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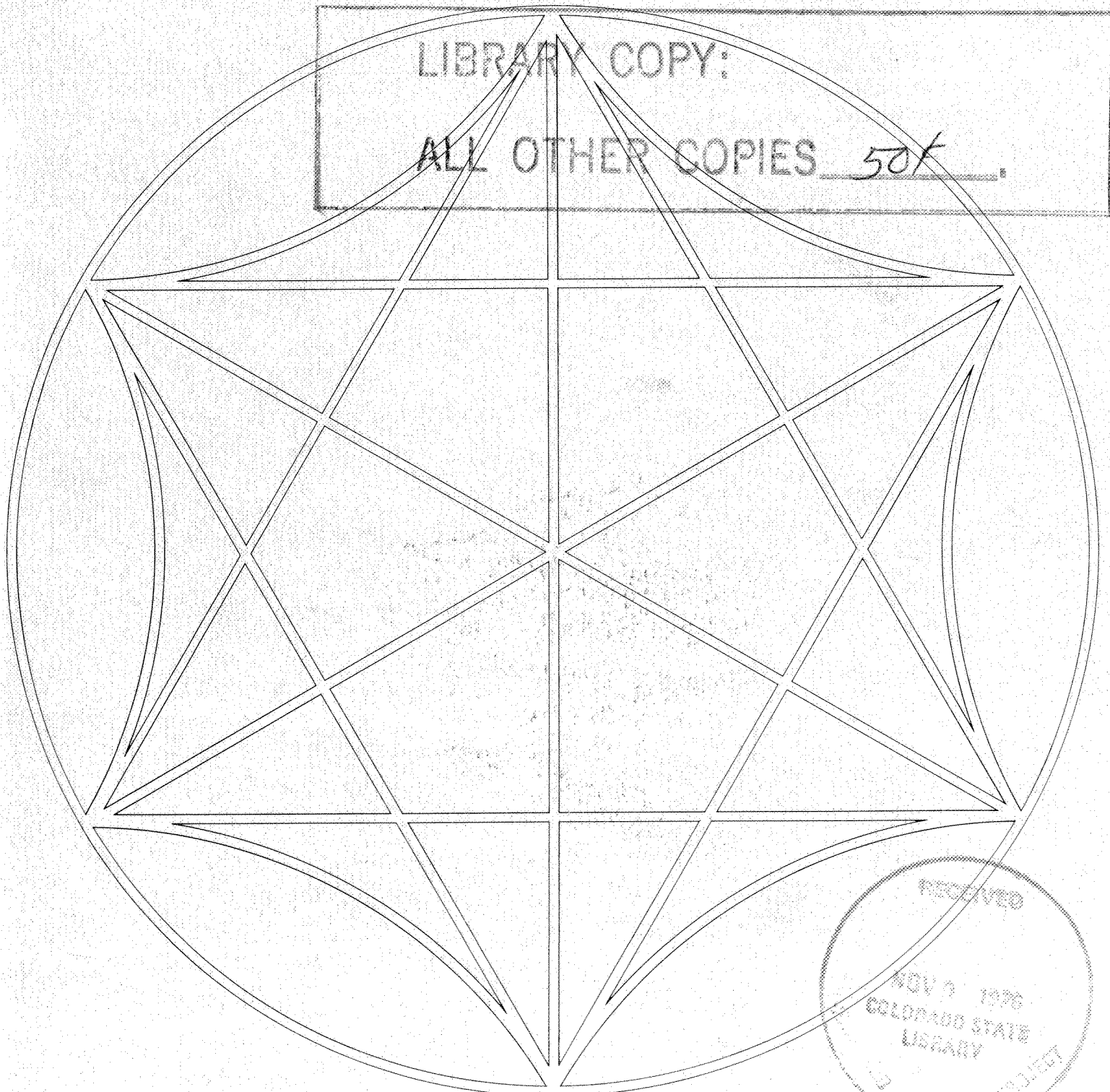
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# Studying Ecosystems

Bulletin 489A

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STUDYING ECOSYSTEMS

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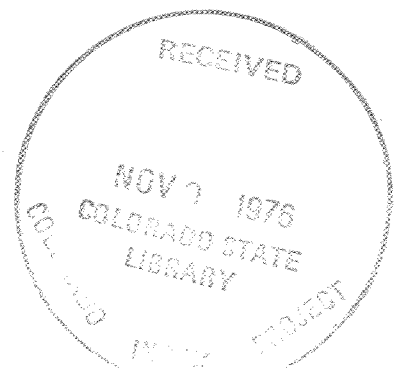
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June 1975



