K–4 standards, FI includes more specific content describing the development of foundational skills in reading and writing in their 1–2 span. In addition, the end-of-span performance descriptions for grades two and five describe the culmination of learning within each span.	Finland's three-year 3–5 grade span overlaps with two different CO grade spans, K–4 and 5–8, both broader, four-year spans. Nearly all of the content of CO's K–4 and much of the content of CO's 5–8 can be found in Finland's 3–5 span. Because Finland has addressed objectives for grades 1–5 in smaller grade spans, thy have described more specific content for each and also shown more differentiation between learning goals for students in these two spans.
Grades 5–8	The distribution of related content in CO's standards for their 5–8 span and in Finland's objectives for their 3–5 and 6–9 spans is similar in many respects. For example, CO's 5-8 benchmarks for standard 4 ("thinking skills") include "separating fact from opinion," "making predictions, drawing conclusions, and analyzing what they read, hear, and view;" and "recognizing, expressing, and defending a point of view," both orally and in writing. All of the above can be found in the core contents and end-of-span descriptions for Finland's 3-5 span.	Because of the different years included in their grade spans, there is not an exact parallel between the contents of CO's 5–8 standards and either of Finland's two overlapping spans (3–5, 6–9).	As noted above, CO standards and benchmarks do not describe a sequence of learning within each span. This is broadly true of Finland's objectives and core contents, also, which describe student learning across all grades within each span. However, Finland's end-of-span learning descriptions do provide some sense of the progression, or the culmination, of learning within each span. For example, an objective for "students' skills in producing texts" in Finland's 3-5 span is that students "will gain experience in producing various texts with a word-processing program." By the end of grade five, students will be "able to produce text with word-processing programs." The end-of-span descriptions are generally more specific than the objectives/core contents, describing concrete student performances and attainments.
Grades 9–12	The distribution of related content in CO's standards for the 9–12 span and in Finland's objectives for the 6–9 span and upper secondary courses is similar in many	At the upper secondary level, some Finland objectives parallel the content of CO standards and benchmarks while many do not. For example, a benchmark for CO	Neither CO nor Finland describes a sequence of learning within the grade spans for 9–12 (CO) and 10–12 (Finland). Finland's end-of-span descriptions for 9th

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 9–12 (Continued)	respects. Much of the content of CO's 9–12 standards and benchmarks is distributed in Finland's objectives for its 6–9 grade span. Some is distributed in Finland's objectives for upper secondary courses. For example, 9–12 benchmarks for CO's standard 6 (literature) include a breadth of reading content description, such as novels, poetry, plays, etc. Finland's objectives for 6-9 include a comparable breadth of reading content. CO's benchmarks also call for students to use literary terms accurately, such as "theme, mood, diction, idiom, etc." Finland's 6–9 objectives and end-of-span descriptions call for students to "make connections between the text's purpose and tone" and elements such as "word choices, figurative language, sentence forms, and idioms."	standard 4 ("thinking skills") calls for students to recognize "an author's historical and cultural context." A parallel objective for Finland's upper secondary course on "Text, style, and context" requires students to analyze "both fictional and factual texts in their cultural context." However, many of Finland's upper secondary objectives/core contents describe skills and knowledge not articulated in CO's standards and benchmarks. For example, an objective for the study of literature in the upper secondary is for students to "consolidate their knowledge of literary genres and their distinctive characteristics," (including lyric poetry and drama as genres). Objectives for "Texts and influence" include being able to "critically assess information communicated by the media and its effects on individuals and society" and to "examine the effects of literature on society."	grade, however, describe the culmination of learning for that span. Grade nine is also the final year of Finland's compulsory "basic education." The objectives and core contents for Finland's upper secondary school are organized quite differently from those of the primary grades and there is a clear sense of transition to a more integrated and rigorous curriculum.
Across All Grades	The distribution of related content across CO's grade span standards and Finland's grade span and upper secondary objectives is mostly similar. Both sets of standards also describe a progression of student learning across all spans.	Although both CO and Finland show a progression in student learning across spans, they have organized their spans differently. Compared to CO, Finland has organized their first five grades into two smaller spans (1-2, 3-5), allowing for a fuller elaboration of the developmental sequence of student learning in these grades. Finland also organizes their three spans for grades 1-9 quite differently from their upper secondary school so that there is a more pronounced transition from grade nine to the upper school.	Despite the differences in grade span organization, there is substantial similarity in the distribution of content across spans in Finland and CO. Perhaps the most notable difference is in Finland's upper secondary objectives and core contents, which integrate strands of the language arts in theme-based courses, and which address some knowledge and skills not articulated in CO's 9-12 standards.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades (Continued)			Finland's inclusion of end-of-span performance descriptions creates another difference in sequencing of content. Finland provides a culminating picture of student learning at the end of grades two, five, and nine. These are, in effect, grade level benchmarks for those grades. Although CO's benchmarks seem at times to emphasize knowledge and skills more typical of the upper range of their grade spans, the benchmarks are typically broad enough to apply across all grades within each span.
Wording/Specificity	The language in both CO's and Finland's 'standards' and benchmarks/indicators is fairly concise and accessible.	Overall, the language used in Finland's end-of-span performance descriptions is more specific than the language used in their objectives and core contents, and often, more specific than CO's grade span benchmarks. The performance descriptions define fairly concretely what students will know and be able to do at the end of a span (i.e. "are able to summarize a fictional text's plot, to prepare character descriptions, and to follow the characters and the evolution of their relationship"). CO's benchmarks addressing four or five grades at once are often more broad and general.	The language used in Finland's objectives, core contents, and end-of-span performance descriptions reflects broad educational values not articulated in CO's standards and benchmarks. In particular, Finland uses language throughout its materials that emphasizes such values as students' interest and motivation, their self-awareness and respect for others, and the importance of developing students' imagination, creativity, and powers of self-expression. Language reflecting the values described above is embedded in many of the objectives and "core contents," as in the emphasis in grades 1–2 writing on "the joy of creating" or in 6–9 interaction skills on "developing the courage and confidence to communicate." The values expressed in Finland's objectives and core contents may be implicit in some of CO's standards and benchmarks; what's distinctive in Finland's materials is that they are explicitly stated and integrated into the language of their objectives.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity (Continued)			NOTE: Finland has produced 11 different versions of its objectives and core contents for "Mother Tongue and Literature" to accommodate students using different native languages as well as users of sign language. The content is parallel across all versions but there are interesting and sometimes substantive differences in phrasing. For example, the 6–9 core contents for "interpreting texts" in the Finnish language document includes: "choosing a skimming, searching, literal, or inferential way of reading;" the Swedish language document reads: "treating fictional texts in different ways, such as author-, text-, and reader-oriented analyses."

Appendix E. Reading and Writing: External Referent Review—Singapore
External Referent: English Language Syllabus 2001 For Primary and Secondary Schools (Singapore)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	CO's 6 standards cross all grade spans, K–12. Singapore's 10 standards also cross all grade spans, Primary 1–Secondary 4.	Singapore organizes its standards ("learning outcomes") by two-year grade spans across the six primary grades (primary grades 1–6) and four secondary grades (secondary grades 1–4 or 5) in their educational system. (A fifth year of secondary education is optional in Singapore.) CO organizes standards by three broader grade spans, K–4, 5–8, and 9–12. Students in Singapore start primary grade at age seven and are always one year older than American students in the corresponding grades. Kindergarten has its own curriculum in Singapore and is not included in the primary grades.	Singapore's grade spans and the ages of students within those spans differ significantly from CO's. In addition to starting first grade one year later than American students, students in Singapore also finish their secondary school one or two years earlier, at ages 16–17, depending on which track they follow for secondary school. Singapore's two-year grade spans are much shorter than CO's four-five-year grade spans, defining the skills and knowledge expected of students at every second year throughout their education.
Hierarchy of Standards	Both CO and Singapore have a set of broader, cross-span standards or "learning outcomes," elaborated by more specific benchmarks for each grade span. Singapore's ten learning outcomes, like CO's six standards, are relatively broad in scope, and recur across all grade spans. CO defines specific skills and knowledge for each standard at each grade span through its benchmarks. Singapore also defines specific skills and strategies (or benchmarks) for each learning outcome at each grade span.	CO's benchmarks apply to all grades within each span, K–4, 5–8, and 9–12. Singapore's benchmarks describe "attainment targets for pupils at the end of each two-year period." However, unlike individual grade level standards, Singapore's end-of-span learning outcomes describe the goals toward which students are working throughout the two-year period. Singapore's learning outcomes are organized by three broad "areas of language use": Language for Information; Language for Literary Response and Expression; and Language for Social Interaction.	Singapore's end-of-span learning outcomes at the end of primary grades and secondary grades provide a culminating set of benchmarks to define the level of attainment at the completion of each span. CO does not define end-of-span benchmarks. CO does not specifically organize its six standards by three different areas of language use. However, four of six standards (1–4) describe skills that apply across literary, informational, and social uses of language, while one (6) describes knowledge and skills specific to

Subcategory	Similarities	Differences	Comments
Hierarchy of Standards (Continued)	*Singapore does not use the word benchmarks, but to facilitate comparison, their grade-specific skills and knowledge will be referred to by that term.*	Learning outcomes 1–7 describe skills and knowledge that apply to all three areas of language use. Learning outcomes 8–10 describe skills and knowledge that apply to specific areas of language use.	literature and one (5) describes knowledge and skills specific to language used for informational purposes.
Number of Standards		CO has six broad standards, each elaborated through 3-4 bulleted statements describing specific skills and knowledge included in the standard at all levels. Singapore has ten learning outcomes, each stated in one sentence. The skills and strategies listed under each of Singapore's learning outcomes are specific to a grade span and are equivalent to CO's grade span benchmarks. At the level of each of its two-year spans, Singapore has more benchmarks than CO has for its four-year spans. For example, Singapore has 56 specific benchmarks for the end of primary grade. CO has 33 benchmarks for its 5–8 span.	Singapore's learning outcomes 8–9 are subdivided into three parallel statements (8.1, 8.2, 8.3) each addressing one of the three areas of language use. In effect, this gives Singapore the equivalent of 14 learning outcomes per two-year span. Overall, Singapore has significantly more learning outcomes (standards) and benchmarks than CO.
Design/Format	CO and Singapore have broad standard or learning outcome statements, elaborated by benchmarks describing more specific skills and knowledge for each grade level or grade span.	Singapore's learning outcomes and benchmarks are organized horizontally, presenting a unified picture of all learning outcomes and benchmarks for each two-year grade span. CO organizes its standards vertically, presenting each of the six standards one at a time across all grade spans, K-12. Singapore's format emphasizes grade span goals, but there is sufficient	In addition to the learning outcomes, Singapore also includes "text types" for each two-year grade span. These include texts representing the three areas of language use: Language for Information; Language for Literary Response and Expression; and Language for Social Interaction.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)		cross span repetition to indicate the continuity of learning outcomes across all grade spans. CO's format places the emphasis on broader goals across all grade spans. Singapore's learning outcomes for each grade span are part of a larger document ("English Language Syllabus 2001"), which includes an overview of Singapore's broad aims for education in the English Language Arts. There are also statements of the core "principles of language learning and teaching" as well as of the philosophy and principles underlying Singapore's approach to teaching and learning reading, writing, and oral communication. This introductory material helps to create a meaningful context for Singapore's learning outcomes and benchmarks, and to clarify the principles underlying their content. Singapore's learning outcomes are organized by number (1-10); its grade span benchmarks for each learning outcome are organized by alphabetical order. For example, in primary grade, learning outcome 1 has three benchmarks, a-c. CO numbers its six standards; its benchmarks for each grade span are not identified by numbers or letters.	For each area of language, at each span, there are "text types" that students read, listen to, and create through writing or speaking. Although not included as learning outcomes, the text types convey the breadth and variety of content students are expected to read, write, present, and listen to at each grade span. There is also a "Grammar Focus" for each grade span, listing the topics in grammar to be covered for that span. Singapore's document also includes additional resources for teachers. For example, a long chapter on Grammar provides a comprehensive list of all the grammatical items and structures to be taught during each two-year period. The organization of Singapore's learning outcomes and benchmarks make it easy to refer to specific benchmarks (for example, P2, 1a) by letter and number.

External Referent: English Language Syllabus 2001 For Primary and Secondary Schools (Singapore)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	The content of CO's standard 1 ("Students read and understand a variety of materials"), including the content of its bulleted statements describing specific reading skills and strategies, can be found in Singapore's learning outcomes and benchmarks.	CO's standard 1 has only one benchmark per grade span, referring to the types of material students read in that span. Singapore's learning outcomes and benchmarks show a progression of reading comprehension and interpretation skills across grade spans. For example, Singapore's P2 benchmarks emphasize the acquisition of phonological awareness, decoding skills, and concepts about print. Students in P3 continue to use decoding skills and "read aloud to check pronunciation and understanding." In its S4 span, Singapore includes new comprehension strategies, such as using knowledge of "text organization" and "logical relationship of ideas."	Singapore's learning outcomes and benchmarks also differentiate between skills used to comprehend literary, informational, and social/interactive texts (speeches, dialogue, etc). At every grade span, Singapore's learning outcome 8 includes three parallel sets of skills (8.1–8.3) to address the comprehension of texts used for literary, informational, and social purposes. Singapore's learning outcome 9 also addresses three parallel sets of skills (9.1–9.3) for acquiring and using knowledge from each area of language. Overall, there is substantial similarity between the content of CO standard 1 and Singapore's learning outcomes. However, Singapore differentiates the content by grade span and area of language use to a greater extent than CO.
Standard 2	All of the content of CO's standard 2 ("Students write and speak for a variety of purposes and audiences") can be found in Singapore's learning outcomes. Both CO and Singapore emphasize writing and speaking for a variety of purposes and audiences, and drafting, revising, and editing written communications. In addition, both CO and Singapore integrate writing and speaking, CO in standard 2 and Singapore in learning outcomes 4 and 9.	Singapore's learning outcomes also address oral language communication skills separately from writing skills in learning outcomes 3 ("Speak fluently and expressively on a range of topics") and 10 ("Interact effectively with people from own or different cultures/religions"). Focused on oral presentations, Singapore's 3 has specific benchmarks at each grade span for oral communication skills and strategies, such as the effective use of "pitch, tone, pace and volume." Singapore's 10 focuses on a wide range of social interaction skills, with span-specific benchmarks such as	Singapore also includes some benchmarks for P2 and P4 that show a progression in students' foundational writing skills, such as the ability to "space letters, words, and sentences appropriately (P2). Singapore's learning outcome 9 describes types of organizational structures students will apply to both writing and speaking at each grade span. For example, students in the P4 span will organize their writing/speaking by "list, sequence, compare, contrast, and classify." CO's grade span benchmarks for standard 2 do not describe specific organizational structures or strategies.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2 (Continued)		"Give instructions on how to do something." Compared to some of CO's benchmarks for standard 2 (such as "organizing their writing" in K-4), Singapore's writing benchmarks describe more specific skills and knowledge at the end of each two-year span. For example, by the end of P2, students can "select a central idea with teacher guidance" and "write paragraphs that develop a central idea." By the end of P4, students can "select an appropriate focus with teacher guidance" and "use details that elaborate on main ideas."	Overall, there is substantial similarity in the content of CO standard 2 and Singapore's related learning outcomes. However, Singapore describes a greater breadth and depth of content. Its learning outcomes place more emphasis on oral language skills and its benchmarks for both writing and speaking are typically more specific than CO's.
Standard 3	Most of the content of CO's standard 3 ("Students write and speak using conventional grammar, usage, sentence structure, punctuation, capitalization, and spelling") can be found in Singapore's learning outcomes. Like CO, Singapore integrates the knowledge and use of conventions in both speaking and writing.	Singapore integrates the knowledge and use of conventions in its benchmarks for writing speaking, and comprehending texts at all grade spans. Conventions are not addressed in a separate learning outcome. Singapore's approach to grammar and conventions is quite different from CO's. CO includes specific skills in the use of conventions at each grade span (i.e. "subject-verb agreement" at K-4). Singapore does not list specific conventions to be mastered at each span in their benchmarks.	An interesting feature of Singapore's approach to grammar is reflected in the "Grammar Focus" for each grade span. Like the "Text Type," the Grammar Focus is not presented as a learning outcome. However, it provides a list of the grammatical structures students in each span will need to know and use in order to read and write the text types specified for that span. For example, students in P4 write "Factual Accounts" and will need to know and use "simple past tense, nouns and noun phrases, adverbs and adverbials," etc. Although the content of CO's standard 3 is represented in Singapore's related learning outcomes, Singapore does not define specific skills and knowledge in the use of conventions in its benchmarks.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 3 (Continued)		Understanding and using "grammatical items and structures" is also a cross-span benchmark for Singapore 6 ("Demonstrate knowledge about language and text types") that again does not specify content for each span. Instead, it refers to *Grammar*, an appendix to the learning outcomes that provides a highly detailed summary of the grammar curriculum across all grade spans.	Overall, CO gives more emphasis to conventions as a separate standard with applications for both writing and speaking. Singapore integrates conventions into other learning outcomes addressing reading, writing, and speaking. CO describes more breadth of content in their benchmarks for conventions at each grade span.
Standard 4 (Continued)	Most of the content of CO's standard 4 ("Students apply thinking skills to their reading, writing, speaking, listening, and viewing"), including the skills described in the bulleted statements under the standard, can be found in Singapore's related reading, writing, and oral language learning outcomes.	CO's standard 4 addresses thinking skills across multiple strands of the language arts (reading, writing, speaking, listening, and viewing). Singapore has no comparable learning outcome addressing thinking skills. Instead, most of the skills described in CO's standard 4 and grade span benchmarks are integrated into Singapore's learning outcomes 8 and 9 and their grade span benchmarks. For example, a CO Standard 4 benchmark for K–4 refers to "making predictions, drawing conclusions, and analyzing what they read, hear, and view." All of this content can be found in Singapore's learning outcomes 8.1–8.3 and 9.2–9.3. As noted earlier, Singapore 8 and 9 describe skills applied to three areas of language: informational, literary, and social/interactive. Learning outcome 8 focuses on "demonstrating understanding of the content" of these texts, while learning outcome 9 focuses on "acquiring and using knowledge" from these texts for "a variety of purposes."	Although Singapore does not have a separate objective for thinking skills, it does share with CO the close linking of reading/listening and writing/speaking. Singapore learning outcomes 8 and 9 both refer to texts students "listen to, read, or hear." Singapore's learning outcomes 8 and 9 describe most of the same content as CO standard 4. However, Singapore's benchmarks are typically more specific. Benchmarks also differentiate between skills applied to literary, informational, and social/interactive texts, and describe these sets of skills more specifically ("draw conclusions about characters" in literary texts and "draw conclusions using contextual clues and prior knowledge" in informational texts). Overall, Singapore's more specific learning outcomes and benchmarks articulate more breadth and depth of content.
Standard 5	The content of CO's standard 5 ("Students read to locate, select, and make use of relevant information from a variety of media, reference, and technological	The content of CO standard 5 is addressed in three Singapore learning outcomes 6, 9.1, and 7. Singapore 6 focuses on "knowledge about language and text types," including	There is considerable similarity in the content of CO standard 5 and Singapore learning outcomes 6, 7, and 9.1. Singapore's integrates related skills and knowledge in three

