COURSE OF Study in Agriculture

FOR THE

SEVENTH AND EIGHTH GRADES

OF THE PUBLIC SCHOOLS

OF THE

State of Colorado
1910

ISSUED BY
KATHERINE M. COOK
State Superintendent of Public Instruction

Denver, Colorado
The Smith-Brooks Printing Co., State Printers
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[PART 2]

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ALLIED PRINTING TRADES UNION LABEL COUNCIL DENVER

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of the Public Schools of the State of Colorado

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OUTLINE OF WORK IN THE FIELD OF AGRICULTURE.

The work covered in agriculture is briefly outlined here to give an idea of its extent and in general the way in which it is divided in many agricultural schools and colleges.

Work given in any of the lines mentioned is in the field of agriculture, and if it relates to the activities of the people in the community where taught, or assists to arouse the interest of the people of the community in their occupation, it is fulfilling the purpose for which "Rural School Agriculture" is being introduced.

The work in agriculture is based on the underlying sciences of botany, zoology (including entomology), physics, chemistry and economics. Any work given must necessarily be a mixture of agriculture and its basic sciences.

It is desirable to give beginners in the work lessons which are interesting, first of all, and which have a practical application to their environment. This will stimulate a desire for additional knowledge as to the why of things and will largely do away with the necessity of compelling pupils to study the pure sciences because they will later be of use to them.

OUTLINE OF THE WORK COVERED IN THE FIELD OF AGRICULTURE.

AGRICULTURE—The production of plants and animals.

A—Horticulture—The production of vegetables, fruits, flowers and ornamental plants.

REPORT ON SEED GERMINATION.

Name of student..

Date experiment began..

KIND OF SEED	Number Placed in Germinator	NUMBER OF SEED GERMINATED AT THE END OF							Total Number Germinated	Per Cent. Germinated
		1st Day	2d Day	3d Day	4th Day	5th Day	6th Day	7th Day		

Discard daily all of the seeds which have a sprout one-fourth of an inch long, and record the number in the proper place. At the end of the seventh day discard all seeds left. Add up the number germinated and figure out the percentages.

All good commercial seeds, with the exception of some of the smaller seeds and grasses, should germinate between 90 and 100 per cent. Other seeds will range from 50 per cent. up. Good alfalfa seed should germinate 80 per cent. or more.

Seed low in vitality is worth considerably less than seed high in vitality. When better seed is not obtainable it is necessary to increase the amount planted per acre according to the per cent. of germinations.

References: 1—pp. 77-80; 2—pp. 145-151; 3—p. 20.

*The names of the references which these numbers refer to will be found at the end of the set of exercises.

EXERCISE—SEED PURITY.

(2) Purity—Freedom from foreign seeds and other material.

- (a) Some impurities—Weed and other kind of seeds, chaff, pieces of stem, sand, gravel, etc.
- (b) Seeds most likely to be impure are grass and other small seeds, those that resemble some weed seed, those that are difficult to clean, and those which resemble some other less valuable commercial seed.

Purity test. Illustrative material—Named samples of common commercial and weed seeds, such as corn, oats, barley, wheat, flax, rye, millet, milo, kafir, sorghum, alfalfa, red, white and sweet clover, Russian thistle, wild oat, mustard, dandelion, lamb's quarters, wild barley, amaranth, etc. These seeds may be collected at various times during the year and kept in envelopes or, preferably, in small bottles, which can likely be furnished by pupils.

Names of unknown seeds can be obtained by sending a small sample to the Agricultural College at Fort Collins.

A tripod lens, which can be purchased for fifty cents, is very useful in identifying the smaller seeds.

How to make the test. Mix thoroughly each lot of seed to be examined. Place a small amount on a sheet of white paper. Separate and place into different piles all of the kinds of seeds, weeds, etc. Identify by means of the named samples all of the foreign seeds.

Make a form like the following and fill in the proper places:

REPORT ON PURITY OF SEED.

Name of student..

Date ....

Name of seed tested....................................

No. of seed including weeds............................