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# INTRODUCTION



the  
things  
around  
you

## INTRODUCTION

The term ecology comes from the Greek word oikos meaning "house" or "place to live." Thus, ecology is the study of an organism or group of organisms and their environment. Ecology involves study of the structure and function of nature. A recent term, ecosystem is more appropriate in describing structure and function of natural biological communities. The composite of all ecosystems including soil, air, and water is called the biosphere. The biosphere is that part of our planet in which life exists and on which life depends. Therefore, the ecosystem is the home of plants and animals living together in an environment that has food, shelter, and space.

The ecosystem is divided into two broad compartments called the biotic or living and the abiotic or non-living. The biotic is further divided into feeding levels or components fixing and using solar energy. These trophic or feeding levels include plants, which are the producers, and animals, which are the consumers. The consumer organisms include four trophic levels: the herbivores, that eat plants; the carnivores, that eat meat; the omnivores, that eat both plants and animals; and the decomposers, known as detritus feeders. They feed upon and break down the remains of plants and animals. All organisms in an ecosystem have a habitat and an ecological niche. Habitat refers to the place an organism lives including soil, climate, and space; and the niche is what the organism does or the manner in which it behaves in the ecosystem. More simply, consider habitat as an organism's home and niche as its occupation.

The number of each species of organism in an ecosystem will vary widely over an extended time period. The number of individuals of a

particular species will vary with many habitat factors that act as population regulators, such as the number of other similar organisms, with food supply, with space available, with climatic conditions, with communicable diseases, with adequate shelter availability and with general social structure of life in the biological community.

The structure of an ecosystem involves the entire community complex that would be used in identifying or describing an ecosystem. These include: 1) the kind and number of plants and animals that are present; and, 2) topographic features, soil conditions, and climate. The function or processes that take place within an ecosystem involve many biotic and abiotic interactions. These may be interrelationships among organisms or between organisms and climatic factors (see the ecosystem chart). These functions explain how an ecosystem operates. The two major processes that take place within an ecosystem are: 1) the conversion of solar energy to chemical energy in plants including transfer of this energy to animal life along the food chain from one trophic level to another; and, 2) the cycling of nutrients such as a phosphorus or calcium molecule that returns again and again in plants or is transferred to animals to later reappear in plants. If it were not for the decomposer organisms there would be a build up of nutrients or elements in one part of an ecosystem and a critical deficiency of them in another part. Decomposition of plant and animal biomass, permitting nutrient cycling is essential to the perpetuation of all biological systems.

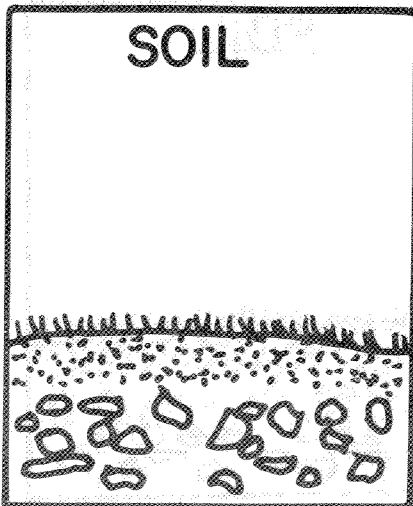
The process of energy passing from the sun into plants and then to animals in the food chain is called energy flow. Plants furnish protein, vitamins, and minerals that are essential for both plant and animal life. Green plants are the only living organisms capable of food manufacture or converting solar energy into usable forms of chemical energy.