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 5 (Continued)	sources") can be found in Singapore's related learning outcomes.	knowledge of the organizational features of texts ("glossary, index, references," etc.). SG 9.1 focuses on acquiring and using knowledge from informational texts in student writing or speaking. This Singapore learning outcome is most similar to CO standard 5, with many benchmarks describing skills used to locate and organize information. Singapore learning outcome 7 focuses on the "use of strategies to construct meaning" from texts. Singapore 7 benchmarks describe a broad range of reading comprehension strategies, including the interpretation of "diagrams, charts, symbols, graphs, maps, and tables" in texts (Secondary 4).	different learning outcomes depending on the larger context in which those skills are applied—in reading comprehension, for example (Singapore 7), or in using information in student writing or speaking (Singapore 9.1). Overall, Singapore's learning outcomes and benchmarks describe a greater breadth and depth of content.
Standard 6	Some of the content of CO's standard 6 ("Students read and recognize literature as a record of human experience") can be found in Singapore's related learning outcomes.	CO's standard 6 focuses primarily on the study of literature for its cultural and historical significance. Some benchmarks for the CO grade spans also include skills related to the accurate use of literary terminology and the understanding of literary "classics." Singapore addresses knowledge and skills related to the understanding, appreciation, and interpretation of literature in four learning outcomes Singapore 1, 6, 8.2, and 9.2. Knowledge of literary terms is included in a benchmark for Singapore 6 ("knowledge about language and text types") at all spans.	CO's standard 6 has depth within the dimension of literature that it addresses, that is, literary works as a source of insight into human experience, culture, and history. In regards to this dimension of literature, CO standard 6 describes greater depth of content compared to Singapore, which barely addresses this content.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 6 (Continued)		Singapore 8.2 focuses on "comprehension" of literary texts (characters, plot, setting, with new elements added at higher spans). At all grade spans, Singapore 8.2 includes one benchmark for inferring meaning using "knowledge of familiar cultures in Singapore, Asia, and the rest of the world." This is the only benchmark in Singapore's learning outcomes to refer to the interaction of literature and culture.	Singapore's learning outcomes and benchmarks do not emphasize literature as a source of insight into history and culture. However, its learning outcomes and benchmarks describe a greater breadth and depth of skills and knowledge related to the understanding, appreciation, and interpretation of literature. For example, Singapore 1 includes benchmarks at every span for creative and imaginative responses to literature ("re-create a text from a different perspective" at S2).
Grades K–4	The distribution of related content in CO's standards and benchmarks for the K-4 span and in Singapore's learning outcomes and benchmarks for the P2 and P4 spans is mostly similar. Overall, neither CO nor Singapore attempts to describe a grade-by-grade sequence of learning within their grade span standards.	CO's K-4 standards and benchmarks typically describe skills broad enough to apply to all five grades within the span or skills representing goals for students in the upper range of that span. Singapore's learning outcomes and benchmarks for grades 1-4 are organized into two separate grade spans, 1-2 (P2) and 3-4 (P4). (Kindergarten is not included in the primary school.) Its benchmarks describe the sequential progression of students' reading and writing skills from P2 to P4 in more detail than CO's K-4 benchmarks, including students' developing concepts about print, decoding skills, and phonological awareness, for example.	Singapore's smaller two-year grade spans allow it to describe a more finely gradated progression in students' knowledge and skills than is possible in CO's five-year K-4 span.
Grades 5–8	The distribution of related content in CO's standards for its 5-8 span and in Singapore's learning outcomes for their P6 and S2 spans is similar in many respects. Note: Singapore's primary grades end at grade six; its secondary grades are numbered 1-4 or 5 (some tracks include a 5th year). Thus Singapore's secondary grades 1-2 are the equivalent of grades 7 and 8 in the US. Singapore's two spans P6 and S4 closely	Singapore's benchmarks for their smaller two-year grade spans show a more differentiated sequence of skills and knowledge from grades 6 to 8. CO's four-year 5-8 span describes broader skills and knowledge that apply across all grades within the span. For example, a standard 2 ("writing/speaking") benchmark for CO's 5-8 span includes "applying skills in analysis, synthesis, evaluation, and explanation to	The broader language of CO's benchmarks makes it difficult to compare them to Singapore's more specific benchmarks. CO's "skills in analysis, synthesis, evaluation, and explanation," for example, could include a number of the more specific skills described in Singapore's benchmarks.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
	parallel CO grades 6-8	their writing and speaking." A Singapore benchmark for Primary 6 is to "organize information" using "list, sequence, compare, contrast, and classify." A benchmark for S2 is "to organize, summarize, and synthesize information using a variety of organizational patterns," including "cause-effect and chronology." The Singapore benchmarks show progression of skills from P4 to S2 while CO's broader 5-8 benchmark applies across all four grades.	Overall, Singapore's smaller two-year benchmarks allow it to articulate a more specific sequence of student learning from grade 6–8 that is not described by CO's 5–8 span benchmarks.
Grades 9–12	The distribution of related content in CO's standards for its 9–12 span and in Singapore's learning outcomes for its S4 span is similar in many respects. Both Singapore and CO extend the types of informational, electronic, and technical materials students are expected to know and use at this level; both also emphasize analytical and evaluative skills in response to written/oral texts. Neither CO's 9-12 benchmarks nor Singapore's S4/5 benchmarks describe a sequence of learning within the grade span.	Singapore's P4 grade span does not precisely parallel CO's 9–12. Students in Singapore complete their secondary education in either four ("special" or "express" tracks) or five years ("normal")—P2–P4/5. There are also separate tracks for academic or technical education; references in this comparison are to the normal academic track. Singapore's S4/5 is approximately parallel to grades 9–11 in the U.S. As in other grade spans, Singapore's benchmarks for S4/5 tend to be more specific than CO's. For example, a standard 4 ("thinking skills") benchmark for CO's 9-12 span is "critiquing the content of written and oral presentations." Singapore has six related benchmarks for S4/5, including to "evaluate information for truth, relevance, exaggeration, or persuasive language" and to "identify and analyze techniques used in different media."	Singapore's S4/5 benchmarks refer to three years (maximum) while CO's 9–12 benchmarks cover four years. The differences in the level of generality of CO and Singapore benchmarks make it difficult to compare the distribution of content very precisely.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades	The distribution of related content across CO's grade span standards and Singapore's end-of-span learning outcomes is similar. Both sets of standards also describe a progression of student learning across spans.	CO's six standards repeat across all grade spans. However, the grade span benchmarks for each standard describe a sequence of student learning from one span to the next. Singapore's learning outcomes also recur across all grade spans, with benchmarks describing the specific level of skills and knowledge expected at the end of every two-year span. One notable difference in both distribution and sequencing of content is seen in Singapore's more detailed description of the gradual acquisition of foundational knowledge and skills in the P2 and P4 spans.	Although Singapore's benchmarks describe "expected attainment targets for pupils at the end of each two-year period," they refer to student learning throughout each two-year period in a way that individual grade level standards do not. In the introduction to the learning outcomes, the Singapore document states that "This two-year period for the attainment of each set of Learning Outcomes will give teachers time and flexibility to cater to the different learning needs and abilities of their pupils." Singapore's smaller two-year spans allow for a more specific and differentiated sequencing of student learning from one span to the next than is possible with CO's broader grade spans.
Wording/Specificity	The language in both CO's and Singapore's standards is fairly concise and accessible, with few lengthy, overly abstract, or complex sentences. Both sets of standards or learning outcomes are characterized by the use of verbs or verb forms, emphasizing student performance.	Each of CO's six standards is elaborated through bulleted statements that become fairly lengthy at times (notably CO standard 1). Often the content of the bulleted statements is comparable in level of specificity to that of CO or Singapore benchmarks. Singapore learning outcomes are each one sentence long. All of their learning outcomes and benchmarks use active verbs and the language is notably concrete and concise. CO's benchmarks use verbal forms and the language tends to be more general and abstract at times.	To some extent, the more abstract language in at least some of CO's benchmarks may reflect a choice to include a relatively small number of standards and of related benchmarks for each grade span. More content is added, however, through the bulleted statements under the standard and in benchmarks that combine multiple skills or areas of knowledge.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity Continued			For example, the content of a single 5-8 CO benchmark for "making predictions, drawing conclusions, and analyzing what they read, hear, and view" is described in six different benchmarks for Singapore's P6 span. This makes it easier for Singapore's benchmarks to be expressed in language that is more specific and more concise.

Appendix F. Reading and Writing: 21st Century Skills and Postsecondary and Workforce Readiness Review

21st Century Skills

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
1	K-4	F	P	N	P	P	
1	5-8	F	P	N	P	P	
1	9-12	F	P	N	P	P	
1	Across	F	P	N	P	N	Some skills under standard 1 (i.e. "make connections between") imply a degree of self-direction; however, the standard and benchmarks do not appear to explicitly require or emphasize self-direction.
2	K-4	F	P	N	P	P	
2	5-8	F	P	N	P	P	
2	9-12	F	P	N	P	P	
2	Across	F	P	N	P	P	As above, a degree of self-direction is implicit in some skills ("choosing vocabulary"); to give more emphasis to this skill, the standard could incorporate more references to students planning their work, generating ideas, selecting topics, evaluating their own writing, and publishing, etc.
3	K-4						
3	5-8						

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
3	9-12					P	One 9-12 benchmark ("becoming a self-evaluator") suggests self-direction.
3	Across						
4	K-4	F	F	N	P	P	
4	5-8	F	F	N	P	P	
4	9-12	F	F	N	P	P	
4	Across	F	F	N	P	P	To more fully address skills of self-direction and invention, benchmarks would need to incorporate language giving more explicit emphasis to these skills (i.e. planning, selecting, evaluating).
5	K-4	N	F	N	P	P	
5	5-8	N	F	N	P	P	
5	9-12	P	F	N	P	P	
5	Across	N	F	N	P	N	Note: Some of the "beyond the standard" benchmarks for 9-12 do require more self-direction.
6	K-4	P		N	N	N	
6	5-8	P		N	P	N	
6	9-12	F		N	P	P	
6	Across	P	N	N	P	N	In some benchmarks, changes in language could more fully describe critical thinking. For example, "identifying

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
							recurrent themes" could be revised to "analyzing recurrent themes." The use of verbs like analyze, interpret, develop, explain, infer, and draw conclusions would strengthen the element of critical thinking in these benchmarks.
Comments			To the extent that "information literacy" includes skills and strategies used to comprehend "technical publications" or online sources of news, opinions, and information, it would seem appropriate to address this skill more fully in standard 1 as well as in standard 5.	No language in any of the current standards and benchmarks explicitly addresses collaboration skills. Collaboration could be addressed in most standards. Some examples include peer review/editing of writing, class or group publications, collaborative oral or multi-media presentations, dramatic readings or performances of literary texts.		Some standards and benchmarks suggest opportunities for invention, but could more explicitly require or emphasize it. Examples: A standard 4 benchmark refers to using language arts skills to "solve problems."	A benchmark requiring students to define a problem, identify and evaluate possible solutions, then develop and explain their own solution, would explicitly require both critical and inventive thinking. Standard 2 includes benchmarks for "choosing figures of speech that communicate clearly" and "using fictional, dramatic, and poetic techniques in writing," both skills imply invention. However, no standard 2 benchmark specifically calls for students to compose their own works of fiction, poetry or other form of creative writing; or to use diction and figurative language in fresh and creative ways; only one (at K-4) calls for students to generate and develop their own topics and ideas for writing/speaking.

Reading and Writing: 21st Century Skills and Postsecondary and Workforce Readiness Review

Postsecondary and Workforce Readiness

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
1	K-4							
1	5-8		P					
1	9-12	P				P	P	The specific skills and strategies students use to comprehend, interpret, and analyze texts (both literary and informational) need to be more clearly described in grade span benchmarks to clarify level of performance. Some strategies listed in the standard require logical reasoning but aren't described in specific 9-12 benchmarks. Self-direction is implied in some strategies, but is not given explicit emphasis; skills requiring students to make and defend judgments or express opinions about texts could strengthen self-direction.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
								Skills related to collaborative work could address cooperation.
1	Across							
2	K-4							
2	5-8		P					
2	9-12	P		N	N	N	P	Level of performance (control of organization, development, sentence variety, diction, voice) is not specifically described in the benchmarks. Logical reasoning is required to support an opinion, but skills are described in very general terms. Benchmarks do not address analytic or interpretative skills, self-direction, collaboration, or innovation.
2	Across							
3	K-4							
3	5-8							
3	9-12							
3	Across							

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
4	K-4							
4	5-8		P					
4	9-12	P		P	N	N	P	Benchmarks do not provide enough specific info to determine level of performance (i.e. readiness for college w/o remediation). Logical reasoning, argumentation, and problem solving are required by some benchmarks but skills are described in very general terms. The benchmarks would need to be rewritten to more specifically address the readiness skills.
4	Across							
5	K-4							
5	5-8		N					
5	9-12	P		P	N	N	N	The “beyond the standard” benchmarks for this standard address self-direction, analysis, problem-solving, and the application of reading,

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
								writing, and computing skills to a greater extent than the benchmarks. The benchmarks would need to give more emphasis to the application and use of research skills (for specific purposes) to address the readiness skills.
5	Across							
6	K-4							
6	5-8		P					
6	9-12	P				P	P	Only one benchmark (develop and support a thesis) clearly requires logical reasoning and interpretative or analytic skills. There is a potential to strengthen these skills and some human relations skills for this standard.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
Comments		To more fully address this skill, standards and benchmarks would need to describe the level of specific reading, writing, and computing skills and the types of applications of those skills for 9-12 students. For example, skills used for the analysis, interpretation, and evaluation of informational texts and resources (including online resources), need to be more specifically articulated. Colorado might want to include a review and update of computing skills, to include more analysis and use of online information and tools.	Logical reasoning and argumentation abilities are either required or hinted at in a number of Colorado standards and benchmarks (including standards 4 and 2). These can be strengthened by developing more specific benchmarks and by linking more discrete knowledge and skills (research or use of terminology) to applications requiring reasoning.	Problem-solving skills can be more fully integrated into research and writing standards and potentially into standards/benchmarks that address oral language skills (group discussion, partner or group presentations). Standard 4 includes a broad benchmark for problem-solving; Colorado might consider defining this skill more specifically and integrating it into benchmarks, which address specific rather than multiple strands.	Systems thinking competencies could be integrated into writing, research, and oral language standards. Benchmarks would need to be rewritten with these skills in mind.	Human relation skills, particularly self-direction and cooperation, can be integrated into many standards. For example, benchmarks can give students more responsibility for generating their own topics in writing and speaking; for developing criteria and evaluating their own writing and speaking as well as that of others; for developing and defending their own interpretations, evaluations, and opinions; for working cooperatively and collaboratively with others in peer editing groups or group presentations; dramatic presentations, and other projects.	The benchmarks in Colorado's standard 4 are particularly related to this skill, but they tend to be described in rather general terms. Colorado might consider describing specific analytic and interpretative skills for application to informational texts, media, oral language, etc.	Colorado's standards and benchmarks clearly were not written with this set of skills in mind. Much of the content of the current standards is relevant and has the potential to address these skills more fully and explicitly; however, the standards and benchmarks would need to be rewritten with the content of these skills in mind.

Appendix G. Mathematics: Internal Quality Review

Depth

Standard	Grade Span	Within span	Across span	Comments
1	K-4	F		
1	5-8	F		
1	9-12	F		Rating assumes concepts such as absolute value and scientific notation (benchmark 1) may be introduced, though not specified, in earlier grades, without requiring mastery. Also assumes middle grades concepts such as ratio and proportion (benchmark 1.5-8.4) will be extended in grades 9-12 as incorporated with another standard(s). Appropriate that less emphasis is placed on number in grades 9-12.
1	Across		F	Benchmarks describe appropriate and sufficient content applicable to each year in the span. Though depth is not specifically articulated, it is inherent in the progression of types of numbers and relationships that students will learn within and across the spans.
2	K-4	F		
2	5-8	F		
2	9-12	F		
2	Across		F	Note that the language of the standard includes “data” which is not specifically mentioned in the benchmarks for standard 2, but provides a connection with standard 3.
3	K-4	P		Although it seems appropriate that K-4 students generate data based on chance devices (benchmark 3), analyzing and predicting may be beyond expectations for grade 4. Also, although generating some combinations of objects is reasonable for this span, students may not fully accomplish benchmark 4 as indicated by the example until they reach benchmark 3.5-8.7. Note that benchmark 2 lists only four concepts; thus it is unclear whether these are intended to represent examples or an exhaustive list. For example, specifying most often but not least often, no mention of least and most, or more and less. For the purposes of this review, it was not assumed to be an exhaustive list.
3	5-8	F		

Standard	Grade Span	Within span	Across span	Comments
3	9-12	F		Based on the examples provided, benchmarks 5 and 6 do not seem significantly different from grades 5-8 expectations.
3	Across		F	
4	K-4	F		
4	5-8	P		Benchmarks 4 and 5 could be addressed superficially, but rating assumes students experience varying depths of problems to be solved.
4	9-12	I		Not clear that these benchmarks describe content sufficiently beyond the grades 5-8 span.
4	Across		P	Expectation ceiling may be set too low, particularly in grades 9-12 span.
5	K-4	F		
5	5-8	P		Some benchmarks could be addressed superficially (e.g., benchmarks 1, 2, and 3), and benchmark 5 may be too specific (not sufficiently crossing the grade span) although overall depth could also be appropriate, depending upon implementation.
5	9-12	I		Not clear that these benchmarks describe content much beyond the grades 5-8 span. Only benchmark 1 seems to take previous benchmark 5.5-8.2 to a deeper level, and other two benchmarks may be too specific to sufficiently span the grades 9-12. [Note: It is not clear that benchmark 4 differs from the extended benchmark bullet below it.]
5	Across		P	Overall, depth does not seem as "deep" compared to other standards, but may be sufficient for this content, assuming limited emphasis in the upper grades.
6	K-4	F		
6	5-8	F		
6	9-12	I		Although students may be using real numbers, it is unclear if benchmarks 1 and 2 describe content much beyond the grades 5-8 span.
6	Across		P	Overall, depth does not seem as "deep" compared to other standards, but may be sufficient for this content, assuming limited emphasis in the upper grades.

Mathematics: Internal Quality Review

Coherence

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
1	K-4		F	
1	5-8		F	
1	9-12		F	
1	Across	F	F	
2	K-4		P	Limited in what is specified as appropriate for K-2.
2	5-8		F	
2	9-12		F	
2	Across	F	F	
3	K-4		N	Limited in what is specified as appropriate for K-2. Upper level of content in benchmarks 3 and 4 may be above grade 4.
3	5-8		F	
3	9-12		F	
3	Across	F	P	Content for grades K-4 may need more specificity regarding the starting points and ending points for benchmarks 3 and 4.
4	K-4		F	
4	5-8		F	
4	9-12		F	
4	Across	F	F	
5	K-4		F	
5	5-8		F	
5	9-12		F	[Note: It is not clear that benchmark 4 differs from the extended benchmark bullet below it.]

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
5	Across	F	F	
6	K-4		P	Limited in what is specified as appropriate for K-2.
6	5-8		F	
6	9-12		P	Endpoints for grade 12 may be too low; consider including content from the extended benchmarks. Since matrices are referenced in standard 2, may consider specifying operations with matrices.
6	Across	F	P	Although overall the sequencing seems appropriate, consider specifying content for grades K-2 and extending content for grades 11-12.

Mathematics: Internal Quality Review

Rigor

Standard	Grade Span	Rigor	Comments
1	K-4	F	
1	5-8	F	
1	9-12	F	
1	Across	F	Although statements are general and subject to interpretation, there are opportunities to provide the appropriate amount of rigor in student learning experiences.
2	K-4	F	
2	5-8	F	
2	9-12	F	
2	Across	F	Although statements are general and subject to interpretation, there are opportunities to provide the appropriate amount of rigor in student learning experiences.
3	K-4	P	Benchmarks 3 and 4 may contain content that requires more rigor than is appropriate for K-4.
3	5-8	F	
3	9-12	F	Rating assumes that benchmarks 5 and 6 include content that is more rigorously learned beyond what is indicated for grades 5-8.
3	Across	F	Although statements are general and subject to interpretation, there are opportunities to provide the appropriate amount of rigor in student learning experiences.
4	K-4	F	Benchmark 4.K-4.3 may need further clarification as to which geometric ideas are to be related to measurement and number sense.
4	5-8	F	May need more specification as to intention of benchmark 4.
4	9-12	P	Based on depth not being sufficiently evident, it is not clear that rigor is sufficient.
4	Across	P	Most benchmarks contain language that reflects appropriate rigor.

Standard	Grade Span	Rigor	Comments
5	K-4	F	Rigor seems appropriate for grade span.
5	5-8	P	Benchmark descriptions do not specify full range of rigor that might be expected in this grade span.
5	9-12	I	Two of the three benchmarks are too specific to sufficiently span grades 9-12, so insufficient evidence of appropriate level of rigor.
5	Across	I	There is insufficient evidence that there is an appropriate amount of rigor across the grade spans.
6	K-4	F	Rigor seems appropriate for grade span.
6	5-8	P	Benchmark descriptions do not specify full range of rigor that might be expected in this grade span.
6	9-12	I	Benchmark descriptions do not sufficiently describe range of rigor that might be expected in this grade span.
6	Across	I	There is insufficient evidence that there is an appropriate amount of rigor across the grade spans.

Mathematics: Internal Quality Review

Breadth

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
Across	K-4	F	F	F	Some essential content may be missing (see below).
1	K-4		F	F	Not apparent when/if students are comparing and/or using place value with rational numbers; not clear where money is introduced--as measurement or as number, for decimals.
2	K-4		F	F	Not apparent if skip counting is included in patterns (standard 2) or operations (standard 6); same for fact families and inverse relationships.
3	K-4		F	P	Benchmarks 3 and 4 may include content beyond grade 4 expectations. [Note: Benchmark 2 would be limited if it does not address concepts other than the four listed.]
4	K-4		F	F	Not clear if money is considered in standard 4 and/or standard 1. Not clear if content includes circles, angles and/or parallel/perpendicular lines.
5	K-4		F	F	
6	K-4		F	F	Not clear if properties of operations are included.
Across	5-8	F	F	F	Some essential content may be missing (see below).
1	5-8		F	F	The following is not apparent from the wording of the benchmarks: when/if students are comparing and/or using place value with rational numbers, especially with specificity of problem-solving situations; if rules of powers and roots are included; if order of operations is used in simplifying numerical expressions; whether problems in benchmark 6 involve operations (as in standard 6).
2	5-8		F	F	The following is not apparent from the wording of the benchmarks: if identity properties are included; if students are evaluating expressions by replacing variables, using order of operations.
3	5-8		F	F	

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
4	5-8		F	F	Not apparent if Pythagorean theorem is introduced or used, and whether this would be in geometry or measurement (standard 5); also consider 4.5-8.5 may be a measurement concept and included in 5.5-8.4.
5	5-8		F	F	Not clear if elapsed time and/or conversions with measures are included.
6	5-8		F	F	Not clear if properties of operations and/or order of operations are included.
Across	9-12	F	F	F	Some essential content may be missing (see below).
1	9-12		F	F	Not clear if problems mentioned in 1.9-12.3 include operations, and may better fit in standard 6.
2	9-12		F	F	Not clear if operations with rational expressions and/or operations with polynomials or simplifying polynomials is included; also unclear whether informal solving of simultaneous equations is included.
3	9-12		F	F	
4	9-12		F	F	May consider including third bullet of extended benchmarks for all students.
5	9-12		F	F	
6	9-12		P	F	May need further specificity to distinguish from grade 5-8 content, other than using real numbers; also consider operations with matrices.
Across	Across	F	F	F	Some essential content may be missing (see above).
1	Across		F	F	Some essential content may be missing (see above).
2	Across		F	F	Some essential content may be missing (see above).
3	Across		F	F	Some essential content may be missing (see above).
4	Across		F	F	Some essential content may be missing (see above).
5	Across		F	F	Some essential content may be missing (see above).
6	Across		F	F	Some essential content may be missing (see above).

Appendix H: Mathematics: External Referent Review— Massachusetts
External Referent: Massachusetts Mathematics Curriculum Framework (November 2000) and Supplement to Massachusetts Mathematics Curriculum Framework (May 2004)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Both sets of documents have grade span articulation.	MA provides seven 2-year grade spans for preK through grade 12, whereas CO has three grade spans of 4 or 5 years each. MA also provides grade level standards for grades 3, 5, and 7, and single-year course standards for Algebra I, Geometry, Algebra II, and Precalculus, which are offered in grades 7 through 12.	More different than similar.
Hierarchy of Standards	CO's six standards cross all grade spans and correspond to MA's five content strands, which cross grades K–12. For each of the six standards, CO has between 3 and 7 benchmark statements describing what students should be able to do. For each of the five content strands in spans preK–12, MA has between 1 and 18 standards statements describing what students should be able to do.	CO's six standards provide text with no heading (label), whereas MA's strands are labeled, and often followed by brief descriptions of broad concepts in the strand.	Though named differently—CO's Standards and Benchmarks corresponding to MA's Strands and Standards—the hierarchy of the standards is primarily similar. For each standard, MA also provides checklists of Exploratory Concepts and Skills, often followed by Selected Problems and Classroom Activities. Many of the MA course-specific standards are cross-referenced to the grade span standards.
Number of Standards		In grade spans preK–12, MA has 241 standards that students are expected to meet, with an additional 20 course-specific standards, whereas CO has 86 benchmarks that all students are expected to meet, with an additional 20 benchmarks for higher mathematics.	