NAMES OF WEED SEEDS AND OTHER IMPURITIES FOUND	NUMBER FOUND	PER CENT. FOUND
Total Weeds		
Stones and pieces of dirt, pieces stems, leaves and other trash		
Total impurities		

Estimate the percentage of impurities by weight, if possible, but if no scales are at hand estimate it by number. Put down any seeds which cannot be identified as unknown.

References: 1—pp. 77-80; 2—p. 143; 3—p. 23.

EXERCISE—WEEDS.

Illustrative material—Samples of plants and seeds of the common troublesome weeds of the community. Identify, label and keep for identification purposes.

Work with the plants and seeds until the pupils recognize their names at sight.

Definition of a weed—Plants which grow where they are not wanted. A plant out of its place. Emerson says, "A weed is a plant whose virtues have not yet been discovered."

Weeds have some advantages:

(1) Induce frequent and more thorough cultivation, which benefits the crop.
(2) Occupy the soil after a crop has been removed, thus preventing the loss of fertility by utilizing the plant food.
(3) Add fertility and humus to the soil when plowed under.
(4) Furnish food for the birds during the year, especially in the winter.

Weeds have many disadvantages:

(1) Rob cultivated plants of fertility and moisture.
(2) Injure crops by crowding and shading.
(3) Retard the drying of grain and hay.
(4) Increase the labor of threshing and cleaning of grain.
(5) Damage the quality of crops for feeding and manufacturing purposes.
(6) Some weeds injure stock by means of barbed awns. (Wild barley and wild oats.)
(7) Some of them injure wool and disfigure the tails of cattle and manes and tails of horses. (Cocklebur, sandbur.)
(8) Some injure the quality of dairy products. (Leeks, wild onions and, perhaps, sweet clover.)
(9) Some are very poisonous. (Loco weed, larkspur, nightshade, water hemlock.)

Have pupils write down as many advantages and disadvantages of weeds as they can think of.

How weeds are spread:

(1) By live stock, carried in the hair or fleece or on the feet.
(2) By underground feed-stuff.
(3) By adhering to the inside of sacks where they were placed with grain.
(4) In barnyard manure drawn from town.
(5) By sleighs, wagons, threshing machines, seeders and other kinds of farm machinery.
(6) By railroad trains passing through or near a farm.
(7) By birds, squirrels and mice.

(8) By creeks, rivers, irrigating ditches and washing rains.

(9) By the wind.

(10) In farm seeds purchased. (One of the most serious means of spreading injurious weed seeds.)

Have pupils think of as many ways as they can in which weeds are spread and then add any ways which they omit.

The importance of the weed question will justify the teacher in spending considerable time on it.

References: 1—pp. 73-76; 2—pp. 173-178; 4.

EXERCISE—SOIL.

Definition—A medium for the development of plants. That part of the earth's surface in which plants grow.

Composition:

(1) Mineral matter (decayed rocks), (inorganic matter).

(2) Organic matter (decaying animal and plant matter).

Properties of organic matter:

Weight—Lightest soil constituent, 20 to 45 pounds per cubic foot.

Absorption—Very much decayed organic matter has great power to absorb gases and salts in the soil.

Volume changes—When wet, decayed organic matter expands more than the finest clay and when dried it shrinks much more.

Plasticity (stickiness)—Humus is less plastic than clay and more plastic than sand, hence it is very valuable in binding together light sandy soils and in loosening up heavy clay soils.

Water holding capacity—Organic matter, especially in the form of humus, has great power of taking up and holding great quantities of water.

Kinds of organic matter:

(1) Crude organic matter: that which has undergone little decay.

(2) Humus: organic matter which is in the last stages of decay.

As a food—When organic matter decays, much of the plant food of which it is composed is made available to and used by other plants.

EXERCISE—SOIL CLASSIFICATION.

Classification of, based on the size of the mineral particles composing it—(mm.=millimeter=about 1/25 of an inch).

(A) Gravel and stone; all material above 2 mm. in diameter.

(B) Fine earth; 2.00 to 0.00 mm. in diameter; what is commonly meant by word soil.