### Basic Concepts

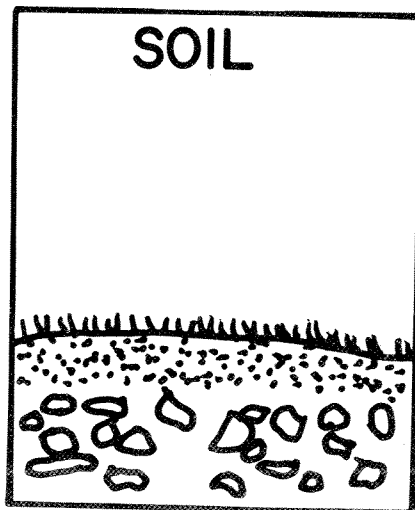
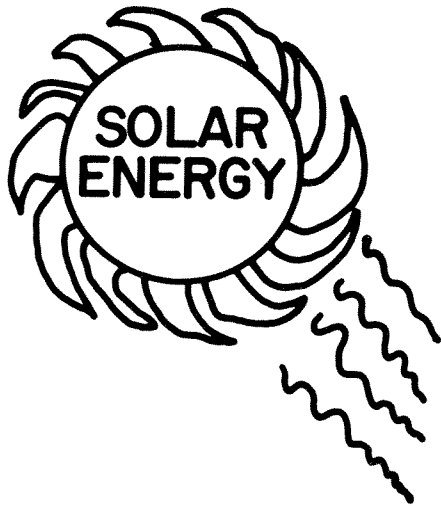
1. Structure of an ecosystem refers to the kind and number of organisms including a description of their habitat.
2. Function of an ecosystem refers to interactions among organisms and their habitat factors.
3. An ecosystem is the home of plants and animals living together.
4. Plants are producers while animals are consumers.
5. Decomposers are essential for nutrient cycling in the ecosystem.
6. Habitat is an organism's home and niche is its occupation.
7. Green plants convert solar energy into usable forms of chemical energy.



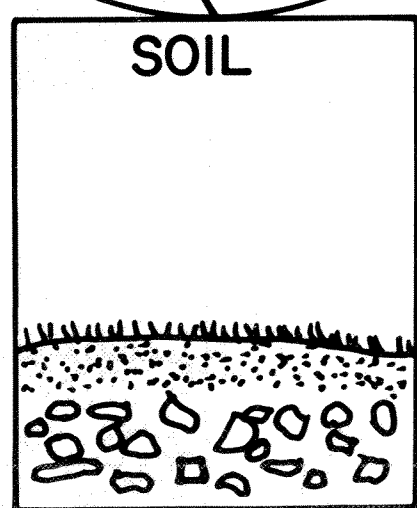
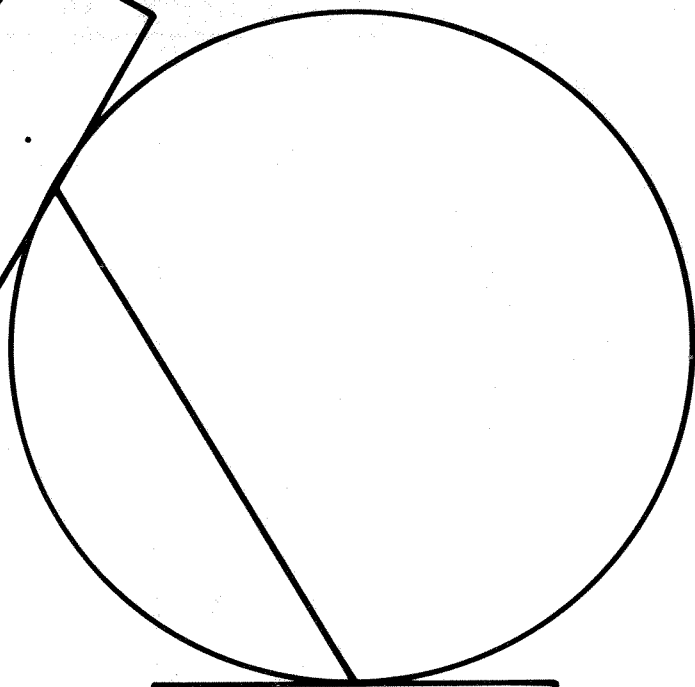
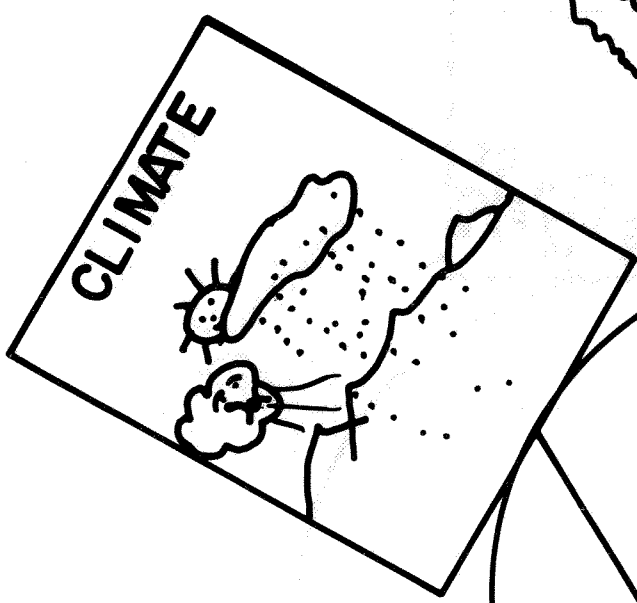
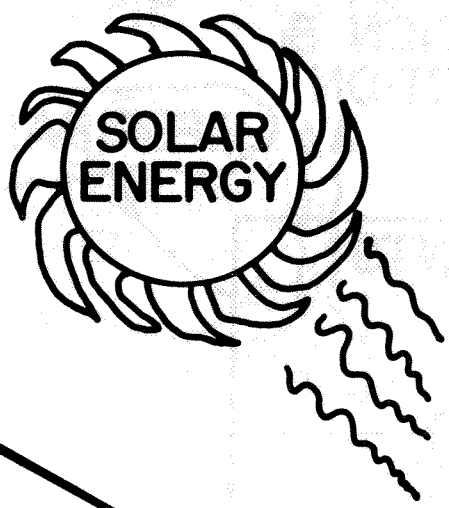
# THE ECOSYSTEM – OUR HOME