Subcategory	Similarities	Differences	Comments
Number of Standards (Continued)		In K–4, MA has 100 standards: preK–K: 20; grades 1–2: 36; grades 3–4: 44. Across K–4, CO has 28 benchmarks. In grades 5–8, MA has 82 standards: grades 5–6: 43; grades 7–8: 39. Across grades 5–8, CO has 34 benchmarks. In grades 9–12, MA has 59 standards: grades 9–10: 30; grades 11–12: 29. Across grades 9–12, CO has 24 benchmarks for all students. In grades 9–12, MA has an additional 20 standards: Algebra I: 3; Geometry: 7; Algebra II: 1; Precalculus: 9. Across grades 9–12, CO has 20 benchmarks for students going beyond the 24 benchmarks for all students.	MA also has grade-specific standards for grade 3, which are a subset of the grades 3–4 span. MA also has grade-specific standards for grade 5, which are a subset of the grades 5–6 span, and grade 7 standards, which are a subset of the grades 7–8 span. In MA, Algebra I has a total of 19 standards, 18 of which are also standards in the grade spans; Geometry has 23 standards, 16 of which are also standards in the grade spans; Algebra II has 20 standards, 19 of which are also standards in the grade spans; Precalculus has 20 standards, 11 of which are also standards in the grade spans.
Design/Format		MA's standards statements are presented in a variety of ways: by strand for grades preK through 6, and by grade spans and by course for grades 7 through 12, with strand names (and descriptions) separating standards. An appendix also presents standards by grade span for grades preK through 6, with bulleted statements listed beneath each strand name. CO's benchmarks are arranged by standard, with benchmarks for each grade span.	A teacher using the MA document can easily see the standards for which his students are responsible within a 2-year span and also know how the strands develop or progress across preK through grade 6. Course standards and grade-level standards for grades 3, 5, and 7 are also specified.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)	Each document provides rationale for the standards/benchmarks or the grade span strands, and a glossary of terms.	MA's statements are uniquely labeled for each strand within each grade span. The first letter or number designates the final grade in the grade span or course name. The second letter designates the strand, and the final number represents the order of that standard within the strand. CO's benchmark statements are numbered consecutively within a grade span, for each standard; but numbers begin at 1 for each new standard and grade span. That is, there are three benchmarks numbered "1" for each standard, one in each of the grade spans. There is no way to distinguish which grade span a benchmark statement represents based on its number, as presented in the document. MA's grade span and course standards are much more specific and detailed than CO's benchmarks. The MA document is 131 pages, whereas CO's document is 18 pages, only six of which are for the standards; most of the others, for history, rationales, glossary, and index. MA provides an overview of the strands. Checklists of exploratory concepts and skills, and sample activities, accompany strands by grade span. Appendices include Criteria for Evaluating Instructional Materials and Programs, a Glossary, and Internet Resources, followed by References and Selected Bibliography.	A teacher using the CO document can readily see the progression of the standards, but must go to each standard and find the benchmarks for her grade span to know the type of learning her students need—though more specific learning experiences for her students must still be determined. For example, MA's statement labeled 4.G.5 is the 5th Geometry standard in the set of standards for the grade 3–4 span. For a CO benchmark numbered "3," there is no way to know which standard or grade span it represents without finding the benchmark in the document. Using just the MA document, a teacher may have a better idea what the curriculum should look like, at least in the grade span, whereas the CO teacher needs additional documents. Overall, the design/format of the documents is more different than similar.

External Referent: Massachusetts Mathematics Curriculum Framework (November 2000) and Supplement to Massachusetts Mathematics Curriculum Framework (May 2004)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1 (Number)	In both sets of standards, about one-sixth of the MA standards and CO benchmarks represent Standard 1, with fairly heavy emphasis in grades K–8, and generally decreasing as grade spans increase.	In the upper grade spans in MA, there is a sharper decrease in emphasis on number than in CO. CO may place greater emphasis than MA on benchmarks 5 and 6 in grade span 5 –8. MA specifies use of symbols for comparisons and includes decimals in the K–4 span, and continues with place value in the 5–8 span. Absolute value and scientific notation occur in MA grade span 7-8, but not until 9–12 in CO.	MA combines number and operations into one strand. In CO, these are separate standards—Standards 1 and 6. To separate number from operations, MA standards were mapped to both Standards 1 and 6. Overall, the emphasis of the standards seems more similar than different.
Standard 2 (Algebra)	For both MA and CO, emphasis on algebra increases as the grade spans increase.	Across the grades, about one-fourth of MA standards relate to algebra, whereas about one-sixth of CO's benchmarks focus on algebra. MA is more specific about inequalities and writing closed equations in the lower grades, in evaluating expressions and identifying properties (including identities) in the middle grades, and in simplifying and operations with polynomials in the upper grades.	Overall, the emphasis of the standards seems more different than similar, given the specificity of the MA standards with concepts such as developing meaning for slope, zeros of a function, etc. CO's broader benchmarks likely include such concepts, but not based on this document alone.
Standard 3 (Data and Statistics)	In general, emphasis on data and statistics increases as the grade spans increase.	Overall, MA places less emphasis on data and statistics than CO. For CO, benchmarks for this standard represent one-fifth of the standards, whereas for MA, the strand contains about one-eighth of the standards. CO develops concepts of measures of central tendency earlier than MA, as well as formulating hypotheses and making convincing arguments. MA places less emphasis on probability.	Overall, the emphasis of the standards seems more different than similar, though the content covered is similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 4 (Geometry)	Across the grade spans, MA designates about one-fifth of its standards for geometry, with increased emphasis in grades 9–10. CO also designates about the same amount of its benchmarks (about one-sixth) to geometry at each grade span.	In the middle grades, benchmark 5 (solving problems involving perimeter, area, surface area, and volume) is addressed in MA with measurement standards. MA also specifies perspective drawings and maps in its middle- grade geometry standards, as well as use of vectors in the upper grades.	Overall, the emphasis of the standards seems more similar than different.
Standard 5 (Measurement)	Overall, MA and CO designate about the same amount of their benchmarks (about one-sixth in CO and one-eighth in MA) to measurement, with decreased emphasis at grades 9–12.	CO students in grades K–4 spend more time developing sense of measurement using approximate measures of familiar objects, and middle-grade students may have more emphasis on reading and interpreting various scales. MA does not specify that students learn to describe how a change in linear measurement affects its perimeter, area, or volume until grade span 9–10. MA also does not specify that upper-grade students determine the degree of accuracy of a measurement.	Overall, the emphasis of the standards seems more similar than different.
Standard 6 (Operations and Computations)	In both sets of standards, about one-sixth of the MA standards and CO benchmarks represent Standard 6, with heavy emphasis in grades K–8, and generally decreasing as grade spans increase.	In the upper grade spans in MA, there is a sharper decrease in emphasis on operations than in CO. MA is more specific with counting with money, skip counting, and using inverse relationships, properties of operations, order of operations, and rules of powers and roots to solve problems. CO may place greater emphasis than MA on using models to explain how ratios, proportions, and percents can be used to solve real-world problems, whereas MA may be more formal in the middle grades, and develop the concepts earlier.	MA combines number and operations into one strand. In CO, these are separate standards—Standards 1 and 6. To separate number from operations, MA standards were mapped to both Standards 1 and 6. Overall, the emphasis of the standards seems more similar than different.
Grades K–4	Across the CO standards, there is a high degree of similarity in content with the K–4 grade span benchmarks and MA standards. Almost all of the 28 benchmarks contain content that corresponds to at least one MA standard statement in grade spans preK	In this grade span, CO designates about the same number of benchmarks (4 or 5) to each standard. MA designates the fewest number of its standards (about one-tenth) to its data strand (CO Standard 3) and the most (about one-fifth) to its geometry strand (CO	There seems to be a high amount of overlap between MA standards in grades preK-4 and the content described in CO benchmarks, though the emphasis may vary; consider the grade span content more similar than different.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades K–4 (continued)	through 4. Comparing MA's Number & Operations strand with CO by combining Standard 1 (Number) and Standard 6 (Operations), both sets of standards put the greatest emphasis (about two-fifths) on these concepts.	Standard 4), not including its number and operation strand. Not explicitly covered by MA standards: interpreting data using concepts of central tendency, recognizing geometry in their word, using approximate measures of familiar objects to develop a sense of measurement.	
Grades 5–8	Across the CO standards, there is a high degree of similarity in content with the grade span 5-8 benchmarks and MA standards. Almost all of the 34 benchmarks contain content that corresponds to at least one MA standard statement. Comparing MA's Number & Operations strand with CO by combining Standard 1 (Number) and Standard 6 (Operations), both sets of standards put the greatest emphasis (about one-third) on these concepts.	In this grade span, CO designates about the same number of benchmarks (5 to 7) to each of the other standards (2, 3, 4, and 5). MA designates the least amount (about one-tenth) to its data strand (CO Standard 3) with algebra (CO Standard 2) and geometry (CO Standard 4) each containing about one-fifth of the standards. Some concepts possibly better covered, or at least specified, in MA standards include place value with decimals, absolute value, the Pythagorean theorem, identity properties, order of operations, and simplifying numerical and variable expressions.	There seems to be a high amount of overlap between MA standards in grades 5 through 8 and the content described in CO benchmarks, though the emphasis may vary; overall, the grade span content is more similar than different.
Grades 9–12	Across the CO standards, there is similarity in content with the grade span 9-12 benchmarks and MA standards. Almost all of the 24 benchmarks contain content that corresponds to at least one MA standard statement. Both MA and CO de-emphasize number and operations in this span. However, in MA, the strand involves only about one-tenth of the standards, whereas in CO about one-fourth of the benchmarks address Standard 1 (Number) and Standard 6 (Operations) combined.	In this grade span, about one-fourth of the CO benchmarks address data and statistics, about one-fifth address algebra, one-sixth address geometry, and one-eighth address measurement. MA puts most emphasis on algebra (over one-third) and on geometry (over one-fourth). MA puts less emphasis on data and statistics (about one-sixth) and measurement (about one-tenth).	Of the three grade spans, it is less clear that there is similar emphasis in content for grades 9–12. Although there is overlap in content, the two sets of standards are more different than similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades	Both documents reinforce connections to problem solving and communication: MA prefaces each of its strands with "Students engage in problem solving, communicating, reasoning, connecting, and representing as they:" and CO ends each standard statement with "…in problem-solving situations and communicate the reasoning used in solving these problems." CO's six standards cross all grade spans and correspond to MA's five content strands, which cross grade spans preK–12: Standard 1 ↔ Number Sense and Operations (about half); Standard 2 ↔ Patterns, Relations, and Algebra; Standard 3 ↔ Data Analysis, Statistics, and Probability; Standard 4 ↔ Geometry; Standard 5 ↔ Measurement; Standard 6 ↔ Number Sense and Operations (about half). In K–12, most CO benchmarks seem related to at least one MA standard in the grade span, and vice versa.		More similar than different.
Wording/specificity		MA's standards have a high degree of specificity, whereas CO's benchmarks are typically quite broad to encompass content across the grade spans. Thus, it is not always apparent where concepts such as order of operations, rules of powers and roots, properties of operations, or complex numbers are covered in the CO standards. Especially in grades 9–12, MA standards seem more academically oriented, and most of these standard statements also appear in MA's course-specific standards.	More different than similar.

Appendix I. Mathematics: External Referent Review— Virginia
External Referent: Mathematics Standards of Learning for Virginia Public Schools (October 2001)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation		VA has standards for nine grades (K–8) and for 10 courses for high school, whereas CO has benchmarks in three grade spans: K–4, 5–8, and 9–12.	More different than similar.
Hierarchy of Standards	CO's six standards cross all grade spans and correspond to VA's six content strands, which cross grades K–8. For each of the six standards, CO has between three and seven benchmark statements describing what students should be able to do. For each of the six content strands in grades K–8, VA has between one and ten standards statements describing what students should be able to do.	CO's six standards provide text with no heading (label) without additional text, whereas VA's strands are labeled. Many of VA's standards statements are further detailed with between two and six statements including additional context or content.	Though named differently—CO's standards and benchmarks corresponding to VA's Strands and Standards—the hierarchy of the standards is primarily similar.
Number of Standards		Overall, VA has 249 standards that most students are expected to meet, with an additional 122 standards for higher mathematics courses, whereas CO has 86 benchmarks that all students are expected to meet, with an additional 20 benchmarks for higher math. In K–4, VA has 112 standards: K: 18; grade 1: 21; grade 2: 26; grade 3: 25; grade 4: 22. Across K–4, CO has 28 benchmarks. In grade 5–8, VA has 85 standards: grade 5: 22; grade 6: 23; grade 7: 22; grades 8: 18. Across grade 5–8, CO has 34 benchmarks.	More different than similar.

Subcategory	Similarities	Differences	Comments
Number of Standards (Continued)		In grade 9–12, VA has 52 standards for courses that most students are expected to take: Algebra I: 18; Geometry: 14; Algebra II: 20. Across grades 9–12, CO has 24 benchmarks for all students. In grades 9–12, VA has an additional 122 standards for higher math: Trigonometry: 9 for one semester; Algebra II & Trigonometry: 29; Computer Math: 20; Probability & Stat.: 21, or 12 if one semester; Discrete Math: 13, or 7 if one semester; Math Analysis: 13; AP Calculus: 17. Across grades 9–12, CO has 20 benchmarks for students going beyond the 24 benchmarks for all students.	

Subcategory	Similarities	Differences	Comments
Design/Format	Neither VA nor CO documents provide numbering of statements that designates the content area the statement describes. Each document provides some rationale for the standards/benchmarks or the grade level set.	VA's standards statements are presented by grade level, with strand names separating standards, whereas CO's benchmarks are arranged by standard, with benchmarks for each grade span. VA's standards statements are numbered consecutively within each grade, with the first letter or numeral designating the grade level or course name. CO's benchmark statements are numbered consecutively within a grade span, for each standard; however, numbers begin at 1 for each new standard and grade span. That is, there are three benchmarks numbered "1" for each standard, one in each of the grade spans. There is no way to distinguish which grade span a benchmark statement represents based on its number, as presented in the documents. VA's grade level standards are much more specific and detailed than CO's benchmarks. The VA document is 64 pages, whereas CO's document is 18 pages, only six of which are for the standards; most of the others are for history, rationales, glossary, and index.	More different than similar. A teacher using the VA document can easily see the standards for which his students are responsible, but not know how the strands develop or progress across the grades. A teacher using the CO document can readily see the progression of the standards, but she must go to each standard and find the benchmarks for her grade span to know the type of learning her students need—though more specific learning experiences for her students must still be determined. For example, VA's statement labeled K.15 indicates that it is the 15th standard in the set of Kindergarten standards, but does not indicate that it is in the Probability and Statistics strand, nor that it is the second Kindergarten standard in that strand. For a CO benchmark numbered "3," there is no way to know which Standard or grade span it represents without the document. Using just the document, a VA teacher may have a better idea what the curriculum should look like, whereas the CO teacher needs additional documents.

External Referent: Mathematics Standards of Learning for Virginia Public Schools (October 2001)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1 (Number)	In grades K-8, reading, writing, and ordering of numbers are emphasized by VA standards and CO benchmarks. In both sets of standards, about one-fifth of the VA standards and one-sixth of the CO benchmarks represent Standard 1, with fairly heavy emphasis in grades K–4, and generally decreasing as grade levels/spans increase.	Across the grades, VA does not emphasize using number sense for estimation and justification. VA standards are more specific about finding equivalences, comparing numbers, and simplifying numerical expressions. CO benchmarks are more specific about applying concepts in problem-solving contexts.	Though emphasis is comparable, it is more different than similar due to the specificity of VA standards.
Standard 2 (Algebra)	Both documents focus on patterns, relationships, and functional relationships across grades K–8, designating about one-seventh to one-eighth of the total number of standards/benchmarks to algebraic content.	VA has less emphasis in grades K–4 (about one-tenth) than does CO (about one-seventh), but increases in grades 5–8, (about one-fifth), whereas CO has about the same amount in grades 5–8 as in K–4. In 9–12, algebra represents about one-fifth of the CO benchmarks, whereas VA has two one-year courses specifically on algebra, and additional coverage in the precalculus course. VA is more explicit about evaluating and simplifying expressions, and using correct order of operations.	Emphasis is more similar than different.
Standard 3 (Data and Statistics)	Overall, VA standards seem directly related to CO benchmarks across the grades, with increasing emphasis as the grade spans/levels increase.	Overall, VA places less emphasis on data and statistics than CO. In grades K–8, CO designates about one-fifth of its benchmarks to this standard, whereas VA designates about one-eighth of its standards to this strand. In grades 9–12, about one-fourth of the CO benchmarks address data and statistics, and VA offers a one-year	Emphasis is generally more similar than different in grades K–8.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 3 (Data and Statistics) (Continued)		course, with some data and statistics content also present in other courses. CO puts more emphasis on evaluating arguments based on statistical claims for erroneous conclusions or distortions.	
Standard 4 (Geometry)	Overall, VA standards seem directly related to CO benchmarks across the grades. Across the grades K–8, VA designates about one-seventh to one-sixth of its standards for geometry, with increased emphasis in grades 9–10. CO also designates about the same amount of its benchmarks to geometry at each grade span.	In grades K–8, CO may put more emphasis on recognizing geometry in the world and solving problems involving perimeter, area, surface area, and volume. In grades 9–12, geometry benchmarks continue representing about one-sixth of the content. VA has a one-year geometry course.	Emphasis is more similar than different.
Standard 5 (Measurement)	Across the grades, both documents emphasize knowing, using, describing and estimating measures, using both direct and indirect measurements, with each having about one-fifth of the standards/benchmarks dealing with measurement.	Across grades K–4, VA designates about one-fourth of its standards to measurement, decreasing to just over one-sixth in grades 5–8, whereas CO has about one-fifth at both grade spans. In grades 9–12, CO designates about one-eighth of its benchmarks to measurement, which are only linked to once by VA's Geometry course standards. VA standards are more explicit about money, time (elapsed), and conversions within and between standard and metric measures. VA high school courses show very little overlap with CO benchmarks.	Emphasis is more similar than different in grades K–8.
Standard 6 (Operations and Computations)	Both documents specify fluency in basic operations across grades K–8, with VA being more detailed about various procedures.	In grades K–4, CO designates about one-fifth of the benchmarks to operations, and decreases to about one-eighth in both grade spans 5–8 and 9–12. VA designates about one-sixth of its standards across K–8. Only a few VA standards in Algebra I and geometry address a CO benchmark.	In grades K–8, emphasis is com[arable however it is a bit more different than similar due to specificity of VA standards. In 9–12, there is very little overlap in content.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 6 (Operations and Computations) (Continued)		Problem-solving context, reasonable answers, and also the use of algorithms may be more explicit in the CO benchmarks. CO also puts more emphasis on estimation strategies and when to use estimation instead of an exact answer. VA is more specific about properties of operations and order of operations. VA high school courses show very little overlap with CO benchmarks.	
Grades K–4	Across the CO standards, there is a high degree of similarity in content with the K–4 grade span benchmarks and VA standards. Almost all of the 28 benchmarks contain content that corresponds to at least one VA standard statement in grades K-4. CO Standards 1 (Number) and 5 (Measurement) seem well represented by VA standards, which designate about one-fourth of the standards to each of these strands.	In this grade span, CO designates about the same number of benchmarks (4 or 5) to each standard. VA designates the fewest number of its standards (about one-tenth) to its Data strand (CO Standard 3) and to its Algebra strand (CO Standard 2). About one-sixth of the VA standards are designated in the Operations strand (CO Standard 6) and the Geometry strand (CO Standard 4). Possibly not explicitly covered by VA standards is selecting algorithms for computing with whole numbers in problem solving situations.	Of the three grade spans, K–4 may have the greatest relationship to VA standards, and these are more similar than different.
Grades 5–8	Across the CO standards, there is a high degree of similarity in content with the grade 5–8 grade span benchmarks and VA standards. Almost all of the 34 benchmarks contain content that corresponds to at least one VA standard statement.	In this grade span, VA designates about the same number of standards to each of the strands (from one-seventh to just over one-sixth), whereas CO designates the least, about one-eighth, to Operations and the most (about one-fifth) to Data and Statistics. The VA standards put less emphasis on standards 2 (Algebra) and 5 (Measurement) as described by CO benchmarks.	There seems to be a fairly high amount of overlap between VA standards in grades 5-8 and the content described in CO benchmarks, and these are more similar than different.
Grades 9–12	Almost all of CO's 24 benchmarks contain content that corresponds to at least one VA standard statement. There is a high degree	In this grade span, about one-fourth of the CO benchmarks address data and statistics, about one-fifth address algebra, one-sixth	There is least overlap of CO benchmarks in this span with VA course standards for Algebra I, Geometry, Algebra II, and

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 9–12 (Continued)	of overlap with the algebra benchmarks based on VA course standards for Algebra I and II and also with CO's data and statistics benchmarks based on VA's Probability and Statistics course standards and Geometry. Geometry benchmarks are also covered by course standards in geometry.	address geometry, and one-eighth address measurement. VA provides course-specific standards for several courses, several of which exceed CO's 9–12 benchmarks. There is less overlap in content between VA standards and CO's benchmarks for Standard 1 Number, and Standard 5 Measurement.	Probability and Statistics. These may be more different than similar.
Across All Grades	VA describes five goals for students: becoming mathematical problem solvers, communicating mathematically, reasoning mathematically, making mathematical connections, and using mathematical representations to model and interpret practical situations. In the CDE website's html version of their mathematics standards, CO describes six goals, the first four of which are the same as VA's goals: become mathematical problem solvers, learn to communicate mathematically, learn to reason mathematically, make mathematical connections, become confident of their mathematical abilities, and learn the value of mathematics. For both states, problem solving is woven throughout their standards. CO's six standards cross all grade spans and correspond to VA's six content strands, which cross grades K–8: Standard 1 ↔ Number and Number Sense; Standard 2 ↔ Patterns, Functions, and Algebra; Standard 3 ↔ Probability and Statistics; Standard 4 ↔ Geometry; Standard 5 ↔ Measurement; Standard 6 ↔ Computation and Estimation	In grades 9–12, CO continues its six standards, whereas VA offers courses that emphasize various strands, and do not incorporate all six strands.	These are more similar than different.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades (Continued)	In K–8, most CO benchmarks seem related to at least one VA standard in the grade span, and vice versa.	In grades 9–12, there is less evidence of overlap or similar emphases in content.	
Wording/Specificity		VA's standards have a high degree of specificity, whereas CO's benchmarks are typically quite broad to encompass content across the grade spans. For CO benchmarks that are more specific, there was less or no overlap with VA standards. For example, in grade 5–8 Standard 2, benchmark 4 may be too specific; likewise with Standard 5, benchmark 5.	More different than similar.