(1) Fine gravel; 2.00 to 1.00 mm. in diameter.

(2) Sand; 1.00 to 0.5 mm. in diameter.

(a) Coarse sand 1.000 to 0.50 mm. in diameter.

(b) Medium sand 0.50 to 0.25 mm. in diameter.

(c) Fine sand 0.25 to 0.10 mm. in diameter.

(d) Very fine sand 0.10 to 0.05 mm. in diameter.

(3) Silt; 0.05 to 0.005 mm. in diameter.

(4) Clay; 0.005 to 0.000 mm. in diameter.

Popular general classification:

(A) Sandy, one containing a very large amount of sand.

(B) Sandy loam, one containing all kinds of particles, but more sand than any one other kind of particles.

(C) Loam, one containing all sizes of particles, without a preponderance of any one.

(D) Clay loam, one containing all sizes of particles, but more clay than any one other size of particles.

(E) Clay, one containing a very large amount of clay.

Properties of:

Weight—The larger the particles the greater the weight.

The greater the amount of organic matter the less the weight.

Ability to hold water—The smaller the particles the greater the ability to hold water.

The greater the content of decayed organic matter and humus the greater the ability to hold water.

Color—Varies greatly according to the color of the composing minerals and the amount of organic matter.

The greater the amount of decaying organic matter the darker the color.

References: 1—pp. 1-8; 2—pp. 24-42; 3—pp. 38-39.

EXERCISE—SOIL WATER.

Illustrative material—Three cylindrical lamp chimneys (student chimneys) and a frame for holding them perpendicular, with the larger end up and the smaller end high enough from the table to allow a cup or glass to be placed under each; enough sand, loam and clay to fill one chimney of each; some pieces of cloth to place over the lower ends of the chimneys to hold the soil in, and some rubber bands to hold the cloths onto the chimneys; three cups to place under the chimneys; a shallow, narrow dish to place under the three chimneys; a small cloth sack, a large paper bag and a sieve (one can be made by tacking a piece of screen over the bottom of a small box).

Soil water is divided into three classes according to its value and availability to plants.

(1) Hygroscopic water: That which is present on the surface of air-dry soil particles. (No soil exposed to the atmosphere is absolutely dry. The water evaporates entirely only when the soil is raised to a high temperature.)

This water is not available to plants, since it clings so tightly to the surface of the soil particles that the plant root hairs cannot remove it.

(2) Gravitational water: That which moves through the soil under the influence of gravity. This is the water which moves freely downward through the soil after a rain. Sheet water is gravitational water. Gravitational water, as such, is of no use to most plants; in fact, it is often of great injury to them. When it is present in the layers of soil penetrated by plant roots it occupies the spaces which would otherwise be filled with air, and as a result the roots are not able to perform their normal functions and sooner or later will die. They are drowned out. When the upper layers of soil become dry the gravitational water begins to move upward to replace that lost by evaporation and the demands of the plants' roots. It is then known as capillary water.

(3) Capillary water: The water which moves through the soil due to attraction between the water and the soil particles. Its movement may be in any direction, but is usually upward and sideways. When this kind of water is present in the soil without any gravitational water, all soil particles and the smaller spaces are filled with it; but the larger spaces between the particles surrounded by a film of water are filled with air.

Capillary water only is available to and made use of by most plants (exceptions, rice, cranberries, etc.), hence it is the most important kind of soil water with which we have to deal.

The forms of soil water merge into one another, and no distinct line can be drawn between them.

EXERCISE—SOIL WATER EXPERIMENTS.

The soil used for these experiments must be air-dry. If it is at all moist spread it out thinly on a piece of paper until it dries.

In some communities it may be difficult to obtain natural samples of the three kinds of soils required for these experiments, in which case they can usually be prepared with little trouble.

Preparation of Soil. With a small household sieve, enough sand can be screened from sandy soil to fill several chimneys. If, after screening, the sand appears to contain considerable fine soil it can be largely removed by washing the sand. Place it in a dish and turn running water into it, allowing the waste water containing the fine soil to run over the side of the dish. If running water cannot be had, pour water onto the sand, stir well, and then pour off the water containing the fine soil. Repeat several times until the water poured off appears clear.