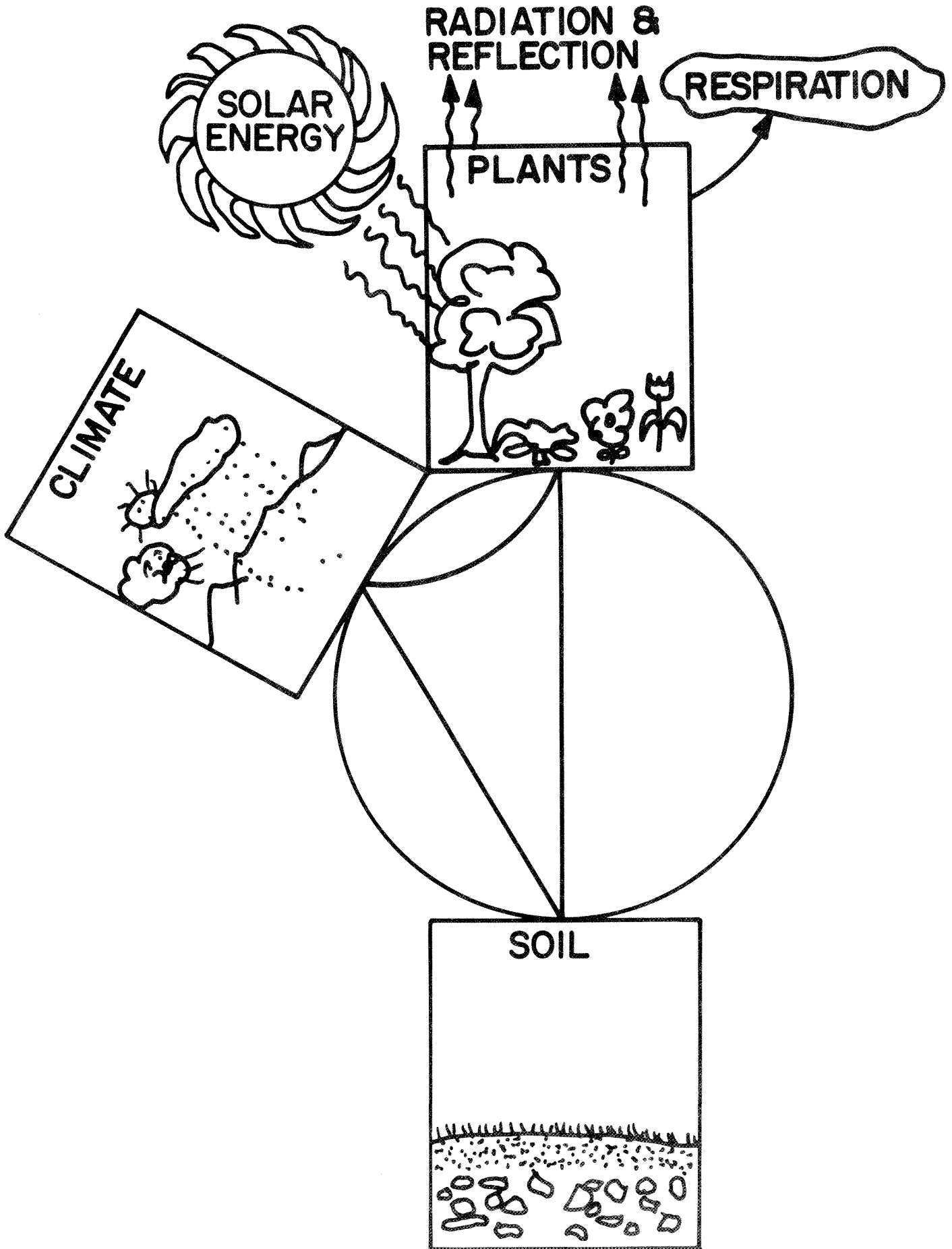
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