Appendix J. Mathematics: External Referent Review— Finland
External Referent: National Core Curriculum for Basic Education 2004 (Finland) and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Finland and CO articulate objectives/Core Content and benchmarks in three grade spans.	Finland lists objectives, core content, and descriptions of good performance for three grade spans: grades 1–2, 3–5, and 6–9. Beyond 9th grade, Finland provides syllabi for courses in advanced mathematics (10 compulsory and 3 specialization) and in basic mathematics (6 compulsory and 2 specialization) listing Objectives and Core Content topics. The compulsory courses likely require one quarter or semester to be completed. CO has benchmarks in three grade spans: K–4, 5–8, and 9–12.	More different than similar.
Hierarchy of Standards	CO's six standards cross all grade spans and correspond to Finland's five content areas, which cross grades 1–9. Bullet points in Finland's Objectives and Core Content (and Descriptions of Good Performance in grades 1–9) correspond to CO's benchmarks. For each of the six standards, CO has between 3 and 7 benchmark statements describing what students should be able to do from grade K through 12. For each core content area in grades 1–9, Finland has between 2 and 13 bulleted statements describing what students will experience and should be able to do.	Finland's core content areas are labeled separately and grouped differently across the grade spans. CO's six standards provide text with no heading (label) at each grade span.	More similar than different.
Number of Standards		Considering only the statements of Core Content in grades 1–9, and compulsory courses in Advanced Math (which generally subsume the Objectives and Core Content for compulsory Basic Math), Finland has	More different than similar.

Subcategory	Similarities	Differences	Comments
Number of Standards (Continued)		173 Core Content statements: 24 in grades 1–2, 34 in grades 3–5, 56 in grades 6–9, and 59 in the 10 advanced mathematics courses. An additional 19 Core Content statements describe Finland's 3 upper level specialization courses. CO has 86 benchmarks that all students are expected to meet—28 in grades K–4, 34 in grades 5–8, and 24 in grades 9–12—with an additional 20 benchmarks for students who extend their studies to include higher math.	
Design/Format	Neither Finland nor CO documents provide numbering of statements or other labeling techniques that designate the content area the statement describes.	Finland's Core Content statements are presented by grade span with content area names separating the bulleted statements, whereas CO's benchmarks are arranged by standard, with benchmarks for each grade span. Finland prefaces the Core Content statements with bulleted Objectives, and in grades 1–9, the Core Content statements are followed by bulleted Descriptions of Good Performance at the end of each grade span. These additional statements provide teachers with further understanding of what is expected of their students for assessment purposes. Finland's statements are presented as bullet points. CO's benchmark statements are numbered consecutively within a grade span, for each standard, but numbers begin at 1 for each new standard and grade span. That is, there are three benchmarks numbered "1" for each standard, one in each of the grade spans. There is no way to distinguish which grade span a benchmark statement represents based on its number, as presented in the documents.	A teacher using the Finland document can easily see the standards for which his students are responsible, but not know how the strands develop or progress across the grades. A teacher using the CO document can readily see the progression of the standards, but she must go to each standard and find the benchmarks for her grade span to know the type of learning her students need—though more specific learning experiences for her students must still be determined.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)		Finland's Core Content statements are more specific and detailed than CO's benchmarks, particularly in the high school content. However, Finland only lists the Core Content topics without detailing what the students are to do with the topics. The number of pages directly related to mathematics in the Finland documents (over 315 pages for grades 1–9, including all subject areas and several appendices) is 10 pages in grades 1–9 and 11 pages for the advanced and basic math upper-grade courses, including both compulsory and specialization courses. CO's document is 18 pages, only six of which are for the standards; most of the others are for history, rationales, glossary, and index.	Using just the document, a Finnish teacher may have a better idea what the curriculum should look like, whereas the CO teacher may need additional documents. Overall, the design/format of the documents is more different than similar.

External Referent: National Core Curriculum for Basic Education 2004 (Finland) and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1 (Number)	CO and Finland place emphasis on Number in grades K–8 and grades 1–9, respectively, with decreasing emphasis as grade spans increase. In these grades, about one-sixth of both CO's benchmarks and Finland's Core Content topics address Standard 1.	Finland may introduce multiplication and division concepts earlier than CO (as indicated in grades 1–2 core content) and is more specific about using parentheses and simplifying expressions. In grades 10–12, none of Finland's Core Content topics in advanced or basic mathematics directly address any of CO's three grades 9–12 benchmarks. However, the first two of the three benchmarks are well represented in Finland's grades 6–9 Core Content topics. Across the grades, Finland does not emphasize using number sense for estimation and justification, and CO benchmarks are more specific about applying concepts in problem-solving contexts.	Finland combines number and calculations under one category, whereas CO separates the content into Standards 1 and 6. Overall, emphasis is more similar than different
Standard 2 (Algebra)	In both sets of standards/core content, the emphasis on algebra increases as grade spans increase.	In grades 1–5, Finland designates about one-tenth of its core content to sequences, ratios, and correlations, whereas CO, in grades K–4, designates more (about one-seventh) of its benchmarks to patterns and relationships. In the middle grades the emphasis reverses: In grades 6–9, Finland includes a content area of Functions in addition to the Algebra core content, together representing almost one-third of the core content in that span. However, in grades 5–8, CO continues to designate about one-seventh of its benchmarks to algebraic methods. Of Finland's core content statements in grade	Emphasis is more different than similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2 (Algebra) (Continued)		10–12 courses that address CO 9–12 benchmarks, over one-half emphasize algebra, whereas in CO, about one-fifth of the 9–12 benchmarks address algebra. Finland is more explicit about content including exponential expressions, operations with polynomials, and solving incomplete quadratic equations. CO is more explicit about problem-solving contexts and distinguishing between linear and non-linear functions.	
Standard 3 (Data and Statistics)	In the lower grades, both Finland and CO designate about one-seventh of their core content or benchmarks to data and statistics. In grades 9–12, CO designates about one-fourth of its benchmarks to data and statistics and, of Finland's core content statements in grades 10–12 courses that address CO 9–12 benchmarks, over one-fifth emphasize this content.	In the middle grades, CO increases its emphasis to about one-fifth, whereas Finland's emphasis decreases to about one-tenth of its core content. Also, Finland's emphasis changes somewhat, as indicated by the labels across the grade spans: Finland labels this core content as Data Processing and Statistics in grades 1 and 2; labels it as Data Processing, Statistics, and Probability in grades 3–5; and labels it as Probability and Statistics in grades 6–9. CO has more emphasis on evaluating arguments based on statistical claims in the middle grades and analyzing claims for erroneous conclusions or distortions in upper grades. Finland's core content also addresses storing data, which is more along the lines of data processing.	Overall, emphasis is more similar than different.
Standard 4 (Geometry)		In grades 1–2, about one-fourth of Finland's core content represents geometry; in grades 3–9, geometry is combined with measurement, which together represent between one-third and one-fourth of the core content, indicating that the emphasis on geometry decreases as grades increase from grades 1–9. In grades 10–12, Finland	Although content areas do overlap, emphasis is more different than similar, given the specificity of Finland's content lists.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 4 (Geometry) (Continued)	There is considerable overlap between CO grades 5–8 benchmarks and Finland's grade 6–9 core content.	designates about one-fifth of its core content to geometry. CO designates about one-sixth of its benchmarks to geometry at each grade span. In grades 1–2, Finland core content specifies basic geometric concepts that include point, line segment, horizontal line, ray, straight line, and angle; and by grade 5, core content includes rays, circles and their ports, parallel and perpendicular lines, and more about angles and the Pythagorean theorem. These are concepts that either are not directly specified or may come later in CO benchmarks. In grades 10–12, Finland provides core content for three geometry-related courses: Geometry, Analytical Geometry, and Vectors.	
Standard 5 (Measurement)	Measurement represents about one-fifth of Finland's core content across grades 1–5, and one-sixth in grades 6–9, allowing that geometry and measurement are combined in grades 3–9. This is similar to CO, where one-fifth of the benchmarks address measurement in K–8, and about one-eighth in 9–12.	In grades 1–2, Finland core content specifies basic measurement concepts that include surface area, volume, and price, which may be addressed later in CO standards. In grades 3–5, Finland core content includes conversion of units of measurement, directly references circumference and circles, and expects students to be able to dilate and reduce figures by a given ratio. CO is more specific about reading and interpreting scales, and describing how a change in a linear dimension affects perimeter, area, and volume. In grades 9–12, only one of CO's three benchmarks seems directly related to specific core content in Finland's grades 6–9 or 10–12.	Although content areas do overlap, emphasis is more different than similar, given specificity of Finland's content lists.
Standard 6 (Operations and Computations)	In grades K–4, CO designates about one-fifth of the benchmarks to operations, and decreases to about one-eighth in grade spans 5–8 and 9–12. Although Finland combines calculations with number, it can	Finland's core content is more specific as to concepts such as time calculations and time intervals, reduction of expressions, order of operations, and rounding. CO puts more emphasis on estimation strategies and when	Although content areas do overlap, emphasis is more different than similar, given specificity of Finland's content lists.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 6 (Operations and Computations) (Continued)	be estimated to have about one-eighth of the core content topics on calculations in grades 1–9. Every CO benchmark in this standard is addressed by at least one core content topic in grades 1–9, although there may be no direct matches for CO 9–12 benchmarks with Finland grades 10–12 content.	to use estimation instead of an exact answer.	
Grades K–4	Across the CO standards, there is a fair amount of similarity in content with the K–4 grade span benchmarks and Finland's grades 1–2 and 3–5 core content topics. Most of the 28 benchmarks contain content that corresponds to at least one Finland core content topic listed in grades 1–5. Standards 1 (Number) and 6 (Operation) are well represented by both CO and Finland.	Finland puts about half the emphasis as CO does on Standards 2 (Algebra) and 3 (Statistics), and about twice the emphasis on Standards 4 (Geometry) and 5 (Measurement).	Although there is overlap in content, emphasis in this grade span may be more different than similar.
Grades 5–8	Across the CO standards, there is a fair amount of similarity in content with the grades 5–8 grade span benchmarks and Finland's grades 3–5 and 6–9 spans. Most of the 34 benchmarks contain content that corresponds to at least one Finland core content topic listed in grades 3–9.	In this grade span, Finland introduces a new topic: Thinking Skills and Methods, which contains seven core content subtopics. About half of these are included in CO's Standard 3, but subtopics such as history of mathematics, use of tools and drawings that assist thinking, and interpretation and production of mathematical texts are not specified in CO's benchmarks. Another new topic Finland includes is Functions, separate from Algebra. Combining these two topics, Finland designates about one-third of its core content to what best correlates to CO's Standard 2, which represents about one-sixth of CO's grade 5–8 benchmarks. CO designates about one-fifth of its benchmarks to Standard 3 (Data), where as Finland designates about one-tenth. Geometry and Measurement are combined in Finland at this span and represent about one-fourth of the core content, whereas in CO these two standards together represent over one-third of the benchmarks.	Although there is overlap in content, emphasis in this grade span is more different than similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 9–12	Almost all of CO's 24 benchmarks contain content that corresponds to at least one core content topic in Finland grades 1–9. There is a high degree of overlap between CO Standards 2 (Algebra) and 4 (Geometry) benchmarks and some Finland grade 10–12 courses.	There is limited overlap between Finland grade 10–12 courses and CO Standards 3 (Data) and 5 (Measurement), and no overlap with Standards 1 (Number) and 6 (Operations).	Although there is overlap in content, emphasis in this grade span is more different than similar.
Across All Grades	Both Finland and CO emphasize problem solving, though Finland's documents may be less specific in putting these in the core content statements themselves, wanting students to "derive satisfaction…solving problems" whereas CO states this in the text of each standard. The introduction to Finland's grades 1–9 core content topics states "The instruction is to develop the pupil's creative and precise thinking, and guide the pupil in finding and formulating problems, and in seeking solutions to them." The introduction to Finland's advanced courses syllabi states that teaching should be organized "to inspire students to ask questions, make assumptions and draw conclusions based on their observations, and to justify these." This corresponds to the intent of some CO benchmarks as well. In K–8, most CO benchmarks seem related to at least one Finland core content topic in grades 1–9, and vice versa.	Finland's documents may embed their mathematics core content and syllabi within seven integration and cross-curricular themes including: Growth as a person; Cultural identity and internationalism; Media skills and communication; Participatory citizenship and entrepreneurship; Responsibility for the environment, well-being, and a sustainable future; Safety and traffic; and Technology and the individual. In grades 9–12, CO continues its six standards, whereas in grades 10–12 Finland offers courses that emphasize some of the topics. In grades 9 –12, there is less evidence of overlap or similar emphases in content.	Although there is overlap in content, emphasis on non-content-related philosophy of teaching and learning is more different than similar.
Wording/Specificity		CO's benchmarks provide verbs that specify what a student is to do with the content, whereas Finland's core contents consist of headings and lists of topics or content within the headings. These are not so much standards as they are curriculum content. The Finland document, however, also provides greater detail as to specificity of concepts and the grade years these may be introduced or learned.	More different than similar.

Appendix K. Mathematics: External Referent Review— Singapore
External Referent: Mathematics Syllabus Primary (Singapore, 2006) and Secondary Mathematics Syllabuses (Singapore, 2006)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation		Singapore has syllabi for eight grades (P1–P6, Secondary 1, and Secondary 2) and one grade span (Secondary 3/4), whereas CO has benchmarks in three grade spans: K–4, 5–8, and 9–12. Also, Singapore provides additional syllabi for Foundations in P5 and P6, which contain more review of P1–P4. For Secondary, syllabi are provided at three levels: O, N(A), and N(T); and additional level O and level N(A) syllabi are provided for Secondary 3/4.	More different than similar.
Hierarchy of Standards	CO's six standards cross all grade spans and correspond somewhat to Singapore's Topics, although Topics change across the grades, especially between P6 and Sec1 (Secondary 1), and between Sec3/4 (Secondary 3/4) and Sec3/4+ (additional Secondary 3/4).	CO's six standards provide text with no heading (label), whereas Singapore's Topics are labeled with no text. For each of the six standards, CO has between 3 and 7 benchmark statements describing what students should be able to do. Singapore lists from four to eight Topics in grades P1–P6, with from 10 to 20 subtopics at each grade. In secondary, there are three topics in the syllabus for each grade, with from 11 to 16 subtopics at each grade. Each subtopic has between 1 and 18 content listings describing what content should be in the curricula, and many content bullets have further sub-bullets providing examples or specifics of content in more detail.	The hierarchy of the standards/benchmarks differs from the hierarchy of the Topics/ subtopics/content.

Subcategory	Similarities	Differences	Comments
Number of Standards		In P1–P6 and Level O Sec1, 2, and 3/4, Singapore lists 122 subtopics that students encounter, with an additional 11 subtopics in Level O Sec3/4+. CO has 86 benchmarks that all students are expected to meet, with an additional 20 benchmarks for higher mathematics. In P1–P4, Singapore has 56 subtopics: P1: 10; P2: 13; P3: 13; P4: 20. Across K–4, CO has 28 benchmarks. For grades 5–8, Singapore has 50 subtopics: P5: 15; P6: 11; sec1: 11; sec2: 13. Across grades 5–8, CO has 34 benchmarks. For grades 9–10, Singapore has 27 subtopics: Sec3/4: 16; and Sec3/4+: 11. Across grades 9–12, CO has 24 benchmarks for all students and 20 benchmarks for students extending their mathematics education.	More different than similar.
Design/Format	Neither Singapore nor CO documents provide numbering of statements that designates the content area the statement describes.	For each grade, Singapore provides a table showing the Topic name. The names of subtopics are then listed with the corresponding content bullets. CO's benchmarks are arranged by standard, with benchmarks for each grade span. Singapore's subtopics are much more specific and detailed, based on the content bullets, than CO's benchmarks.	A teacher using the Singapore documents can easily see the Topics, subtopics, and content for which his students are responsible. A teacher using the CO document can readily see the progression of the standards, but must go to each standard and find the benchmarks for her grade span to know the type of learning her students need—though more specific learning experiences for her students must still be determined.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)	Each document provides rationale for the Topics/subtopics or standards/benchmarks.	Singapore provides two 40-page documents—one for primary (P1–P6) and one for secondary, whereas CO's document is 18 pages, only six of which are for the standards; most of the others are for history, rationales, glossary, and index. Singapore further provides sections, which describe the aims of mathematics education, a mathematics framework, objectives of the curriculum, and use of calculator and technology.	Using just the Singapore document, a teacher should have a better idea what the curriculum is, whereas the CO teacher needs additional documents. Overall, the design/format of the documents is more different than similar.

External Referent: Mathematics Syllabus Primary (Singapore, 2006) and Secondary Mathematics Syllabuses (Singapore, 2006)

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1 (Number)		Singapore combines both number and operations into six Topics in P1–P6: whole numbers, fractions, decimals, percentage, ratio, and speed. In Sec1, 2, and 3/4, number (including operations) is combined with algebra. In Sec3/4+, there is no mention of number. In P1–P6, Number (including Operations) accounts for almost one-half of the number of subtopics. Due to the separation of types of numbers, it is apparent that P1–P5 place consistent emphasis on whole numbers, then P2–P6 include fractions, P4–P5 include decimals, P5–P6 include percentage and ratio; and P6 includes speed. There is a sharp decrease in emphasis on number (and operations) after P6. Across the grades, about one-sixth of the CO benchmarks represent Standard 1, with fairly heavy emphasis in grades K–8, and generally decreasing as grade spans increase. Singapore P1–P4 content includes comparing and ordering fractions and knowing place value concepts for decimals. Across the grades, Singapore does not emphasize using number sense for estimation and justification, or developing and testing conjectures. CO benchmarks are	Overall, the emphasis on this standard is more different than similar when considering specificity of Singapore content bullets, and the combination of operations with number.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1 (Number) (Continued)		more specific about applying concepts in problem-solving contexts.	
Standard 2 (Algebra)		As a Topic, algebra does not appear in the Singapore course syllabi until P6, and is definitely an area of emphasis in Sec1, 2, and 3/4, where it is combined with number as one of only three Topics in those years. In Sec3/4+, algebra is one of the three Topics containing about two-thirds of the subtopics. Across the grades, about one-sixth of CO's benchmarks focus on algebra, with increasing emphasis as the grade spans increase. In early grades, CO describes more experiences with patterns and solving problems with patterns.	Overall, the emphasis on algebra is different than similar, given the specificity of the Singapore content with concepts, such as polynomials, simultaneous equations, logarithms, and set notation. CO's broader benchmarks may include such concepts, but not based on this document alone.
Standard 3 (Data and Statistics)		Overall, Singapore places less emphasis on data and statistics than CO. For CO, benchmarks for this standard represent one-fifth of the standards, and emphasis on data and statistics increases as the grade spans increase. In Singapore the emphasis remains steady, involving about one-tenth of the subtopics at each grade from P1–Sec1, and one-sixth to one-eighth at Sec2 and Sec3/4, respectively. CO develops concepts of measures of central tendency earlier than Singapore, as well as formulating hypotheses and making convincing arguments. In P1–P4, Singapore emphasizes only constructing and interpreting displays, with different types of displays emphasized each year. There is	Overall, the emphasis on Data is more different than similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 3 (Data and Statistics) (Continued)		more overlap of content in the middle and upper grades, although Singapore does not emphasize probability as much as CO.	
Standard 4 (Geometry)	Across P1–P6, Singapore designates about one-fifth of its subtopics for geometry, with increased emphasis in Secondary. CO also designates about the same amount of its benchmarks (about one-sixth) to geometry at each grade span.	In the middle grades, Singapore combines Geometry and Measurement to be one of three Topics, and geometry is combined with trigonometry in Sec 3/4+. Singapore emphasizes length and mass in early grades, and then brings in area. Its syllabi are more specific about lines and curves, and nets. CO does more with transformations earlier than Singapore, and designates problem-solving settings more specifically.	Overall, the emphasis on geometry is more similar than different.
Standard 5 (Measurement)		In P1–P6, the content of almost one-fourth of Singapore's subtopics deals with measurement. Measurement is combined with geometry in Sec1, 2, and 3/4 as one of three topics at each year, together representing more than one-fourth of the subtopics. CO students in grades K–4 may spend more time developing sense of measurement using approximate measures of familiar objects; middle-grade students may have more emphasis on reading and interpreting various scales, and describing how a change in linear measurement affects its perimeter, area, or volume; and upper-grade students more specifically must measure with specified degrees of precision, accuracy, and error, and determine the degree of accuracy of a measurement, using significant digits.	Overall, the emphasis on measurement is more different than similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 6 (Operations and Computations)	In CO, about one-sixth of the benchmarks represent Standard 6, with heavy emphasis in grades K–8, and generally decreasing as grade spans increase. There seems to be a high overlap of Singapore content with CO benchmarks in these grades as well.	In the upper level in Singapore, there is a sharper decrease in emphasis on operations than in CO. CO places greater emphasis than Singapore on using models to explain how ratios, proportions, and percents can be used to solve real-world problems. None of Singapore's Sec3/4 content deals specifically with operations, although content in Sec1 and Sec2 does overlap with two of the three CO benchmarks in grades 9–12.	Singapore combines Number and Operations in six Topics. In CO, these are separate standards—Standards 1 and 6. Overall, the emphasis on Operations is more similar than different.
Grades K–4	Across the CO standards, there is a high degree of similarity in content with lower and middle grades benchmarks and Singapore subtopics and content bullets. Almost all of the 28 K–4 benchmarks contain content that corresponds to at least one Singapore subtopic in P1–4. Comparing Singapore's six number topics, which include operations, with CO by combining Standard 1 (Number) and Standard 6 (Operations), both sets of documents put the greatest emphasis (about two-fifths to one-half) on these concepts.	In this grade span, CO designates about the same number of benchmarks (4 or 5) to each standard. Singapore designates no subtopics to algebra (CO Standard 2), less than one-tenth to data analysis (CO Standard 3), and the most (about one-half) to topics in number and operations (CO Standards 1 and 6).	There is to be a fair amount of overlap between CO standards in grades K–4 and the content described in Singapore subtopics, though the emphasis varies. More similar than different.
Grades 5–8	Across the CO standards, there is a high degree of similarity in content with the grade 5–8 benchmarks and Singapore subtopics. Almost all of the 34 benchmarks contain content that corresponds to content in at least one MA subtopic. Comparing Singapore's six number topics, including operations, with CO by combining Standard 1 (number) and Standard 6 (operations), both sets of standards put the greatest	In this grade span, CO designates about the same number of benchmarks (5 to 7) to each of the other standards (2, 3, 4, and 5). Singapore designates the least amount (about one-tenth) to its data strand (CO Standard 3). Some concepts possibly better covered, or at least specified in Singapore subtopics include place value with decimals, set language and notation, the Pythagorean theorem, order of operations, and	There is to be a fair amount of overlap between CO standards in grades 5-8 and the content described in Singapore subtopics in P5, P6, Sec1, and Sec2, though the emphasis varies. More similar than different.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 5-8 (Continued)	emphasis on these concepts—about one-half of the content in Singapore's subtopics and about one-third of CO's benchmarks.	simplifying numerical and variable expressions.	
Grades 9–12	Across the CO standards, there is some similarity in content with the grade 9–12 benchmarks and content in the Singapore subtopics, particularly if Sec1 and Sec2 content is considered. Almost all of the 24 benchmarks contain content that corresponds to at least one Singapore subtopic, with number (CO Standard 1) and operations (CO Standard 6) having the least amount of overlap.	In this grade span, about one-fourth of the CO benchmarks address data and statistics, about one-fifth address algebra, one-sixth address geometry, and one-eighth address measurement. Singapore designates only three Topics at each grade, by combining topics named in P1–P6: number & algebra, geometry & measurement, and statistics & probability.	Of the three grade spans, it is less clear that there is similar emphasis in content for grades 9–12. Although there is overlap in content, the CO standards and Singapore subtopics are more different than similar.
Across All Grades	Both documents reinforce connections to problem solving: Singapore provides a mathematics framework centered around mathematical problem solving, indicating that "[problem solving] involves the acquisition and application of mathematics concepts and skills in a wide range of situations, including non-routine, open-ended and real-world problems. CO specifies problem-solving contexts in many of its benchmarks and ends each standard statement with "…in problem-solving situations and communicate the reasoning used in solving these problems." In K–12, most CO benchmarks seem related to content in at least one Singapore subtopic in the grade span, and vice versa.	Singapore does not present standards, but rather course/grade-level curriculum syllabi. CO's standards are described by benchmarks that do not designate the curriculum topics, subtopics, and content to be covered, but rather the general experiences students should encounter within each standard across the grade spans. CO's six standards cross all grade spans and roughly correspond to Topics named in the Singapore syllabi, which are designated by year.	Although there is substantial overlap in content, the emphasis varies and the documents are more different than similar.
Wording/Specificity		The content listed in Singapore's subtopics provides a high degree of specificity, whereas CO's benchmarks are typically quite broad to encompass content across the grade spans. Thus, it is not always apparent	More different than similar.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity (Continued)		where concepts specified by Singapore are actually addressed in the CO standards. Especially in grades 9–12, Singapore standards seem more academically oriented, and at levels higher than CO's more general benchmarks.	