Very little difficulty will be experienced in finding suitable loam. If not just right, add sand or clay or decayed vegetable matter until it appears to be made up of the proper amount of each.

Clay may be obtained from a mixture if it cannot be found in a pure state. Place some soil in a small cotton sack and place the cotton sack inside of a larger paper sack. Grasp the necks of both sacks in one hand and shake up and down. The finer soil will pass through the cloth sack into the paper sack. Enough can be separated in a short time to fill a chimney.

Rise of capillary water—Fill one chimney with sand, one with loam and one with clay. Place in the frame. Under the three chimneys place a shallow dish so that the edge of the dish comes about an inch above the bottom of the chimneys. Pour water into the dish, replenishing the supply from time to time as it is taken up by the soil. Observe the rise of the water in the soils. Keep a record of the time which is required for it to reach the top of each kind of soil.

Answer the following questions:

What kind of water is rising in the soil? Can you see it? In which kind of soil does it rise the most rapidly? The least rapidly? Can you give any reason for this? In which soil will the water rise the highest? In which the lowest? (The water will rise the highest in the clay and lowest in the sand.) Can you give any reason for this?

EXERCISE—GRAVITATIONAL WATER.

Fill the chimneys as for the previous exercise, but place a separate dish under each one. Measure out into three separate dishes the same amount of water. Gradually pour the water from a dish into each chimney. Keep a record of the time which is required for the water to pass through the soil and begin to drip into the dishes below. Cease adding water as soon as it begins to drip freely. When all dripping has ceased, pour the drippings into the original dish and measure all of the water left.

Answer the following questions:

What kind of water dripped from the ends of the chimneys? What kind of water remained in the soil? In which soil did the dripping begin first? In which last? How long did it take for the water to pass through each kind of soil? What effect would this time have on the value of short hard rains and long slow rains? Why? On the length of time required to irrigate? Why?

EXERCISE—POWER OF SOILS TO ABSORB WATER.

From the results of the above experiments determine the amount of water which each kind of soil absorbed. Which one absorbed the most? Which one the least? Using the least amount as a basis, determine what percentage more each of the other soils absorbed. Which of these soils would be the best for the dryer sections of the country? Which one for sections where there were frequent and abundant rains? Which one where the rain all came in the winter and had to be stored in the soil? Which one where the rains were less frequent, slow and of long duration?

In actual experience we should not find soils with as much sand or as much clay as two of these samples have, but the comparison would be the same for all general conclusions.

References: 1—pp. 10-21; 2—pp. 43-54; 3—pp. 39-44.

EXERCISE—VALUE OF CULTIVATION.

Illustrative material—Two boxes about two feet square and six inches deep.

Fill the boxes equally full of the same kind of good soil free from stones, sticks, etc. Water the soil in the boxes until it is well soaked, applying the same amount of water to each.

Set the boxes under cover where they will not be rained on and will get sunshine, if possible.

With a stick cultivate daily the soil in one box, two inches deep. Do not disturb the soil in the other box. Note any differences between the two soils which may appear. At the end of two weeks dig down carefully into the soil near the center of each box and examine the soil.

Do you notice any difference between the apparent amounts of water in the two soils? Which one has lost the most water? Was the surface of either soil cracked? If so, what effect would this have on the rapidity of loss of water? What effect does cultivation have on the loss of soil water? When should soil be cultivated? (As soon as possible after a rain.) Why? (So as to prevent evaporation by the formation of a soil mulch.)

Continue this experiment indefinitely, examining the soils from time to time to note any differences between them, especially with reference to the amount of water which they contain.

References: 1—pp. 6-9, 18-21; 2—pp. 56-62; 3—pp. 45, 46.

EXERCISE—SOIL MULCHES.

Definition—A mulch is any material applied to the surface of the soil for the purpose of preventing evaporation, and sometimes keeping weeds down or preventing winter killing.