Appendix L. Mathematics: 21st Century Skills and Abilities and Postsecondary and Workforce Readiness Review

21st Century Skills and Abilities

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
1	K-4	P				P	Partials because lower level skill in development phase; opportunity for invention in benchmarks 1 and 4.
1	5-8	P				P	Partials because less complex, but supporting the skills; opportunity for invention in benchmark 5.
1	9-12	F				N	Full because all benchmarks tap critical thinking/reasoning in meaningful ways. N for invention because earlier grades did show opportunities for invention. The 3 benchmarks in 9–12 do not seem to evoke creativity or innovation, though integration of ideas may be tapped by developing conjectures.
1	Across	F				P	Although this is the "number" strand, there are opportunities for critical thinking as well as invention, though invention may not presently be fully tapped.
2	K-4	F				P	Full because all benchmarks require critical thinking or reasoning that would be grade-appropriate; partial because lower level skills in development phase.

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
2	5-8	F				N	Full because all benchmarks require critical thinking or reasoning that would be grade-appropriate. Seems there is opportunity for invention though not specified in the benchmarks. For example, in benchmark 1, students could show integration of ideas by creating patterns in a variety of formats that illustrate a certain relationship.
2	9-12	F					Full because all benchmarks tap the skill in meaningful ways. The five grade 9–12 benchmarks do not seem to lend themselves to invention, although they could more specifically require integration of ideas.
2	Across	F				N	Opportunities for critical thinking/reasoning cross all grade spans. Seems there could be more opportunities for invention specified within at least one of the upper grade spans. For example, in 2.5-8.1, students could create patterns in a variety of formats that illustrate a certain relationship.
3	K-4	F	F				Full because all benchmarks require critical thinking or reasoning that would be grade-appropriate; and most benchmarks address information literacy.

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
3	5-8	F	F			P	Full because all benchmarks require critical thinking or reasoning that would be grade-appropriate; and most benchmarks address information literacy. Partial because provides opportunity and support for invention in benchmark 5.
3	9-12	F	F			P	Full because all benchmarks tap critical thinking/reasoning and most benchmarks tap information literacy in meaningful ways. Partial because provides opportunity for invention in benchmark 1.
3	Across	F	F			P	Opportunities for critical thinking/reasoning and information literacy cross all grade spans. Limited opportunities for invention are presented in two of the grade spans.
4	K-4	P					Partial because lower level skill, in development phase.
4	5-8	F				P	Full because all benchmarks require critical thinking or reasoning that would be grade-span appropriate. Partial because less complex, but supporting opportunities for invention in benchmarks 1 and 6.
4	9-12	F				F	Full because all benchmarks tap critical thinking/reasoning and two of the benchmarks sufficiently tap invention in meaningful ways.

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
4	Across	F				F	Opportunities for critical thinking/reasoning cross all grade spans and sufficient opportunities for invention cross the upper grade spans.
5	K-4	P				P	Partials because lower level skill, in development phase; opportunity for Invention in benchmark 5.
5	5-8	F				P	Full because all benchmarks require critical thinking or reasoning that would be grade-appropriate. Partial because less complex, but supporting opportunity for invention in benchmark 4.
5	9-12	P					Partial because not clear that benchmarks sufficiently tap critical thinking/reasoning.
5	Across	P				P	Partials because overall critical thinking/reasoning and invention may be at a less complex level than indicated in the skill.
6	K-4	P				P	Partials because lower level skill, in development phase; opportunity for invention in benchmark 4.

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
6	5-8	F				P	Full because all benchmarks require critical thinking or reasoning that would be grade-appropriate. Partial because less complex, but supporting opportunity for invention in benchmark 3.
6	9-12	F					Full because all benchmarks tap critical thinking/reasoning in meaningful ways. The three grade 9–12 benchmarks do not seem to lend themselves to invention.
6	Across	F				P	Opportunities for critical thinking/reasoning cross all grade spans; however opportunities for invention cross only the lower grade spans at less complex levels. Grades 9–12 benchmarks do not lend themselves to invention.

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
Comments		Critical thinking & reasoning is developed across the lower grade spans and considered fully present in most standards.	Information literacy can be most readily developed in the data standard.	Collaboration may occur in learning situations, but is not specified in standards.	Self-direction may occur in learning situations, but is not specified in standards.	Opportunities for Invention are presented in most standards and seems reasonable that more opportunities could be incorporated in standard 2 (Algebra),	Note that it seems critical thinking & reasoning skills must be present whenever students demonstrate information literacy abilities or invention. Benchmarks relating to invention typically were considered due to integration of ideas, which seems also to be a type of critical thinking and reasoning

Mathematics: 21st Century Skills and Abilities and Postsecondary and Workforce Readiness Review

Postsecondary and Workforce Readiness

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
1	9-12			P			F	Partial because not clear that skills are required to be at levels needed for readiness. For example, if benchmarks 1 and 2 required students to use and "go beyond" the immediate application, the readiness requirement would likely be present.
2	9-12			P			F	Partial because problem solving is addressed by only one benchmark; incorporating the phrase "in a problem-solving situation" in benchmarks 2, 4, and/or 5 would add emphasis. Full for analysis/interpretation because all benchmarks tap these skills in meaningful ways.
3	9-12		F	F			F	Full because all benchmarks tap the skills in meaningful ways.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
4	9-12			P			F	Partial because problem solving is addressed by only one benchmark; incorporating the phrase "in a problem-solving situation" in benchmark 2 would add emphasis. Full because all benchmarks tap analysis and interpretation skills in meaningful ways.
5	9-12			N			F	Not present for problem solving because although the standard specifies that students are to apply their measurement results in problem -solving situations, this point is not reinforced in the benchmarks. Adding the phrase, "required in a problem-solving situation," to benchmark 3 and/or adding, "in a problem-solving situation," to benchmark 2, would emphasize this skill. Full for analysis and interpretation because all benchmarks tap these skills in meaningful ways.
6	9-12	F		F			F	Full because all or most benchmarks tap the skills in meaningful ways.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
Comments		Computing may occur in a variety of standards, but is the focus of Standard 6.	Logical reasoning may occur in a variety of standards, but is most applicable for argumentation in Standard 3.	Identifying/problem-solving is considered at least partially present in all standards.	Information management skills may occur in learning situations, but are not specified in the math standards.	Human relation skills may occur in learning situations, but are not specified in the math standards.	Analysis and interpretation skills are considered fully present in all the standards.	Note that it seems analysis and interpretation skills must be present whenever students demonstrate logical reasoning and argumentation abilities, and whenever identification and problem solving is addressed.

Appendix M. Science: Internal Quality Review

Depth

Standard	Grade Span	Within span	Across span	Comments
1	K-2	F		
1	3-5	F		
1	6-8	P		Needs content specific to designing and conducting investigations.
1	9-12	F		
1	Across		F	
2	K-2	F		
2	3-5	F		
2	6-8	F		
2	9-12	P		Needs content specific to types and characteristics of chemical bonds.
2	Across		F	
3	K-2	F		
3	3-5	F		
3	6-8	F		
3	9-12	F		
3	Across		F	
4	K-2	F		
4	3-5	P		Needs content specific to composition and formation of rock types and soils.
4	6-8	F		
4	9-12	F		
4	Across		F	
5	K-2	F		
5	3-5	P		Needs content specific to changes in scientific knowledge; needs content specific to the interrelationships between science, technology, and society.

Standard	Grade Span	Within span	Across span	Comments
5	6-8	F		
5	9-12	F		
5	Across		F	

Science: Internal Quality Review

Coherence

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
1	K-2		F	
1	3-5		F	
1	6-8		F	Needs content specific to designing and conducting investigations.
1	9-12		F	
1	Across	F	F	
2	K-2		F	
2	3-5		F	
2	6-8		F	
2	9-12		F	Needs content specific to types and characteristics of chemical bonds.
2	Across	F	F	
3	K-2		F	
3	3-5		P	Some examples in benchmark 3.3-5.4 may exceed the grade level range.
3	6-8		F	
3	9-12		F	
3	Across	F	F	
4	K-2		F	
4	3-5		P	Needs content specific to composition and formation of rock types and soils; content in benchmark 4.3-5.4 exceeds the grade level range.
4	6-8		P	Content in benchmark 4.6-8.15 may exceed the grade level range.
4	9-12		F	
4	Across	F	F	
5	K-2		F	

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
5	3-5		F	Needs content specific to changes in scientific knowledge; needs content specific to the interrelationships between science, technology, and society.
5	6-8		F	
5	9-12		F	
5	Across	F	F	

Science: Internal Quality Review

Rigor

Standard	Grade Span	Rigor	Comments
1	K-2	F	
1	3-5	F	
1	6-8	F	
1	9-12	F	
1	Across	F	
2	K-2	F	
2	3-5	F	
2	6-8	F	
2	9-12	F	
2	Across	F	
3	K-2	F	
3	3-5	F	
3	6-8	F	Needs further definition of content associated with the flow of energy and the cycling of matter in ecosystems.
3	9-12	F	
3	Across	F	
4	K-2	F	
4	3-5	F	
4	6-8	F	Needs further definition of the content associated with minerals, rock types, and soils.
4	9-12	P	Needs further definition of the content relating the composition, structure, and transfer of energy in Earth's interior to plate tectonics and changes on Earth's surface; needs further definition of the content associated with the composition and structure of the universe.
4	Across	F	
5	K-2	F	

Standard	Grade Span	Rigor	Comments
5	3-5	F	
5	6-8	F	
5	9-12	F	
5	Across	F	

Science: Internal Quality Review

Breadth

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
Across	K-2	F	F	F	
1	K-2		F	F	
2	K-2		F	F	
3	K-2		F	F	
4	K-2		F	F	
5	K-2		F	F	
Across	3-5	F	F	F	
1	3-5		F	F	
2	3-5		F	F	
3	3-5		F	F	
4	3-5		P	F	Needs content specific to composition and formation of rock types and soils.
5	3-5		P	F	Needs content specific to changes in scientific knowledge; needs content specific to the interrelationships between science, technology, and society.
Across	6-8	F	F	F	
1	6-8		P	F	Needs content specific to designing and conducting investigations.
2	6-8		F	F	
3	6-8		F	F	
4	6-8		F	F	
5	6-8		F	F	
Across	9-12	F	F	F	
1	9-12		F	P	Needs content in benchmark 1.9-12.6 is unclear.
2	9-12		P	F	Needs content specific to types and characteristics of chemical bonds.
3	9-12		F	F	
4	9-12		F	F	
5	9-12		F	F	

Standard	Grade Span	Breadth within span	Contains essential content	Free of extraneous content	Comments
Across	Across	F	F	F	
1	Across		F	F	
2	Across		F	F	
3	Across		F	F	
4	Across		F	F	
5	Across		P	F	Needs content in benchmarks 5.3-5.1 and 5.6-8.1 best included as part of Standard 1; needs content related to the limitations of scientific understanding; needs content related to ethical practice in conducting scientific investigations.

Appendix N. Science: External Referent Review— Massachusetts
External Referent: Massachusetts Science and Technology/Engineering Curriculum Framework (October 2006)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Both CO and MA organize the standards by highly similar grade ranges.	The first grade range is K-2 for CO and PreK-2 for MA. The last grade range is 9-12 for CO and High School for MA.	
Hierarchy of Standards	At the highest level of organization for content, the CO and MA documents are very similar. Both cover the following three large domains of scientific understanding: - physical science - life science - earth and space science	The highest content level of organization for CO is the standard statement, which defines each large domain. MA uses a title rather than a statement to identify each large domain. At all grade ranges, CO also includes two additional standards covering the large domains of scientific investigation and the nature of science. At all grade ranges, MA includes an additional large domain covering Technology/Engineering. At the high school grade range, MA divides the physical science domain into two distinct courses, Chemistry and Physics. MA divides each large domain into smaller subtopics at each grade range. In many cases, the subtopic titles are unique at each grade range, but reflect related content that is grade range appropriate. For example, in the physical sciences domain, at PreK-2 a subtopic is Observable Properties of Objects. At 3-5, the related subtopic is Properties of Objects and Materials. At 6-8 and at High School, the related subtopic is Properties of Matter. At the high school grade range, MA includes an additional set of four Scientific Inquiry Skill Standards.	For CO, the high-level standard statements are further defined by specific benchmarks. For Massachusetts, the high-level content strands or the domain titles are further defined by specific standards. For making reasonable comparisons, the Colorado benchmarks are most similar in content specificity to the Massachusetts standards.

Subcategory	Similarities	Differences	Comments
Number of Standards	In all but a few categories, the number of both CO benchmarks and MA standards increases in each large domain as the grade range moves from a lower level to a higher level.		CO has 155 benchmarks across all grade ranges. MA has nearly twice as many content statements, with 307 standards across all grade ranges.
Design/Format	Both the CO Model Content Standards and the MA Curriculum Framework present the content by large content domains. For example, in the CO physical science standard, all of the benchmarks for that standard are presented together. Then all the benchmarks for the next standard, life science, are presented together.	The CO Model Content Standards include an extensive Glossary of Terms covering the science terms referenced in the standards and benchmarks. The MA Curriculum Framework presents the standards in table format. Each table has three columns: Learning Standards, Ideas for Developing Investigations and Learning Experiences, and Suggested Extensions to Learning in Technology/Engineering. The MA Curriculum Framework is a more expansive document and includes "What it Looks Like in the Classroom" scenarios in the presentation of the learning standards. In addition, the Framework provides several appendices addressing related topics such as additional learning activities, safety practices, dissection, and curriculum review resources. Appendix 1 presents the learning standards by broad topics in a table format that shows the topic as a continuum across the grade ranges. It is interesting to note that the broad topics used to organize the standards in Appendix 1 do not always match the subtopic titles used in the learning standard tables in the body of the document.	A combination of the number of CO benchmarks and the presentation of those benchmarks allows for all five standards and the corresponding 155 benchmarks to be presented in eight pages of the Model Content Standards. In contrast, the presentation of the 307 standards in the Massachusetts Curriculum Framework requires 76 pages.

External Referent: Massachusetts Science and Technology/Engineering Curriculum Framework (October 2006)

Content

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 1	At the grade ranges PreK-2, 3–5, and 6–8, MA does not have inquiry skill standards, but the Curriculum Framework does identify relevant sets of Skills of Inquiry, Experimentation, and Design which are highly similar to the CO Standard 1 benchmarks for those grade ranges. At the high school grade range, the benchmarks in CO Standard 1 addressing scientific inquiry are highly similar to the MA Scientific Inquiry Skills Standards.	At the high school grade range, the MA Scientific Inquiry Skills are more explicit in stating expectations for the proper use of instruments, equipment, and materials and for following safety guidelines.	CO Standard 1 addresses the domain for scientific investigation.
Standard 2	CO and MA have similar emphases on physical science content through the grade ranges K–2, 3–5, and 6–8. However, the MA standards statements are more numerous and tend to be more specific.	At the high school grade range, MA has specific standards addressing the types and characteristics of chemical bonds and chemical reactions. This specific content is missing in the CO benchmarks. At the high school grade range, the MA standards have more explicit emphasis on calculations and quantitative descriptions.	CO Standard 2 addresses the domain for physical science.
Standard 3	CO and MA have similar emphases on life science content through all grade ranges. However, the MA standards statements are more numerous and tend to be more specific.		CO Standard 3 addresses the domain for life science.
Standard 4	CO and MA have similar emphases on Earth and space science content through all grade ranges. However, the MA standards statements are more numerous and tend to be more specific.		CO Standard 4 addresses the domain for Earth and space science.
Standard 5	At the high school grade range, some of the benchmarks in CO Standard 5 addressing the nature of science are covered as part of the MA Science Inquiry Standards, particularly those benchmarks addressing	Many of the benchmarks in CO Standard 5 addressing the nature of science are not covered in the MA standards, particularly those benchmarks addressing how scientific knowledge is acquired and modified and the	CO Standard 5 addresses the domain for the nature of science.

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
	experimentation, models, and evaluation and analysis.	interaction of science, technology, and society.	
Grades K–2			
Grades 3–5			
Grades 6–8			
Grades 9–12		The greatest difference between the number of CO benchmarks and the number of MA standards is at the high school grade range. CO has 57 benchmarks, but MA has 166 standards. At the high school grade range, the MA Framework defines a set of Mathematical Skills relevant to each course.	
Across All Grades		Almost all aspects of the MA Technology/Engineering domain are not addressed in the CO Model Content Standards.	
Wording/Specificity	In general, the MA standards tend to be more specific than the CO benchmarks. This is consistent with the fact that MA has many more standards than the CO benchmarks. For CO, the benchmarks for Standard 1 covering scientific inquiry are phrased as action statements beginning with a verb (e.g., record, interpret, use, demonstrate). In contrast, all the benchmarks for Standards 2–5 are content statements (e.g., matter is made up of parts too small to be seen).		

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Wording/Specificity (Continued)	For MA, all of the standards are phrased as action statements beginning with a verb (e.g., recognize, describe, compare, differentiate). The CO benchmarks and the MA standards include parenthetical lists of examples in some statements. In the Colorado benchmarks, some parenthetical lists begin with "for example:" and others do not. In the Massachusetts standards, some parenthetical lists begin with "e.g.," and others do not.		

Appendix O. Science: External Referent Review— Virginia
External Referent: Science Standards of Learning, January 2003 (Virginia)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	CO and VA organize the standards by similar grade ranges for middle school and high school. The middle school grade range is 6–8 for CO and 7–8 for VA.	Below the middle school grade range, the CO standards are organized by grade ranges (K–2 and 3–5). However, the VA standards are organized by individual grade from kindergarten through grade 6.	
Hierarchy of Standards	At the highest level of organization for content, the CO and VA documents are reasonably similar. Both cover the following four large domains of scientific understanding from kindergarten through the middle school grade range: - scientific investigation - physical science - life science - earth and space science	The highest content level of organization for CO is the standard statement, which defines each large domain. The highest content level of organization for VA at grades K–6 is the content strand (e.g., Matter, Life Processes, Living Systems, Resources). At the middle school and high school grade ranges, VA uses a title rather than a statement to identify each large domain. At the high school grade range, VA does not include the Earth and space science domain. At all grade ranges, CO includes an additional standard covering the large domain of the nature of science. At the high school grade range, VA divides the physical science domain into two distinct courses, Chemistry and Physics.	For CO, the high-level standard statements are further defined by specific benchmarks. For VA, the high-level content strands and the domain titles are further defined by specific standards. The standards are further defined by lists of specific key concepts. The CO benchmarks are most similar in content specificity to the VA standards.

Subcategory	Similarities	Differences	Comments
Number of Standards		In all but a few categories, the number of CO benchmarks increases in each large domain as the grade range moves from a lower level to a higher level. In contrast, the number of VA standards is relatively the same for grades K–6.	CO has 155 benchmarks across all grade ranges. VA has 128 standards across all grades and grade ranges.
Design/Format		The CO Model Content Standards document presents the content by large content domains. For example, in the CO physical science standard, all of the benchmarks for that standard are presented together. Then all the benchmarks for the next standard, life science, are presented together. The VA Standards of Learning are presented by grade for grades K-6, and then by large content domains for the middle school and high school grade ranges. The CO Model Content Standards document includes an extensive Glossary of Terms covering the science terms referenced in the standards and benchmarks.	

External Referent: Virginia Science Standards of Learning, January 2003

Content

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 1	CO and VA have similar emphases through the grade ranges on the skills and concepts associated with scientific investigation. For CO, these skills and concepts are covered in the Standard 1 benchmarks. For VA, these skills and concepts are covered by the first standard in each grade or grade range and the associated key skills and concepts.	The key skills and concepts defined for VA tend to have much greater specificity for the types of measurements to be made, the units of measure to be used, and the types of instruments to be used.	CO Standard 1 addresses the domain for scientific investigation.
Standard 2	CO and VA have similar emphases on physical science content through the grade ranges. However, the VA key concept statements associated with each standard tend to add greater specificity.	As mentioned, at the high school grade range, VA divides the physical science domain into two distinct courses, Chemistry and Physics. At the high school grade range for Chemistry, VA includes specific key concepts addressing chemical bonding types and chemical reaction types. This specific content is missing in the CO benchmarks. At both the middle school and high school grade ranges, VA has key concepts addressing the safe use of chemicals and equipment.	CO Standard 2 addresses the domain for physical science.
Standard 4	CO and VA have similar emphases on Earth and space science content through the middle school grade range. However, the Virginia key concept statements associated with each standard tend to add greater specificity.	As mentioned, VA does not include the Earth and space science domain at the high school grade range.	CO Standard 4 addresses the domain for Earth and space science.

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 5		Many of the benchmarks in CO Standard 5, addressing the nature of science, are not covered in the VA standards. At some grades and grade ranges, VA includes a single, generalized key concept under the scientific investigation standard, which typically states that, "an understanding of the nature of science is developed and reinforced."	CO Standard 5 addresses the domain for the nature of science.
Grades K–2		At each grade K–2, VA includes a specific standard with associated key concepts that address the sources, uses, and limitations of resources.	
Grades 3–5	CO and VA include content that addresses natural resources. However, the VA key concept statements associated with each standard tend to add greater specificity. At grade 4 for VA, the focus is specifically on VA natural resources.		
Grades 6–8	CO and VA include content that addresses natural resources. However, the VA key concept statements associated with each standard tend to add greater specificity.		
Grades 9–12		As mentioned, VA does not include the Earth and space science domain at the high school grade range.	
Across All Grades			
Wording/Specificity	In general, the VA standards with their associated key concepts tend to be more specific than the CO benchmarks. Both the CO benchmarks and the VA key concepts include parenthetical lists of examples in some statements. In the CO	For CO, the benchmarks for Standard 1 covering scientific inquiry are phrased as action statements beginning with a verb (e.g., record, interpret, use, demonstrate). In contrast, all the benchmarks for Standards 2–5 are content statements (e.g., matter is made up of parts too small to be seen).	

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Wording/Specificity (continued)	benchmarks, some parenthetical lists begin with "for example:" and others do not.	The VA scientific investigation standards typically begin with the statement, "The student will plan and conduct investigations in which," followed by the associated key skills. The VA content standards typically begin with the statement, "The student will investigate and understand," followed by the associated key concepts.	

Appendix P. Science: External Referent Review—Finland
External Referent: National Core Curriculum for Basic Education 2004 and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation		The grade ranges for CO are K-2, 3–5, 6–8, and high school. The grade ranges for Finland are 1–4, 5–6, 7–9, and high school (upper secondary schools).	
Hierarchy of Standards	At the highest level of organization for content, both CO and Finland cover the following three large domains of scientific understanding from grade 1 through the high school grade range: - scientific investigation - life science - physical science	The highest content level of organization for CO is the standard statement, which defines each large domain. The highest level for Finland is a major topic or course title. At all grade ranges, Finland divides each major topic or course into two sections, Objectives and Core Contents. Additionally, at grade ranges 1–4 and 5–6, Finland defines a set of Descriptions of Good Performance. At the 7–9 grade range, Finland defines a set of Final Assessment Criteria. At all grade ranges, CO includes an additional standard covering the large domain of the nature of science. At the 7–9 and high school grade ranges, Finland divides the physical science domain into two distinct courses, Chemistry and Physics.	For CO, the high-level standard statements are further defined by specific benchmarks. For Finland, the Core Contents and Descriptions for Good Performance/Final Assessment Criteria are organized by content strands (e.g., Organisms and living environments, Substances around us, Scales and structures, Motion and force). The content strands are further defined by sets of bulleted statements. The CO benchmarks are somewhat similar to the Finland bulleted statements. However, the content specificity of the bulleted statements differs greatly across the Finland grade ranges, so making direct comparisons to the CO benchmarks is challenging.
Number of Standards			The content specificity of the Finland bulleted statements differs significantly across the grade ranges

Subcategory	Similarities	Differences	Comments
Design/Format		The CO Model Content Standards document presents the content by large content domains. For example, in the CO physical science standard, all of the benchmarks for that standard are presented together. Then all the benchmarks for the next standard, life science, are presented together. The Finland curriculum is presented by grade range, then by topic or course. The Colorado Model Content Standards document includes an extensive Glossary of Terms covering the science terms referenced in the standards and benchmarks. The Finland National Core Curriculum for Basic Education and National Core Curriculum for Upper Secondary Schools are expansive documents that cover subject areas besides science and address a number of related topics (e.g., Implementation of Instruction, Instruction of Pupils Needing Special Support, and Pupil Assessment).	

External Referent: National Core Curriculum for Basic Education 2004 and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Content

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 1	CO and Finland address many similar aspects of scientific investigation throughout the grade ranges. For CO, these are addressed in the Standard 1 benchmarks. For Finland, various aspects of scientific investigation are addressed in various parts of the document, including under the Objectives, under the Science Activities strand, and under selected content strands.		CO Standard 1 addresses the domain for scientific investigation.
Standard 2	CO and Finland have similar emphases on physical science content through most of the grade ranges.	At the 7–9 and high school grade ranges, Finland divides the physical science domain into two distinct courses: Chemistry and Physics. Consistent with this approach, the Finland curriculum places earlier and greater emphasis in grades 7–9 on chemical phenomena, including reactivity of elements, chemical bonds, and simple reaction equations. At the high school grade range for Chemistry, Finland includes specific bulleted statements addressing chemical bonding types and chemical reaction types. This specific content is missing in the CO benchmarks.	CO Standard 2 addresses the domain for physical science.

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 3	CO and Finland have similar emphases on life science content throughout the grade ranges.	The CO benchmarks have a more defined emphasis through grade 8 on the principles of natural selection and the factors that influence changes in populations over time. The Finland curriculum has particular emphasis on ecosystems and adaptations of organisms found in Finland and the Nordic countries. The Finland curriculum has more specific emphasis on human biology and health.	Colorado Standard 3 addresses the domain for life science.
Standard 4	CO and Finland address the use, conservation, and recycling of resources throughout the grade ranges.	The CO benchmarks addressing Earth and space science are represented in a limited and much less focused way in the Finland curriculum throughout the grade ranges. In the Finland curriculum, the most thorough coverage of the more traditional Earth and space science concepts is at the high school grade range in the Geography course (aspects of physical geography). In the Finland curriculum, Earth and space science concepts are imbedded in various topics or courses throughout the grade ranges. For example, the following bulleted statement is included in Physics and Chemistry at grades 5–6: "recognize phenomena caused by the motion of the earth and moon, such as times of the day, seasons, phases of the moon, and eclipses; know about the structure of the solar system; and be able to make observations of the night sky."	Colorado Standard 4 addresses the domain for Earth and space science.

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 4 (Continued)		The Finland curriculum has a very strong emphasis on physical and cultural geography (particularly for Finland and the Nordic countries) and on geographic skills.	
Standard 5	CO and Finland have similar emphases on the interaction of science, technology, and society throughout the grade ranges.	Many of the benchmarks in CO Standard 5 addressing the nature of science are not directly covered in the Finland curriculum, particularly those benchmarks addressing how scientific knowledge is acquired and modified.	CO Standard 5 addresses the domain for the nature of science.
Grades K–2			Because the Finland grade range 1–4 is relatively broad, the level of content defined in the CO K–2 benchmarks is not well represented in the Finland curriculum.
Grades 3–5			
Grades 6–8			
Grades 9–12			
Across Grades			
Wording/Specificity		For CO, the benchmarks for Standard 1 covering scientific inquiry are phrased as action statements beginning with a verb (e.g., record, interpret, use, demonstrate). In contrast, all the benchmarks for Standards 2–5 are content statements (e.g., matter is made up of parts too small to be seen). For Finland, the bulleted statements are typically preceded with the phrase, "The pupils will know how to" followed by a wide range of skills and levels of understanding (e.g., use, explain, describe, investigate, examine, determine, perform, assemble).	

Appendix Q. Science: External Referent Review—Singapore
External Referent: Science Syllabus Lower Secondary Normal (Technical) 2008 and Science Syllabus Lower Secondary Express/Normal (Academic) 2008

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation		The grade ranges for CO are K-2, 3-5, 6-8, and high school. The grade ranges for Singapore are P3-P4 as the Primary Lower Block, P5-P6 as the Primary Upper Block, and the Lower Secondary grade range (covering the equivalent of the middle school and high school grade ranges). At the Singapore Lower Secondary level, there are separate syllabi for Express/Normal (Academic) content and Normal (Technical) content. The Academic syllabus is more intended for preparation for university studies, while the Technical syllabus is more intended for technical-vocational studies. The Academic syllabus contains most of the content in the Technical syllabus, but in much greater depth. The Technical syllabus has a somewhat greater emphasis on selected personal health issues (drug abuse, alcohol consumption, and tobacco use) and public health issues (air and water pollution).	At the 6-8 and high school grade ranges, this review is based on comparisons between the CO Model Content Standards and the Singapore Science (Academic) Syllabus.

Subcategory	Similarities	Differences	Comments
Hierarchy of Standards	At the highest level of organization for content, both CO and Singapore cover the following three large domains of scientific understanding from approximately grade 3 through the high school grade range: - scientific investigation - life science - physical science	The highest content level of organization for CO is the standard statement, which defines each large domain. The highest level for Singapore is the theme. At the Singapore P3–P4 and P5–P6 grade ranges, the five themes are Diversity, Cycles, Systems, Interactions, and Energy. At the Lower Secondary grade range, the six themes are Science and Technology, Measurement, Diversity, Models and Systems, Energy, and Interactions. At all grade ranges, CO includes a separate standard covering the large domain of the nature of science.	For CO, the high-level standard statements are further defined by specific benchmarks. For Singapore, the high-level themes are further defined by three broad categories: 1) Knowledge, Understanding and Application; 2) Skills and Processes; and 3) Ethics and Attitudes. These three categories are further defined by specific bulleted statements as learning outcomes. The CO benchmarks are most similar in content specificity to the Singapore bulleted learning outcomes.
Number of Standards			CO has 155 benchmarks across all grade ranges. In this comparison, Singapore has 247 learning outcomes across all grade ranges. The number of CO benchmarks is compared to the number of Singapore learning outcomes in two of the broad categories mentioned above: 1) Knowledge, Understanding and Application; and 2) Skills and Processes. The Singapore learning outcomes in the Ethics and Attitudes category were not included in this number comparison because of the repetitive nature of these statements.

Subcategory	Similarities	Differences	Comments
Design/Format		The CO Model Content Standards document presents the content by large content domains. For example, in the CO physical science standard, all of the benchmarks for that standard are presented together. Then, all the benchmarks for the next standard, life science, are presented together. The Colorado Model Content Standards document includes an extensive Glossary of Terms covering the science terms referenced in the standards and benchmarks. Singapore presents the content by two grade-level syllabi, Primary (P3-P6) and Lower Secondary (middle school through high school). Each Singapore syllabus is an expansive document that addresses a number of related topics (e.g., Teaching and Learning through Inquiry, Assessing Teaching and Learning) and includes a brief Glossary.	

External Referent: Science Syllabus Lower Secondary Normal (Technical) 2008 and Science Syllabus Lower Secondary Express/Normal (Academic) 2008 (Singapore)

Content

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 1	CO and Singapore address many similar aspects of scientific investigation including making observations, using tools and measurements, conducting investigations, and communicating findings. In the Singapore Primary Syllabus, various aspects of scientific investigation are addressed in various themes. The Lower Secondary (Academic) Syllabus adds specific themes for Science & Technology and Measurement that address many aspects of scientific investigation.	Coverage of the scientific investigation process does not begin in the Singapore Primary Syllabus until the P5-P6 grade range. At the Lower Secondary grade range, Singapore has more specific definition of the types, units, and tools of measurement.	CO Standard 1 addresses the domain for scientific investigation.
Standard 2	CO and Singapore have similar emphases on physical science content through the grade ranges.	Singapore introduces some physical science topics at an earlier grade range. These topics include heat and temperature at P3-P4, types of electrical circuits at P5-P6, and kinetic and potential energy at P5-P6.	CO Standard 2 addresses the domain for physical science.
Standard 3	CO and Singapore have similar emphases on life science content through the grade ranges.	The CO benchmarks have a more defined emphasis through grade 8 on the principles of natural selection and the factors that influence changes in populations over time.	CO Standard 3 addresses the domain for life science.
Standard 4		Most of the CO benchmarks for Earth and space science are not addressed in the Singapore Science syllabi at any grade range. At the P5-P6 grade range, Singapore does include learning outcomes addressing the water cycle in the context of the states of matter of water and addressing air as a mixture of gases in the context of the respiration of gases in plants and animals.	CO Standard 4 addresses the domain for Earth and space science.

Subcategory	Similarities in Emphasis	Differences in Emphasis	Comments
Standard 5	CO and Singapore have similar emphases on how scientific knowledge is acquired and modified, and on the interaction of science, technology, and society.	Some aspects that may be considered part of the nature of science domain are addressed in the Singapore learning outcomes in the category for Ethics and Attitudes (e.g., show an appreciation that scientific inquiry requires attitudes such as curiosity, creativity, integrity, open-mindedness, and perseverance).	CO Standard 5 addresses the domain for the nature of science.
Grades K–2		Singapore does not have a Science syllabus addressing the K–2 grade range.	
Grades 3–5	The CO 3–5 grade range most closely corresponds with the Singapore Primary Syllabus for P3–P6.		
Grades 6–8	The CO 6–8 grade range is subsumed in the Singapore Lower Secondary Express/Normal (Academic) Syllabus.		
Grades 9–12	The CO 9–12 grade range is subsumed in the Singapore Lower Secondary Express/Normal (Academic) Syllabus.		
Across All Grades			
Wording/Specificity	Both the CO benchmarks and the Singapore learning outcomes use parenthetical text to add further definition, typically for lists of examples. In the CO benchmarks, some parenthetical lists begin with “for example:” and others do not. In the bulleted Singapore learning outcomes, some parenthetical examples begin with “e.g.,” some with “i.e.” Some examples are presented as sub-bulleted lists rather than as parenthetical lists. Some of the Singapore parenthetical statements limit the expectation of the learning outcome (e.g., action of alkalis on ammonium salts NOT required).	For CO, the benchmarks for Standard 1 covering scientific inquiry are phrased as action statements beginning with a verb (e.g., record, interpret, use, demonstrate). In contrast, all the benchmarks for Standards 2–5 are content statements (e.g., matter is made up of parts too small to be seen). The Singapore learning outcomes are all phrased as action statements beginning with a verb (e.g., describe, recognize, use, classify).	

Appendix R. Science: 21st Century Skills and Postsecondary and Workforce Readiness Review

21st Century Skills

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
1	K-2	F	F		F	F	
1	3-5	F	F		F	F	
1	6-8	F	F		F	F	
1	9-12	F	F		F	F	
1	Across	F	F		F	F	
2	K-2	P			N	N	
2	3-5	P			N	N	
2	6-8	P			N	N	
2	9-12	P			N	N	
2	Across	P			N	N	See skill-specific comments below.
3	K-2	P			N	N	
3	3-5	P			N	N	
3	6-8	P			N	N	
3	9-12	P			N	N	
3	Across	P			N	N	See skill-specific comments below.
4	K-2	P			N	N	
4	3-5	P			N	N	
4	6-8	P			N	N	
4	9-12	P			N	N	
4	Across	P			N	N	See skill-specific comments below.

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
5	K-2	P			N	N	
5	3-5	P	P		N	N	
5	6-8	P	P	P	N	N	
5	9-12	P	P	P	N	N	
5	Across	P	P	P	N	N	See skill-specific comments below.
	Comments	Although standard could include critical thinking and reasoning skills, the language of the knowledge-focused benchmarks does not explicitly state it.	Although information literacy skills are integral to the science enterprise, these skills are not explicitly included in the language of current benchmarks.	Although collaboration skills are integral to the science enterprise, these skills are not explicitly included in the language of current benchmarks.	As currently written, the benchmarks in Standards 2-5 do not explicitly require self-direction skills.	As currently written, the benchmarks in Standards 2-5 do no explicitly require invention skills.	

Science: 21st Century Skills and Abilities and Postsecondary and Workforce Readiness Review

Postsecondary and Workforce Readiness

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
1	K-2	F	F	F	F	F	F	
1	3-5	F	F	F	F	F	F	
1	6-8	F	F	F	F	F	F	
1	9-12	F	F	F	F	F	F	
1	Across	F	F	F	F	F	F	
2	K-2		P	P		N	P	
2	3-5		P	P		N	P	
2	6-8		P	P		N	P	
2	9-12		P	P		N	P	
2	Across		P	P		N	P	
3	K-2		P	P		N	P	
3	3-5		P	P		N	P	
3	6-8		P	P		N	P	
3	9-12		P	P		N	P	
3	Across		P	P		N	P	
4	K-2		P	P		N	P	
4	3-5		P	P		N	P	
4	6-8		P	P		N	P	
4	9-12		P	P		N	P	

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
4	Across		P	P		N	P	
5	K-2		P	P		N	P	
5	3-5	P	P	P	P	N	P	
5	6-8	P	P	P	P	P	P	
5	9-12	P	P	P	P	P	P	
5	Across	P	P	P	P	P	P	
	Comments							

Appendix S. Music: Internal Quality Review

Depth

Standard	Grade Span	Within span	Across span	Comments
1	K-4	I		Unable to determine expected depth of content. Some ambiguity of what "with appropriate technique" means at each grade span.
1	5-8	I		Unable to determine expected depth of content. Some ambiguity of what "with appropriate technique" means at each grade span.
1	9-12	I		Unable to determine expected depth of content. Some ambiguity of what "with appropriate technique" means at each grade span.
1	Across		I	Rated I given the very broad nature of the benchmarks. Benchmarks focus on the activities of singing, playing, responding without specifying level of mastery/expected outcomes of the singing/playing and content (what is sung/played). Benchmarks do specify how (in tempo, with appropriate technique, in two parts...), but these were not interpreted as depth specifications.
2	K-4	F		
2	5-8	F		Expectation of depth is subtle: reading rhythmic notation (K-4) versus reading rhythmic notation "in the context of a meter signature" (5-8); "notating simple melodies and rhythms" (K-4) versus "notating rhythmic, melodic, and expressive musical ideas" (5-8); identifying key signatures, also, is a step above mere identification of symbols.
2	9-12	P		Higher level of what students are expected to identify, read, and notate (i.e., "advanced"); however, expectation of depth is not different from earlier grade spans. Would like to see next level beyond identifying key signatures introduced (e.g., some theoretical foundation, which would lead to true "music literacy" stated in the rationale).
2	Across		F	
3	K-4	I		Unable to determine expected depth of content.

Standard	Grade Span	Within span	Across span	Comments
3	5-8	I		Unable to determine expected depth of content.
3	9-12	P		Assuming grade-appropriate scaling up of 3.9-12.1 (standard not distinct from 5-8). Expectation of improvisation is appropriate for grade span (extemporaneous, harder skill)
3	Across		I	Rated I given the very broad nature of the benchmarks. Benchmarks specify the activity of creating without specifying level of mastery/expected outcomes of the singing/playing. Benchmarks do include descriptive words such as “simple” and “short”; but these were not interpreted as depth specifications.
4	K-4	P		Unable to determine expected depth of content for 4.K-4.1. However, focus on timbre is appropriate for this grade span (somewhat inconsistent with focus on rhythm and tempo in Standard 1).
4	5-8	P		Unable to determine expected depth of content for 4.5-8.1. However, focus on meter, rhythm, melody and timbre is appropriate.
4	9-12	P		Unable to determine expected depth of content. However, the higher expectations (e.g., describing, comparing, evaluating, explaining) is appropriate for this grade span.
4	Across		P	
5	K-4	P		Only 5.K-4.3 is truly appropriate for lower part of span (K-1 or 2). Depth of 5.K-4.1 and 5.K-4.2 is questionable.
5	5-8	F		Rating is based on the broad statements before the example. Seems like appropriate level of depth for 5-8.
5	9-12	F		Rating is based on the broad statements before the example. Seems like appropriate level of depth for 9-12.
5	Across		F	

Music: Internal Quality Review

Coherence

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
1	K-4		P	Beginning point for K-4 could include more level appropriate tasks. K-4 does seem to prepare 5-8.
1	5-8		F	K-4 does seem to prepare 5-8 and 5-8 does seem to lead to 9-12.
1	9-12		F	5-8 does seem to prepare 9-12, despite the ambiguity in 9-12.
1	Across	F	F	P rating at K-4 not a huge issue, so, holistically, F.
2	K-4		F	
2	5-8		F	
2	9-12		F	Assuming grade-appropriate scaling up of expectations for 2.9-12.1.
2	Across	F	F	"Simple" and "advanced" used for K-4 and 9-12, respectively; however, no "level" indication articulated for 5-8 (though probably assumed to be somewhere between "simple" and "advanced").
3	K-4		F	Not much to go on; but probably OK.
3	5-8		F	Assuming grade-appropriate scaling up of expectations ("simple" used for 3.K-4.1 versus no "level" indication for 3.5-8.1.
3	9-12		F	
3	Across	F	F	
4	K-4		P	For lower part of span, could provide more appropriate beginning points (e.g., identifying/distinguishing between repetition, variance, and difference; connecting different sounds/musical ideas with non-musical ideas/emotions…).
4	5-8		F	
4	9-12		F	

Standard	Grade Span	Appropriate sequence	Appropriate beginning and endpoints	Comments
4	Across	F	F	Lack of enough appropriate beginning points at K-4 probably would not lower the overall rating across grade spans.
5	K-4		P	For lower part of span, could provide more beginning points (e.g., function/use of certain types of music).
5	5-8		P	Aside from example, not clear how 5.K-4.1 and 5.5-8.1 are distinct—maybe this is why examples were included in this strand? But, examples are very specific and could be challenging to apply more broadly.
5	9-12		P	For 5.9-12.1, "historical context" not prepared in 5-8—maybe would not expect it at K-4, but would by 5-8 (not to be confused with the roles of musicians in history, which is prepared at lower benchmarks).
5	Across	F	P	Given rationale for Standard 5, would expect ending point/coverage for aesthetics/interpretation to account for "…develop[ing] an understanding and appreciation of various cultures and histories."