Kinds of mulches, two.

(1) Material applied to the surface of the soil; straw, leaves, manure, sawdust, sand, boards, etc.

(2) Those composed of the natural soil and formed by cultivation.

A mulch acts as a cover to the moist surface soil, from which the moisture does not evaporate as rapidly as it would did the dry air come into direct contact with it.

Mulches formed from the natural soil by tillage are called "dust mulches," also "dust blankets." A dust mulch is simply a layer of air-dry soil covering the moist soil below. In order to be effective it must be kept dry and rather loose, so that the water from the moist soil below cannot pass through it. This is done by occasional stirrings. and especially after a rain or irrigation.

It is much better to keep the water in the soil by cultivation, which forms a mulch, than it is to be continually adding water by irrigation.

If a pair of scales are available some interesting experiments can be carried on by trying different kinds of mulches on large cans of soil which have been well soaked with the same amount of water, the same amount and kind of soil being used in all the cans. Weighs should be taken at the beginning of the experiments and daily thereafter, and the daily and total percentage of loss figured out for the different mulches.

NOTE—This question of cultivation, mulches and the storing of water in the soil is one of the most important which we have in the state in both dry farming and irrigated sections, and teachers will do well to spend considerable time on it, and impress upon the pupils the necessity of understanding the principles involved.

References: 1—pp. 6-9, 18-26; 2—pp. 56-62; 3—pp. 45-47.

EXERCISE—ALFALFA—WHY IT IS SUCH A VALUABLE PLANT.

Illustrative material—Some vigorously growing alfalfa or sweet clover roots which grew in the upper foot of soil. (Sweet clover roots are usually easier to obtain and show the same characteristics as the alfalfa roots.)

Alfalfa is one of the most valuable plants grown for two reasons:

(1) Produces large yields of very rich hay, which is one of the best coarse foods for all kinds of farm animals.

(2) It enriches the soil by adding to it a very valuable plant food, which makes possible the raising of very large yields of other crops.

There are many plants which have the same kind of flowers and roots as the alfalfa and which have the same general effect on the soil. They are called legumes. Some legumes closely related to alfalfa are red, white, alsike and sweet clover; some more distantly related are beans, peas and the loco weed, which is a poisonous weed.

The smaller legume roots near the surface have on them some little swellings called tubercles or nodules.

Nodules:

Size—Varied; on alfalfa and sweet clover about 1/16 to 3/16 of an inch across.

Shape—Usually flat; often heart-shaped, knotty or wart-like.

Color—Light. whitish.

Purpose—Are the homes of a large number of very small plants called bacteria. The particular kinds of bacteria which collect nitrogen are called "nitrifying bacteria."

Bacteria:

Size—Microscopic (too small to be seen with the naked eye); about 1/25,000 of an inch in diameter.

Shape—Disc, rod or spiral shaped; composed of a single cell.

Life-habit—Live on plant or animal tissue. Have no ability to gather their own food from the soil.

Use in the nodules—Take nitrogen out of the air in the soil, use it as food, change its form and then give it up to the plant for food. Are the only plants which can make direct use of the atmospheric nitrogen.

Nitrogen—A gas composing about 77% of the volume of the air. It is estimated that there are about 35,000 tons of this gas over every acre of land, which at the present market price of about 18 cents per pound would be worth $12,600,000 if it could be used.

Is necessary for both plant and animal growth.

Animals get their entire supply from plants.

Bacteria live on the juices of the plant and in return for this food furnish the plants with nitrogen. This mutual relationship between these two plants is called symbiosis.

Alfalfa plants remove a large amount of nitrogen from the soil, but they add so much to the soil that there is a surplus left for other plants which follow.

Examine carefully the roots of the specimens gathered and locate the nodules. Draw a piece of root showing several of them.

References: 1—pp. 33-40, 240-297; 2—pp. 96-103.

EXERCISE—ALFALFA—INOCULATING SOIL SO THAT IT WILL RAISE ALFALFA.