Music: Internal Quality Review

Rigor

Standard	Grade Span	Rigor	Comments
1	K-4	F	
1	5-8	F	
1	9-12	F	
1	Across	F	
2	K-4	F	
2	5-8	F	
2	9-12	P	2.9-12.1 less specificity than in lower spans--presumably “standard notation” means all standard symbols.
2	Across	F	The P rating at 9-12 is probably not enough to lower the rating across grade span.
3	K-4	I	Unable to determine expected rigor of content.
3	5-8	P	Inclusion of harmonic patterns does add an appropriately higher level of rigor to this grade span; but still somewhat ambiguous.
3	9-12	P	Inclusion of improvisation over a chord progression does add an appropriately higher level of rigor to this grade span; but still somewhat ambiguous.
3	Across	P	
4	K-4	F	
4	5-8	F	
4	9-12	F	
4	Across	F	
5	K-4	P	5.K-4.1 and 5.K-4.2 may be too rigorous/inappropriate level of rigor for lower part of span, K-1 or 2.
5	5-8	F	
5	9-12	F	
5	Across	P	Given the few bullets for this standard, the lack of appropriate rigor at K-4 lowers this rating to P.

Music: Internal Quality Review

Breadth

Standard	Grade Span	Contains essential content	Free of extraneous content	Breadth within span	Comments
Across	K-4	F	F	F	
1	K-4	F	F		Content in K-4 does contain essential content but placement at K-4 vs. 5-8 is questionable. No extraneous content. • Only 1.K-4.4 is truly appropriate for lower part of span (K-1 or 2). • Some ambiguity of what "with appropriate technique" means at each grade level. • Focus on rhythm and tempo in 1.K-4.3 somewhat inconsistent with focus on timbre in 4.K-4.2; also focus on rhythm and tempo may be more appropriate in 5-8 and dynamic levels in 1.5-8.3 may be more appropriate for K-4.
2	K-4	F	F		
3	K-4	F	F		
4	K-4	F	F		
5	K-4	P	F		Breadth could be improved by including benchmark to capture "appreciation" part of rationale.
Across	5-8	F	F	F	
1	5-8	F	F		
2	5-8	F	F		
3	5-8	F	F		
4	5-8	F	F		
5	5-8	P	F		Cultural part of standard present but historical part missing except within the content of the role of musicians.
Across	9-12	F	F	F	

Standard	Grade Span	Contains essential content	Free of extraneous content	Breadth within span	Comments
1	9-12	F	F		
2	9-12	F	F		
3	9-12	F	F		
4	9-12	P	F		Might expect aesthetic/interpretation to appear at this level.
5	9-12	F	F		
Across	Across	F	F	F	
1	Across	F	F		
2	Across	F	F		
3	Across	F	F		
4	Across	F	F		
5	Across	P	F		Historical context (outside of musicians' role) is missing from K-8. Also, would expect aesthetics/interpretation to support notion of "appreciation" in rationale.

Appendix T. Music: External Referent Review—Massachusetts
External Referent: Arts Curriculum Framework November 1999 (Massachusetts)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Both generally address grades K-12.	MA's Learning Standards articulated at end of grade 4, end of grade 8, and end of basic and extended study in grades 9-12.	Although MA's grade articulation at the end of grade 4 and end of grade 8 may seem comparable to Colorado's K-4 and 5-8 grade articulation of standards, it is important to note that one set pertains to a five grade-range span (K through grade 4) and the other set specifies the endpoint only (*end* of grade 4). One possible advantage for specifying endpoints only is the flexibility that this could allow individual schools/districts to make decisions regarding curriculum (i.e., by determining at which grade level to place specific content and how to do so).
Hierarchy of Standards	MA standards, like CO, are divided into five standards (broad topics)—each of which has individual benchmark statements at end of each grade cluster.		Comparable
Number of Standards	Both CO and MA have five music standards.	MA has an additional five standards in the Connections Strand that include music (and other arts). Further subdivision of standards into benchmark statements: CO: • K-4: 16 benchmark statements • 5-8: 15 benchmark statements • 9-12: 13 benchmark statements	CO Total statements: 44 MA Total Music statements: 84 MA has significantly more benchmark statements than CO, reflecting the additional level of detail in MA's statements. Although the content is basically the same between MA and CO, MA's standards have a higher level of detail/granularity; also broader in range/scope (described further in Content rating below).

Subcategory	Similarities	Differences	Comments
Number of Standards (Continued)		MA (Music, does not include Connections): • End of grade 4: 26 benchmark statements • End of grade 8: 23 benchmark statements • End of basic study grades 9-12: 17 benchmark statements • End of extended study grades 9-12: 18 benchmark statements	
Design/Format	System of organization/presentation of standards by grade clusters/spans (end of 4, end of 8, 9-12) for each standard. Inclusion of key terms/glossary at end of standards. Presentation of content specific terminology found in glossary are identified (via asterisk in CO and via bold font in MA) in both CO and MA.	MA has a separate set of Connections standards that include all art disciplines. These standards tend to be broad ideas and concepts that are applicable to any art discipline (e.g., purposes and meaning in the arts, roles of artists in communities, concepts of style, stylistic influence, and stylistic change). MA's Music standards are unique to discipline of music. That is, unlike CO, MA places the history standards (Concepts of Style, Stylistic Influence, and Stylistic Change) in the Connections Strand as this is applicable to all of the arts. MA defines levels of difficulty in "Key Terms" (following standards) and specifies expected level of difficulty for each grade cluster. CO uses bullets to articulate benchmark statements; MA uses a numbering system that specifies the number of the standard followed by the statement number.	Some of MA's Connections standards map directly to CO's standards. Others go beyond by making connections to other disciplines and areas, such as technology, ELA, health, mathematics. MA defines levels of difficulty in "Key Terms" (following standards) and specifies expected level of difficulty for each grade cluster. Definition of difficulty levels could be helpful in interpreting standards; also promotes consistency in interpretation. A system for identifying each individual benchmark/standard would facilitate ease of reference for users of the document.

External Referent: Arts Curriculum Framework November 1999

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	Although MA mainly has two different standards (Singing and Playing Instruments) comparable to CO's standard 1, both focus on the same things—singing and playing, exposure to music from other cultures, articulation of number of music parts at each grade span, responding to cues of conductor, responding to music with movement.	MA's standards include more concepts related to sound production—clear diction, correct posture, playing position, accurate intonation, expanded breath control, extended vocal range. MA's standards specify the conditions for singing/playing (e.g., sing with and without accompaniment; sing in small ensembles with one student on a part; alone and in large ensembles; perform independent instrumental parts while other students sing or play contrasting parts; play from memory and written notation). Exposure in MA's standards to such skills as play by ear and sing at sight.	Focus of standard more similar than different—wording of comparable standard statements identical in content (e.g., students will sing, alone and with others, a varied repertoire of music). The focus on sound production reflects a broader approach in standards pertaining to performance. Providing more context about expectations not only sends the message that these aspects are important but also sends a clear message about expectations. It should be noted, however, that these types of expectations need not necessarily be a part of the standards, but may be appropriate to include in supplemental documents. Playing by ear implies a fairly sophisticated skill involving multiple processes (listening and internalizing what one heard in order to be able to execute it).
Standard 2	CO's standard 2 (read and notate music) corresponds very closely to MA's standard 2 (reading and notation). Both cover same concepts: identification, notation, use of music symbols. Both specify expectations of rhythmic durations at different grade spans.	MA specifies a system for reading/singing (syllables, numbers, letters). MA incorporates some basic and their inversions in arpeggiated form; seventh chords and their inversions). MA includes concept of playing in this standard (e.g., sight-read in a choral/instrumental ensemble; use a system to read and sing at sight).	MA's comparable standard goes beyond the realm of identifying, notating, and reading musical notation, and heads in the direction of developing musicianship skills and a basic understanding of theoretical concepts underlying music.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2 (Continued)		MA's standards may be interpreted as having more challenging, higher-level skills (e.g., sight-read music; read full instrumental or vocal score by describing how elements are used; explain transpositions, clefs; theory at the high school level in this standard (e.g., read and sing at sight…all intervals and their inversions…and triads	
Standard 3	Concept of composition and improvisation Use of various sound sources (sound sources available in classroom, electronic media) Knowledge of theory (CO: improvise over a chord progression; MA: improvise in pentatonic, major, and minor tonalities)	MA introduces concept of improvisation at each grade span; explicit in CO only at HS level. MA includes concept of arranging music. MA specifies at HS, demonstrate imagination and technical skill in applying principles of composition; demonstrate understanding of choral/instrumental scoring. MA includes concept of stylistically appropriate improvisation and composition in several distinct styles.	Inclusion of concept of arranging music broadens standard (as this involves knowledge of various instrument ranges, capabilities, and sound production). By including concept of style, MA incorporates broader vision in this standard—one that fuses knowledge of different cultures/music with creation (whether is it planned in advance or extemporaneous).
Standard 4	Music analysis	MA includes beat, tempo, rhythm, meter, pitch, melody, texture, dynamics, harmony, and form; CO includes form. MA includes style, genre, culture at every grade span; CO includes style at HS only. MA's standards reflect development of more diverse cognitive skills (perceive; describe; respond; analyze; demonstrate ability to perceive, remember, and describe; compare and contrast) than CO. At individual grade spans, MA's expectations are at a higher level than those of CO, based on the wording of the standards.	Although CO and MA have a similar number of benchmark statements for this standard at each grade span, the breadth of MA is much more expansive than CO as MA encompasses nearly all elements of music in one benchmark statement (timbre in separate statement). CO may want to consider restructuring this standard to ensure sufficient depth and breadth of content (e.g., is it enough to be able to identify form, contrasts in timbre for the entire K-4 span?).

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 4 (Continued)			The third bullet in CO's K-4 standard 4 leaves much room for interpretation (elements could be viewed as form, timbre [in which case, this statement would be redundant with the first two bullets]; expressive qualities could be viewed as changes in dynamic levels, changes in key signature, etc.).
Standard 5	Some of MA's comparable standards are in the Connections Strand; although the Music standards do account for diverse cultures (in a variety of places) and appropriate audience protocol.	MA has a more comprehensive treatment of standard: • appropriate audience protocol included at every grade span (only in CO K-4) • understanding of concepts of style, stylistic influence, and stylistic change by identifying when and where art works were created and by analyzing characteristic features of works from various periods, cultures, genres (Connections Strand) • inclusion of broader community—roles of artists, patrons, cultural organizations, arts institutions (only role of musicians in CO) • application of music to more diverse areas—ELA, foreign languages, health, mathematics, science, technology/ engineering	
Grades K–4	Overall content coverage is very similar to CO.	MA's standards occasionally have more specificity (e.g., sing ostinatos, use a system to read and sing at sight, intervals and their inversions from unison through an octave, seventh chords. MA's standards occasionally include higher-level skills (e.g., perform independent instrumental parts while others sing or play contrasting parts; improvise "answers" in same style, use appropriate terminology in describing music) but it should be reiterated that MA's standards are specified for the *end* of grade 4.	Despite slight differences, more similar than different.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 5–8	Overall content coverage is very similar to CO.	MA's standards specify difficulty levels based on scale of 1-6.	No substantive differences.
Grades 9–12	Overall content coverage is similar to CO.	MA's standards tend to include higher-level skills than CO (e.g., read full score, sight-sing moderately difficult melodies, improvise on pentatonic, major, and minor tonalities).	
Across All Grades			Even though MA's standards often are described above as representing a higher level or acquisition of more challenging skills, the difference in grade-span expectations (K-4 versus *end* of grade 4; 5-8 versus *end* of grade 8) could, in fact, explain the difference in expectations. CO may wish to consider the utility of presenting standards, particularly at K-4 and 5-8, as expectations for groups of students who may be at significantly different levels in their education, and therefore may not sufficiently capture the low and high ends of the grade span (or, may not present enough content at the low and high ends of the grade span).

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades (Continued)			The standards are based on the concept of literacy in the arts—knowledge of the arts is necessary "to understand range and depth of human imagination" (the arts are essential for expressing ideas and emotions that cannot be expressed through language alone). Musical fluency leads to "understanding of contemporary and historical culture, as well as self-knowledge." This basis can be directly linked to the broader contexts of some of the music standards. The standards provide links to other disciplines and areas.
Wording/specificity	In most instances, the wording and specificity are very similar.	Occasionally, there is slightly more specificity in MA.	Comparable

Appendix U. Music: External Referent Review—Virginia
External Referent: Music Standards of Learning for Virginia Public Schools April 2006

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Both generally address grades K–12. Both treat the middle and upper levels as a cluster (CO articulates standards for 5-8 and 9–12; VA articulates standards for 6-8 [general music] and 9–12 [general music]).	CO articulates standards for the lower levels as a group (K–4); VA articulates the standards at each grade level (K, 1, 2, 3, 4, 5). Instrumental Music Standards of Learning and Vocal/Choral Music Standards of Learning articulated at different sequential and developmental levels: • Beginning • Intermediate • Advanced • Artist	By articulating standards at each grade level before middle school, VA provides clear guidance for instruction at lower grade levels, thereby presenting age-appropriate expectations for grades K–1 verses grades 3–4). Specification of standards by developmental stages can be useful as a realistic application based on an individual student's starting point irrespective of grade level. However, organization of standards based on developmental stages may not be consistent with broader state standards and could be impractical. The value of such specification lies mainly in the practical level of detail that it can offer and such information can be communicated via supplemental documents.
Hierarchy of Standards	CO's standards are divided into five standards (broad topics)—each of which has individual benchmark statements at K–4, 5–8, and 9–12. CO's standards are most similar (comparability) to VA's Music Standards of Learning, which are divided into four broad strands (Performance and Production, Cultural Context and Music Theory, Judgment and Criticism, Aesthetics)—each of which has grade-specific statements at K, 1, 2, 3, 4, 5, 6–8, and 9–12.	VA's standards are divided into three broad classes of standards: (1) Music Standards of Learning (4 strands) (2) Instrumental Music Standards of Learning (same 4 strands) (3) Vocal/Choral Music Standards of Learning (same 4 strands) Each broad class has several individual statements—some of which are comparable to CO's benchmark statements, others are at a more specific level of detail. Each benchmark statement in VA is further supplemented with numbered tasks that offer more specificity.	VA's standards—because of the separation into three broad classes united by the same four strands as well as the elaboration of task-specific statements—yields a hierarchy that is both broad and very specific. In this sense, there is a multi-leveled hierarchy. (see more detailed comment in Design/Format)

Subcategory	Similarities	Differences	Comments
Number of Standards	CO has five standards. VA has four comparable standards ("strands").	Further subdivision of standards into benchmark statements: CO: • K–4: 16 benchmark statements • 5–8: 15 benchmark statements • 9–12: 13 benchmark statements VA Music Standards of Learning: • K: 12 benchmark statements • 1: 12 benchmark statements • 2: 11 benchmark statements • 3: 15 benchmark statements • 4: 15 benchmark statements • 5: 13 benchmark statements • 6–8: 9 benchmark statements • 9–12: 9 benchmark statements VA Instrumental Music Standards of Learning: • Beginning: 25 benchmark statements • Intermediate: 25 benchmark statements • Advanced: 26 benchmark statements • Artist: 27 benchmark statements VA Vocal/Choral Music Standards of Learning: • Beginning: 14 benchmark statements • Intermediate: 14 benchmark statements • Advanced: 16 benchmark statements • Artist: 16 benchmark statements	CO Total statements: 44 VA Total statements: 259 (96 Music; 103 Instrumental, 60 Vocal/Choral) In general, greater coverage, greater specificity (explained in Content rating below) in Virginia's standards. Important to note, however, that 1 broad CO statement often times is covered in multiple specific VA statements.
Design/Format		VA's Music Standards of Learning are presented based on three broad classes of standards: • K, 1, 2, 3, 4, 5; 6–8; 9–12 • Instrumental Music Standards of Learning • Vocal/Choral Music Standards of Learning The standards are presented separately but	Although there is some overlap among the Music Standards of Learning and the Instrumental and Vocal/Choral Music Standards, the Instrumental and Vocal/Choral standards tend to address technical aspects of performing and standards that are specific to learning particular instruments. Information that is

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)		intended to be integrated in instruction. VA includes brief introductions at each of the main subdivisions (K–5 standards, 6-8 general standards, 9–12 general standards, instrumental music, vocal/choral music. CO uses bullets to articulate benchmark statements; VA uses a numbering system that specifies the grade level (or K for kindergarten) followed by the standard number. (Abbreviations are used for the Instrumental and Vocal/Choral Music Standards of Learning.)	specific to particular instruments can be useful in that it offers guidelines for expectations based on the instrument type. CO may want to examine the purpose of their standards, whether they are grade-specific skills to be acquired at each grade level, grade-span skills to acquire over the course of study at elementary, middle, and high school, or some combination of this (possible through supplemental document). Regardless of the intent, the standards should contain sufficient content for instruction at the specified grade level or range. These introductions are a helpful way to incorporate the broader context for the standards that follow. CO may wish to adopt a system for identifying each individual benchmark/standard to facilitate ease of reference for users of the document.

External Referent: Music Standards of Learning for Virginia Public Schools April 2006

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	Sing and play instruments Individual and group performance (VA's comparable standards are mainly in the Performance and Production strands of the Music, Instrumental, and Vocal/Choral standards.)	VA's benchmark statements provide specific direction (e.g., imitate two-pitch [sol, mi] patterns; perform rhythmic patterns that include sounds and silences; sing melodies within the range of one octave); CO's benchmark statements are fairly general (e.g., singing or playing music, with appropriate technique, in rhythm, in tempo, and on pitch). Within this standard, VA maintains focus on various performance aspects (e.g., using pitched and non-pitched instruments, with clear tone quality, I, IV, V chords); CO includes non-performance elements into standard (e.g., culturally diverse literature, vocal and instrumental literature). In VA's standards for instrumental and vocal/choral music, additional expected skills are provided on the mechanics of sound production, technical aspects of playing/singing, specific technical skills (e.g., play c and d three-octave minor scales and one-octave tonic arpeggios on viola or cello), etc., as these relate to specific instrument groups.	As directed and specific statements, VA's standards provide tangible starting points for instruction, which could be realized in the classroom. Although there is justification for including culture/history into a performance standard since the music that students sing/play usually does have some cultural/historical context, VA's treatment of performance and cultural context in separate strands provides for a fairly substantive treatment of history/theory, creating a balanced supplement to performance.
Standard 2	Both focus on making sense of music symbols, identifying specific rhythmic values at different grade levels/spans, notation of melody and rhythm.	VA's standards provide a higher level of detail (e.g., division of music into measures; specification of reading music in treble staff; movement by step/leap; use of syllable, number, letter system to read and write simple pitch notation in appropriate clef).	This higher level of detail allows VA's standards to provide tangible starting points for instruction, which could be realized in the classroom.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 2 (Continued)	(VA's comparable standards are mainly in the Reading and Notation strands of the Music, Instrumental, and Vocal/Choral standards.)	VA's standards include wider range of expectations for notation (e.g., notate from dictation; employ technology to notate).	
Standard 3	Creation, improvisation (VA's comparable standards are mainly in the Performance and Production strands of the Music, Instrumental, and Vocal/Choral standards.)	• VA includes arranging music using choice of notation and form. • VA incorporates movement (to illustrate meter and form). • VA includes specific tasks (e.g., create music to enhance songs, stories, poems; create melodies to familiar nursery rhymes or chants; create lyrics to melodies; create accompaniments and ostinatos; discuss how composer communicates ideas by manipulating music elements; create arrangements of known melodies). • VA includes concept of improvisation from grade 1 on.	The task-specific statements in VA could be potentially very helpful for informing classroom instructional activities (concrete ideas that can be easily implemented with no additional resources needed).
Standard 4	Both focus on similar aspects of music: form, timbre, melody, rhythm, meter, expressive qualities, musical style. (VA's comparable standards are mainly in the Cultural Context and Music Theory strand of the Music, Instrumental, and Vocal/Choral standards.)	VA's standards tend to provide more specificity (e.g., like and unlike phrases, ABC, rondo, theme and variations; identify function of top and bottom number of meter signature; distinguish between major and minor; demonstrate contour of phrase and describe how pitches move up, down, stay the same). VA's standards have a more robust/ substantive treatment of style (e.g., place musical examples in categories of style; recognition of composer and music composition from different periods of music history; investigate music sounds, forms, styles, genres through listening, discussing, writing and performing).	Inclusion of a higher level of detail (greater specification) leaves less room for interpretation and facilitates standards-based teaching that is consistent across different learning environments. It should be noted, however, that neither CO nor VA specifically focuses on style.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 5	Use of elements of music from different cultures (study of music from different cultures) Appropriate audience behavior (VA's comparable standards are mainly in the Judgment and Criticism, Cultural Context and Music Theory, and Aesthetics strands of the Music, Instrumental, and Vocal/Choral standards.)	VA has more substantive treatment/depth of culture and history: • explore music of world cultures through song, dance, and movement • compare and contrast material in its historical and cultural context • associate aural examples with variety of cultures, styles, historical periods • identify and analyze cultures, styles, composers, historical periods	
Grades K–4	All of CO's K–4 standards are covered in VA's standards.	VA's standards offer detailed tasks at each grade (e.g., use the voice in speech and song, use the body to illustrate moods and contrasts in music, identify men's, women's, and children's voices).	The advantage of grade-specific standards is the specificity of appropriate standards at the lower grades.
Grades 5–8	All of CO's 5–8 standards are covered in VA's standards.	No substantive differences between CO's standards for grades 5–8 and VA's standards for grade 5, and 6–8 (outside of what has been mentioned).	
Grades 9–12	All of CO's 9–12 standards are covered in VA's standards. Of all grade spans, CO's HS standards provide the most comparable level of specificity to those of VA.		VA does not indicate content expectations with as much precision at HS level as at the lower grade spans. Specific content for HS allows for more flexibility, more interpretation (probably not a problem—guidance of what is meant for HS can be gleaned from knowing the expectations at lower grades).