All soils do not contain the particular kind of bacteria necessary for the production of a crop of alfalfa. In such cases it is necessary to add them to the soil. The introduction of bacteria into a soil is known as inoculation.

Methods of inoculation are three in number:

(1) Pure culture method—A small bottle of liquid containing some bacteria and a package containing some food are obtained from some company which makes a business of supplying them. The food material is emptied into a pail of water. When all is dissolved the bottle of bacteria is emptied into the pail. The bacteria, feeding on the food in the water, increase in numbers very rapidly, their presence soon causing the contents of the pail to assume a thin, milky color. The alfalfa seed is then

dumped into the pail and stirred well. It is then removed and spread out to dry. Each seed will have some bacteria on it. As soon as dry it is sown immediately.

This method has not proven very successful, and cannot be recommended, because much of the culture sold has proven worthless.

(2) Natural method, or self-inoculation—Some soils contain a very few bacteria, but not enough for a full crop of alfalfa. By sowing a small amount of alfalfa seed with some other crop the bacteria will increase in numbers sufficiently in a year or two to supply a full crop with nitrogen. Has proven very successful.

(3) Soil transfer method—The safest, cheapest and most common method of inoculating soils which contain no nitrifying bacteria at all. From three to five hundred pounds of soil from an alfalfa or sweet clover field, because the same kind of bacteria live on it, are spread per acre on the field to be inoculated. It must be mixed with the soil by cultivation immediately, because the sunshine will kill the bacteria. This amount is sufficient to infect most of the plants within a year or two after seeding.

References: 1—pp. 33-40, 290-297; 2—pp. 96-103.

EXERCISE—HOW TO TELL ALFALFA SEED FROM SWEET CLOVER SEED.

Illustrative material—Seeds and pods of both plants and some sweet clover leaves. A 50-cent tripod lens.

Examine the seeds and pods and note the following points:

Pods—Shape and size:

Sweet clover—Small, compressed globular, not twisted. Markings very distinct.

Alfalfa—Large, long, flattish, twisted into from one to five rings. Markings not distinct.

Number of seeds:

Sweet clover—Never more than one.

Alfalfa—From one to eight. Usually several.

Seeds—Shape and size:

Sweet clover—Somewhat blunt heart-shaped, often plumper and larger.

Alfalfa—Mostly kidney shaped.

Color:

Sweet clover—Same, uniformly duller.

Alfalfa—Same, brighter.

Taste:

Sweet clover—Sickening, vanilla. (Taste and smell some of the sweet clover leaves. The seeds taste the same.)

Alfalfa—Decidedly bean-like.

Position of point of attachment, the hilum:

Sweet clover—Towards one end.

Alfalfa—At the center or near it, like in the bean.

Examine seeds until familiar with them, then mix and separate again.

By applying these tests to a lot of seed the presence and amount of sweet clover can nearly always be determined accurately.

Study, also, the flower and seed bearing branches of the two plants.

Note the manner in which the seeds are borne on the two.

Find out at which end of the seed stalk the seeds mature first.

Reference: 5.

EXERCISE—POTATO, EXTERNAL PARTS.

Illustrative material—Some good Irish potatoes.

Place a number of potatoes in the light and some in the dark in a warm, rather moist atmosphere and leave until they have produced sprouts of considerable size.

Examine a potato and observe the following parts:

(1) Eyes—the more or less oval depressions. What are the eyes?

(2) The seed or "rose" end—the end which contains the greater number of eyes, one of which seems to be more prominent than the others.

(3) The base or stem end contains a rather deep depression, in the center of which was attached the small stem which connected the potato to the plant. Find a potato with the small stem still attached.

Observe that the eyes are arranged around the potato more or less spirally and gradually decrease in numbers from the seed end to the base.

Draw a potato showing all of these characteristics.

EXERCISE—POTATO, INTERNAL PARTS.

Cut two potatoes into halves, one lengthwise, the other crosswise. Cut off a thin slice and hold up to the light. Note the areas. Examine the cut surfaces and observe the following characteristics:

(1) The skin around the outside.

(2) The whiteness of the inside. What is it due to? Starch.

(3) Within a half an inch of the skin of the potato a faint dark line which follows in general the outline of the surface. In some places this line runs to the surface. When this occurs, where does it end? This line is the place where the potato makes its growth. It is called the cambium ring. If you have cut the potato directly through the stem end you will find that the cambium ring runs clear to the end. It continues through the small connecting stem and through the entire potato plant into the leaves.

(4) Between the cambium ring and the skin a rather dark, dense area, the cortex, the most valuable part of the potato, because it contains the best food material. The larger this area the better the potatoes. Thick peeling of potatoes wastes a large amount of this part, hence the reason for peeling thinly.

(5) At the center a more or less star-shaped area of a clear, watery appearance; seen best when a thin slice is held to the light. The poorest part of the potato, because it is largely water, with little of the more valuable food materials. The smaller this area the more valuable the potatoes for food. It is called the internal medulla.

(6) Between the internal medulla and the cambium ring a more or less irregular area, dense and starchy in appearance. Is called the external medulla. Comes second in food value. Contains less water than the internal medulla and more starch and other food materials.

(7) Occasionally a hollow will be found at the center of a potato. Large ones are more likely to be hollow than smaller ones because the large size is partly the cause of their being hollow. On this account medium sized potatoes are usually to be preferred to large ones.

Draw the inside view of a potato showing all of the parts.

EXERCISE—POTATO—A STEM OR A ROOT.

Illustrative material—Potatoes which have produced sprouts in the light and in the dark.

Observe the following points:

Potatoes:

Color—Those exposed to the light, greenish tinge; those kept in the dark, natural dark color.

Sprouts:

Color—Those in light, greenish; those in dark, white.

Branches—Those in light, small green leaves; those in dark, no leaves.

Length and thickness—Those in light, shorter and thicker.

From these facts would you conclude that there is any relation between the light and the green coloring of plants?

Explanation—The action of sunlight on living plant tissue which naturally grows above ground, or which is constructed like parts which grow above ground, results in the production of a green coloring matter in the surface tissue. It is known as chlorophyll.

Roots do not produce chlorophyll, because they grow under ground out of the sunlight, have never had a chance to learn how, and do not need it to do their work.

Buds—In the sprouting potatoes we find that the parts which are called "eyes" have produced the sprouts. We know that on trees the branches and leaves are produced from the buds. The sprouts are branches with leaves, consequently the "eyes" must be buds. Roots do not produce buds, as a rule.

Purpose of—From the size of the potatoes what would you suppose their natural purpose to be? (To serve as a store room for food material for the young plants which grow from them when they are planted.) Are they able to gather any food material directly from the soil? (No.) All roots are able to gather food directly from the soil. Considering all of the points of the potato, is it a stem or a root? Why?

Stems which grow under the ground and store up food material like the potato does are called tubers. (A tuber is a short, thick, fleshy underground stem bearing a number of buds or "eyes," from which new plants may be grown.)

What happens to the potatoes as the sprouts increase in size? Explain. Each eye of a potato is capable of producing a plant, and will do so if planted with some of the fleshy part of the potato attached to it.

Plant some pieces of potatoes in a box of soil and watch their development.

References: 1—pp. 58-59; 2—p. 108; 6, 7.

PUBLICATIONS REFERRED TO AT THE ENDS OF THE EXERCISES.

Reference No. 1—"Agriculture for Beginners."—Burkett, Stevens and Hill.

Reference No. 2—"Practical Agriculture."—Wilkinson.

Reference No. 3—"Exercises in Plant Production."—Farmers' Bulletin No. 408.

Reference No. 4—"Weeds and How to Kill Them."—Farmers' Bulletin No. 28.

Reference No. 5—"Alfalfa Seed."—Farmers' Bulletin No. 194.

Refernce No. 6—"Potato Culture on Irrigated Farms of the West."—Farmers' Bulletin No. 386.

Reference No. 7—"Growing Potatoes in Colorado."—Correspondence Circular No. 8, Colorado Experiment Station.