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Across All Grades		VA's standards provide a strong and consistent link of music to other disciplines/areas. This is apparent not only in the Aesthetics strand, but also in standards in other strands (e.g., compare and contrast relationships between music and other disciplines; identify how characteristics of sound, visual stimuli, other stimuli, movement, and human interrelationships can influence the fine arts; investigate role of music in the human experience; discuss musical performance and its value to the community). Prevalent inclusion of computer technology throughout VA's standards (e.g., employ technology to notate and/or read music; role of technology in development of music; employ technology to explore musical sound).	<u>Comments regarding how ideology, design, and principles behind VA's standards contribute to overall strength of standards:</u> • The standards are based on the underlying belief that music provides a foundation for connecting concepts, facts, and higher-order thinking skills throughout the curriculum. • The standards are intended to, and do, provide a practical and realizable basis for instructional strategies, particularly at the lower grades. • The standards provide links to other disciplines. • The standards provide important links to life outside of music. • The standards capture both the broad bird's eye view as well as the microscopic view (e.g., specific technical expectations for particular instruments). • The standards offer consistency in spiraling of similar content through nearly all levels. • The standards are comprehensive in treatment of large categories (music, instrumental, vocal/choral). Inclusion of technology could be both practical and useful.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity		VA's standards tend to be very precise in wording and specific to different areas in music (e.g., using pitch and non-pitched instruments, using sight and sound, traditional and nontraditional sound sources, notate from dictation; identify and perform sets of beats that are grouped in twos and threes, using descriptive terminology to identify which beats are strong and which beats are weak).	As directed and specific statements, VA's standards provide tangible starting points for instruction, which could be realized in the classroom. The task-specific statements in VA could potentially be very helpful for informing classroom instructional activities (concrete ideas that can be easily implemented with no additional resources needed). Inclusion of a higher level of detail (greater specification) leaves less room for interpretation and facilitates standards-based teaching that is consistent across different learning environments.

Appendix V. Music: External Referent Review—Finland
External Referent: National Core Curriculum for Basic Education 2004 and National Core Curriculum for Upper Secondary Schools 2003 (Finland)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Grades 1–4 (comparable to CO's K–4) Grades 5–9 (comparable to CO's 5–8) Upper Secondary (comparable to CO's 9–12)	Upper Secondary is articulated in courses. Although the courses do build on previous statements, it is not directly comparable to Colorado MCS.	
Hierarchy of Standards	Grades 1–4: • Objectives (similar to CO's standards) • Core Contents (exercises/activities to achieve goals/endpoints) Grades 5–9: • Objectives (similar to CO's standards) • Core Contents (exercises/activities to achieve goals/endpoints)	Grades 1–4: • Description of good performance (endpoints based on Objectives articulated) Grades 5–9: • Final-Assessment Criteria for a grade of 8 (good) Upper Secondary: Compulsory and Specialization Courses	Finland's Objectives are very similar to CO's standards and some of their Core Contents are very similar to CO's benchmark statements.
Number of Standards		Finland: Grades 1–4: 5 Objectives, 7 Core Contents Grades 5–9: 4 Objectives, 4 Core Contents Upper Secondary: 2 Compulsory Courses and 3 Specialization Courses CO: • K–4: 16 benchmark statements • 5–8: 15 benchmark statements • 9–12: 13 benchmark statements	

Subcategory	Similarities	Differences	Comments
Design/Format	Like CO's benchmark statements, Finland's Objectives at each grade span are presented with bullets.	Finland's core curriculum is not organized around set topics that are spiraled across different levels. Instead, the focus of the Objectives for grades 1–4 are on creativity (development of musical expression through playful and integrating activity, encourage expression and giving form to ideas). The focus of the Objectives for grades 5–9 are on analysis and integrating knowledge with practice. At Upper Secondary, rather than taking all previous objectives to a higher level, students are provided the opportunity to pursue individual interests via courses.	A system for identifying specific parts of the standard/objective would be useful and practical for users of the document.

External Referent: National Core Curriculum for Basic Education 2004 and National Core Curriculum for Upper Secondary Schools 2003

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	Both focus on • singing/playing, alone and in a group • movement • improving abilities (at higher levels) Both specify performance expectations in terms of number of parts.	Finland includes • exercises using the voice by speaking • talking nonsense • age-appropriate song games • exercises that prepare skills for playing instruments together • singing exercises that prepare the pupils for singing in parts • using their bodies as instruments	Finland's approach to sound production—production of sound that is not necessarily directly connected to music—is more broad than CO's. Finland's comparable statements offer more at the lower grade levels.
Standard 2		Finland does not place a clear emphasis on notation.	
Standard 3	Finland places a similar emphasis on composing, improvising, and experimenting using sound.	Finland specifies • arranging using sound, song, instruments, and musical technology • music technology	
Standard 4	Like CO, Finland focuses on listening to, and critically evaluating, sound environments and knowing musical styles.	Finland's comparable Objectives and Core Contents do not specify elements (form, timbre, meter...), as CO's does; Finland's statements are much broader and more general (e.g., listen to and observe the sound environment and music actively and intently; listening to a variety of music, using various means of activation; describing one's own experiences and ideas).	Although broad statements offer flexibility and room for interpretation, as standards, a balance between broad concepts and specific content to be mastered is more likely to lead to acquisition of specific knowledge and skills than broad statements would. Providing specificity is also more likely to yield overall consistency in how the standards are applied.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 5	Both provide exposure to • music of various cultures/diversity of the musical world • audience protocol	Finland's comparable Objectives and Core Contents are more broad and general than CO's (understand the diversity of the musical world; diverse listening selections and their analysis in terms of time, locale, and culture). Finland also specifies • act responsibly as members of a music-making group • music of Finland • music of different eras and musical genres	Finland's focus on responsible action reflects one of their cross-curricular themes. As national standards intended to serve as the basis for formulation of local curriculum, the focus on the music of Finland is logical..
Grades K–4	Most of the content in Finland's grades 1–4 are present in CO's parallel standards.	Finland accounts for more exercises that would "prepare" students for ensemble work (exercises that prepare the pupils for singing in parts; exercises that prepare the pupils for playing together on instruments).	Though Finland's Objectives and Core Contents are usually represented in CO's standards, there is more room for interpretation in Finland's standards. Finland offers less specificity and detail than CO.
Grades 5–8	Most of the content in Finland's grades 5–8 are present in CO's parallel standards.	Notation explicitly mentioned in this grade span only.	
Grades 9–12		At this level, Finland's curriculum offers the following courses: • *Music and Me* (compulsory) – Students find their own ways of operating within the field of music (making music; observing acoustical environment), reflecting on its significance to people and interpersonal interaction. • *Polyphonic Finland* (compulsory) – Students learn about Finnish music and reinforce their cultural identity. • *Open up to Music* (specialization) – Students learn to know genres and music cultures and understand the culturally bound nature of music. • *Music's Message and Influence* (specialization) – Students familiarize themselves with uses of music and its opportunities to influence different art forms and media.	Given Finland's design at Upper Secondary of compulsory and specialization courses, these are difficult to compare to CO's 9–12 standards. However, based on the course descriptions, the courses expand on themes presented in earlier Objectives and Core Contents.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 9–12 (Continued)		• *Music Project* (specialization) – Students plan and implement a complete music project, in a team or independently.	
Across All Grades		Though Finland's Objectives and Core Contents are usually represented in CO's standards, there is definitely more room for interpretation in Finland. Finland offers less specificity and detail than CO.	Comments regarding how ideology, design, and principles behind Finland's standards contribute to overall strength of standards: National objectives: to enable students to acquire extensive all-round learning and form a structured world view; to strengthen students' self-esteem and recognize personal uniqueness. Upper Secondary instruction must stimulate students to engage in artistic activities, participate in artistic and cultural life and adopt lifestyles that promote health and well-being. Basic values of Upper Secondary instruction: • Finnish cultural history (learn how to treasure, assess, renew cultural heritage) • respect for life and human rights • pursuit of truth, humaneness, and justice • recognize conflicts between stated values and reality and ponder critically disadvantages/opportunities of Finnish society All Upper Secondary instruction is organized around themes common to all content areas (active citizenship, safety and well-being, sustainable development; cultural identity and knowledge of cultures, technology and society, communication and media competence). Curriculum formulated based on notions of integration (interdisciplinary) and cross-curricular themes.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity		In general, Finland offers less specificity in the wording of its curriculum than CO.	Given Finland's stated values (above), less specificity seems to work; however, less specificity would not likely yield effective standards.

* NOTE: Review of Finland Core Curriculum was based on stated Objectives and Core Contents (because these statements were the most comparable to Colorado's benchmarks).

Appendix W. Music: External Referent Review—Singapore
External Referent: General Music Programme Syllabus (Primary/Secondary) 2008 (Singapore)

Organization/Structure

Subcategory	Similarities	Differences	Comments
Grade Articulation	Singapore's Learning Outcomes are articulated based on years in primary and secondary education.	Recommended stage of development corresponding to years in primary and secondary education: • Stage 1 – Primary years 1-4 • Stage 2 – Primary years 5-6 • Stage 3 – Secondary years 1-2 • Stage 4 – Secondary years 3-4 or 5 • Stage 5 – Some students may reach these learning outcomes at end of secondary education, but not an expectation for all students Instructional program to be developed based on individual student's existing music abilities	Despite articulation at stages (Singapore) rather than grade levels (CO), these somewhat corresponds to grades. Singapore's articulation at stages emphasizes ability rather than grade level.
Hierarchy of Standards	Singapore has six broad Objectives—all of which provide substantial detail at each stage and the content is intended to build on skills learned at previous stages (spiraled). Only new Learning Outcomes are articulated at higher stages.	Stages 1 and 2 of the Learning Outcomes are followed by a list of Music Elements/Concepts, Music Instruments, and Repertoire. Stages 3 and 4 of the Learning Outcomes are followed by a list of Music Elements/Concepts and Repertoire.	In terms of the level of information provided for each Objective, Singapore is similar to CO. Singapore's Objectives, in appearance and content, provide a comparable level of information to CO's standards and benchmark statements taken together.
Number of Standards	Six Objectives, most of which read very similar to CO's five standards	No significant differences.	
Design/Format	Music Elements/Concepts at the end of Stages 1 through 4 do offer some definitions, functioning similar to CO's Glossary following the standards. Both use bullets to organize information.		There is overlap in what Singapore includes in the Music Elements/Concepts sections after the presentation of Stages 1 and 2 Learning Outcomes and the content of Colorado's standards.

Subcategory	Similarities	Differences	Comments
Design/Format (Continued)		Front matter of Singapore's General Music Programme offers pedagogical ideas (thematic approach, concept approach, interdisciplinary approach, modular approach). Presentation of all six Learning Outcomes is by stage (all Stage 1 outcomes on one page) in contrast to Colorado's presentation of different benchmarks by standard. CO's use of bullets is more structured/consistent (i.e., nearly all bullets contain the same level and type of information); Singapore mixes use of bullets with paragraph statements for different objectives (different levels of information/inconsistent levels of information depending on the objective).	The presentation of information at different levels (tasks/activities in the different stages of Learning Outcomes; and terms/concepts in the Music Elements/Concepts section) conveys a fairly clear understanding/interpretation of music instruction in Singapore. Inclusion of pedagogical ideas not only is practical and useful, but also reflects flexibility in that a variety of teaching approaches increases the chances for students to succeed, to actively engage with the content, and to growth overall. Both teachers and students benefit from a range of learning methods. Although this type of presentation does not make it easy to recognize connections of a content idea across different stages, it does facilitate use by classroom teachers. A system for identifying specific parts of the standard/objective would be useful and practical for users of the document.

External Referent: General Music Programme Syllabus (Primary/Secondary) 2008

Content

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 1	CO's standard 1 reads very similar to Singapore's Objective 1 (sing and play melodic and rhythmic instruments individually and in groups). Both focus on singing/playing with accurate rhythm, pitch, phrasing, tempo. Both specify number of parts for ensemble playing/singing.	CO identifies elements of music in this standard, such as rhythm, tempo, melody, dynamics, blending, phrasing, expression in their standards. Singapore specifies elements of music in the Music Elements/Concepts sections following the Learning Outcomes section. In the Learning Outcomes, Singapore articulates specific activities (sing in unison, 2-part canons; use solfege names and hand signs; play tuned and untuned instruments, playing/holding technique, accompanying singing; play/sing in parts/a cappella). Singapore's Stage 5 outcome (program a performance) articulates a level of performance that goes beyond what is implied in CO's standards.	Mostly comparable specification of content Specification of tasks could be useful for informing instructional activities and determining stage-appropriate lesson plans. This aspect supports and reinforces Singapore's Objectives as true stages of learning (not bound by instructional activity at specific grades).
Standard 2	Singapore does not have a specific Objective devoted solely to reading and notating music; however, some of this content is covered in other Objectives.	Singapore includes • use of graphic notation to represent sound • cipher notation	Using graphic notation is a practical method for teaching the concept of reading melodic notation to younger students.
Standard 3	CO's standard 3 is very similar to Singapore's Objective 2 (create and improvise music). Both focus on • creation via various sound sources • improvisation	The breadth of content in Singapore is greater with more detailed specification: • explore ways sounds are organized through manipulating, experimenting, and putting it together • improvise 3- and 4-beat rhythmic and melodic patterns and phrases	The focus on technology demonstrates a contemporary relevance; however, in practice, ensuring that schools have the appropriate resources for instruction can be challenging for states.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Standard 3 (Continued)	• composition	• create sound effects with untuned instruments • create sounds to enhance stories and visuals • manipulate and sequence variety of electronic sounds • organize acoustic and electronic sounds Singapore includes improvisation at every stage.	
Standard 4	CO's standard 4 is covered in Singapore's Objectives 4 (develop understanding of music elements/concepts) and 5 (discern and understand music from various cultures and of various genres). Both focus on • identification of elements (timbre, tempo, pitch, dynamics, form) • evaluation of music performances • musical style	Singapore specifies • modes (major, minor, pentatonic) • organization of pitch and time	Focus on modes and organization of pitch implies exposure to theory; however, overall content coverage is more similar than different.
Standard 5	CO's standard 5 is similar to Singapore's Objective 5 (discern and understand music from various cultures and of various genres). Both focus on • music in various cultures • roles of performer, composer	Singapore specifies • folk, popular, art music • use of technology in creating musical identity • personal and group identify in music Singapore also focuses on music of Malay, China, India.	Singapore defines more aspects of the content than CO does and provides a wider context. This wider context can serve as a forum for learning about contemporary notions of creativity (e.g., use of technology in the creative process).
Grades K–4	Mostly Singapore's Stages 1 and 2 correspond to CO's K-4 standards.	No significant differences.	
Grades 5–8	Mostly, Singapore's Stages 3 and 4 correspond to CO's 5–8 standards.	Singapore's Stages 3 and 4 Music Elements/Concepts specify chords/harmony (further indication of grounding in theory).	

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Grades 9–12	Mostly, Singapore's Stages 4 and 5 correspond to CO's 9–12.	Singapore's highest Stage (5) tends to have the least amount of detail (program a performance according to a given context; use relevant music vocabulary to explain preferences).	Not a significant issue given that Stage 5 is not expected of all students.
Across All Grades	Despite a very different organization/structure, the content of Singapore's Objectives parallel Colorado's standards with a few exceptions (noted in next column).	Fairly substantial emphases on • electronic and synthesized sounds/ technology (MP3, MIDI, sampled sound) • Singapore's Objective 6 focuses on the role of music in daily life (computer games, ads, film, Internet). • popular culture (MTV, R & B, techno) Exposure to • music/recording industry • national music (music of Malay, China, India) • sound used to enhance effects in stories and visuals	Singapore's focus on technology and the music/recording industry exposes students to vocational options in music (industry jobs) and presents a wider view of music. This emphasis is very different from looking at the role of the composer or, more generally, music as an art form to be created and studied (but not necessarily as an "industry").
Wording/Specificity	Many parts of Singapore's Objectives provide a comparable level of specificity to CO's standards.	Singapore's Objectives, as tasks, in addition to the inclusion of Music Elements/Concepts, overall offer a slightly broader, more comprehensive picture of instruction and instructional activities at different Stages than CO's standards.	Whether they are part of the standards or a separate support document, additional information—in the form of identifying specific content or specific activities that can be easily implemented in the classroom without any significant new resources—would provide additional support and result in greater consistency in instruction. <u>Comments regarding how ideology, design, and principles behind Singapore's standards contribute to overall strength of standards:</u> • Inclusion of Music Elements/Concepts, Music Instruments, and Repertoire at end of Learning Outcomes provides scope of learning.

Subcategory	Similarities in emphasis	Differences in emphasis	Comments
Wording/Specificity (Continued)			• Specification of tasks in Learning Outcomes could be useful for informing instructional activities and determining stage-appropriate lesson plans. • Amount of information and various levels of information (broad vs. specific) lead to greater understanding by field and consistency in implementation. • Flexibility in syllabus structure (Stages) • Inclusion of pedagogical ideas not only is practical and useful, but also reflects flexibility and the reality that a variety of teaching approaches increase the chances for students to actively engage with the content, to succeed, and to lead to overall growth. Both teachers and students benefit from a range of learning methods. Outcomes could be useful for informing instructional activities and determining stage-appropriate lesson plans. • Amount of information and various levels of information (broad vs. specific) lead to greater understanding by field and consistency in implementation. • Flexibility in syllabus structure (Stages) • Inclusion of pedagogical ideas not only is practical and useful, but also reflects flexibility and the reality that a variety of teaching approaches increase the chances for students to actively engage with the content, to succeed, and to lead to overall growth. Both teachers and students benefit from a range of learning methods.

Appendix X. Music: 21st Century Skills and Postsecondary and Workforce Readiness Review

21st Century Skills

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
1	Across	F		F	F	P	• P for Invention because singing and playing (performing) frequently do involve interpretation and creativity.
2	K-4	F	F				
2	5-8	F	F				
2	9-12	F	F				
2	Across	F	F				
3	K-4	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	5-8	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	9-12	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	Across	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	5-8	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
							standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	9-12	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	Across	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
4	K-4	F	F				
4	5-8	F	F				
3	9-12	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
3	Across	F		N	F	F	• N for Collaboration because although this is not in the standard, it could be a reasonable addition to the standard (e.g., add a phrase similar to "alone or with others," similar to the wording of standard 1).
4	K-4	F	F				
4	9-12	F	F				
4	Across	F	F				
5	K-4	F			P		P for Self-direction because demonstrating appropriate audience behavior does involve personal responsibility.
5	5-8	F			N		N for Self-direction because, although this skill is not in the standard at this grade span, if some version of demonstrating appropriate audience behavior were

Standard	Grade Span	Critical thinking and reasoning	Information literacy	Collaboration	Self-direction	Invention	Comments
							continued or spiraled at the higher levels, this would be represented in the standard.
5	9-12	F			N		N for Self-direction because, although this skill is not in the standard at this grade span, if some version of demonstrating appropriate audience behavior were continued or spiraled at the higher levels, this would be represented in the standard.
5	Across	F			N		Self-direction could be incorporated into this standard (the easiest way would be to continue and expand the bullet on appropriate audience behavior, which currently appears only at K-4).
	Comments	Critical thinking and reasoning is prominent throughout all Music standards.	Information literacy clearly applies to standard 2 (notation). Also, the processes of analyzing, evaluating, and describing music (standard 4) do involve acquiring musical knowledge, discerning sources (instruments, musical elements, etc.), and overall musical literacy.	Collaboration is prominent in Music standard 1. (See comment below regarding Collaboration and Self-direction.)	Self-direction—defined as adaptability, initiative, personal responsibility, work ethics, and self-advocacy—implies more than simply working individually. As such, it did not seem an appropriate fit for many of the music standards.		

Music: 21st Century Skills and Postsecondary and Workforce Readiness Review

Postsecondary and Workforce Readiness

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
1	K-4				F	F	F	
1	5-8				F	F	F	
1	9-12				F	F	F	
1	Across				F	F	F	
2	K-4	F			N			N for Information management skills because, as defined (system thinking competencies, financial awareness, increasing productivity and adapting to new information), this does not relate to reading and notating music. However, since musical notation is a system that requires decoding, a broader approach in the wording of this PWR would make it appropriate for the standard.
2	5-8	F			N			N for Information management skills because, as defined (system thinking competencies, financial awareness, increasing productivity and adapting to new information), this does not relate to reading and notating music. However, since musical notation is a system that requires decoding, a broader approach in the wording of this PWR would make it appropriate for the standard.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
2	9-12	F			N			N for Information management skills because, as defined (system thinking competencies, financial awareness, increasing productivity and adapting to new information), this does not relate to reading and notating music. However, since musical notation is a system that requires decoding, a broader approach in the wording of this PWR would make it appropriate for the standard.
2	Across	F			N			N for Information management skills because, as defined (system thinking competencies, financial awareness, increasing productivity and adapting to new information), this does not relate to reading and notating music. However, since musical notation is a system that requires decoding, a broader approach in the wording of this PWR would make it appropriate for the standard.
3	K-4		P	F	N			• P for Logical reasoning because the process of creating rhythmic/ melodic patterns and short selections would involve reasoning and communication via musical language.• N for Information management skills because if improvisation were extended down (from 9-12), could be appropriate fit.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
3	5-8		P	F	N			• P for Logical reasoning because the process of creating short compositions would involve reasoning and communication via musical language. • N for Information management skills because if improvisation were extended down (from 9-12), could be appropriate fit.
3	9-12		P	F	P			• P for Logical reasoning because the processes of creating phrases and improvising would involve reasoning and communication via musical language.• P for Information management skills because improvising does involve "adapting to new information."
3	Across		P	F	N			
4	K-4		F		N		F	N for Information management skills because although the skill is not present in the current standard, the processes of analysis and evaluation do involve managing information. A broadening of this skill would likely capture this.

Standard	Grade Span	Application of reading, writing, and computing skills with minimal remediation or training	Logical reasoning and argumentation abilities	Identification and solving of problems	Information management skills	Human relation skills	Analysis and interpretation skills	Comments
4	5-8		F		N		F	N for Information management skills because although the skill is not present in the current standard, the processes of analysis and evaluation do involve managing information. A broadening of this skill would likely capture this.
4	9-12		F		N		F	N for Information management skills because although the skill is not present in the current standard, the processes of analysis and evaluation do involve managing information. A broadening of this skill would likely capture this.
4	Across		F		N		F	N for Information management skills because although the skill is not present in the current standard, the processes of analysis and evaluation do involve managing information. A broadening of this skill would likely capture this.
5	K-4		F				F	
5	5-8		F				F	
5	9-12		F				F	
5	Across		F				F	