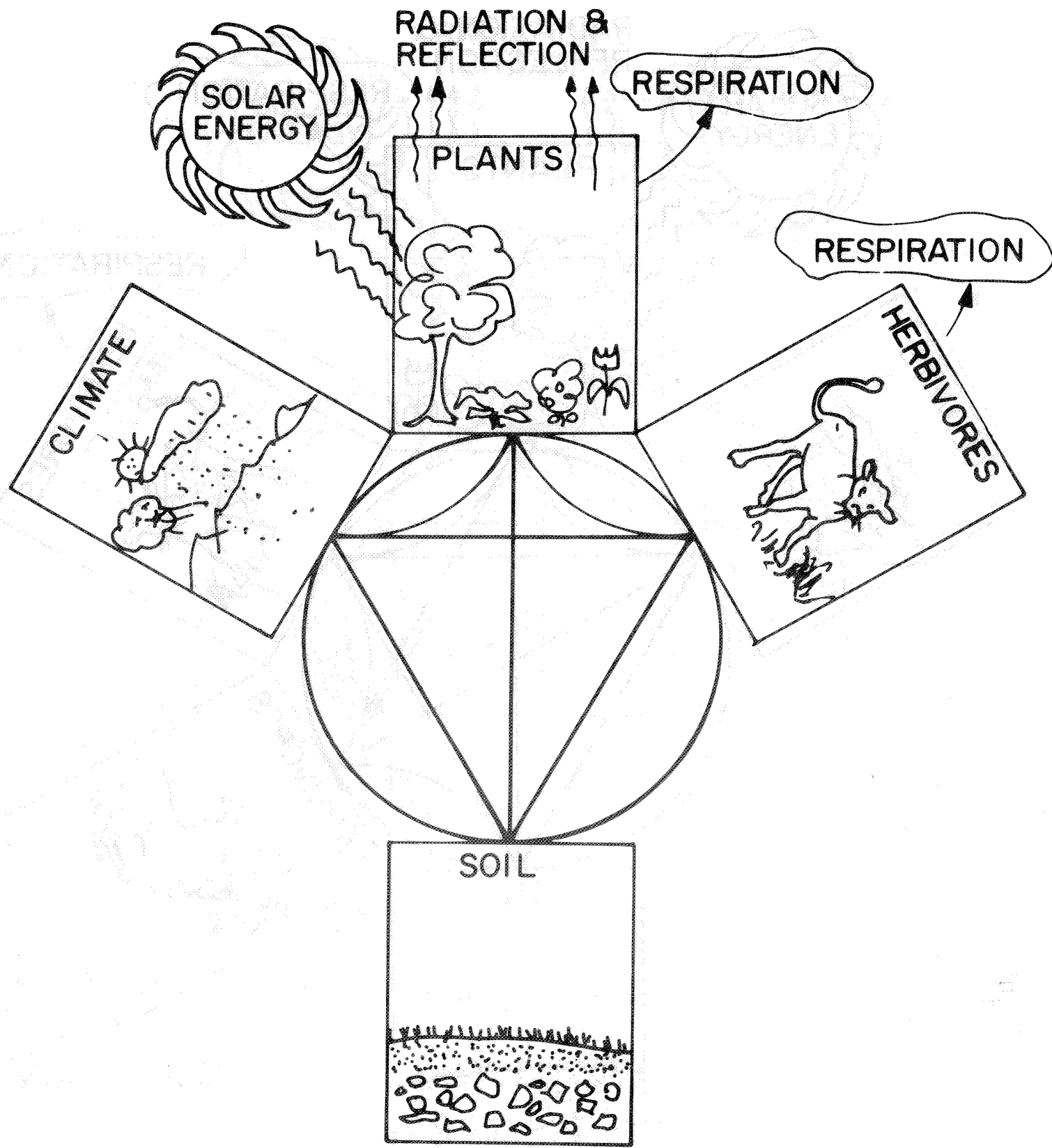
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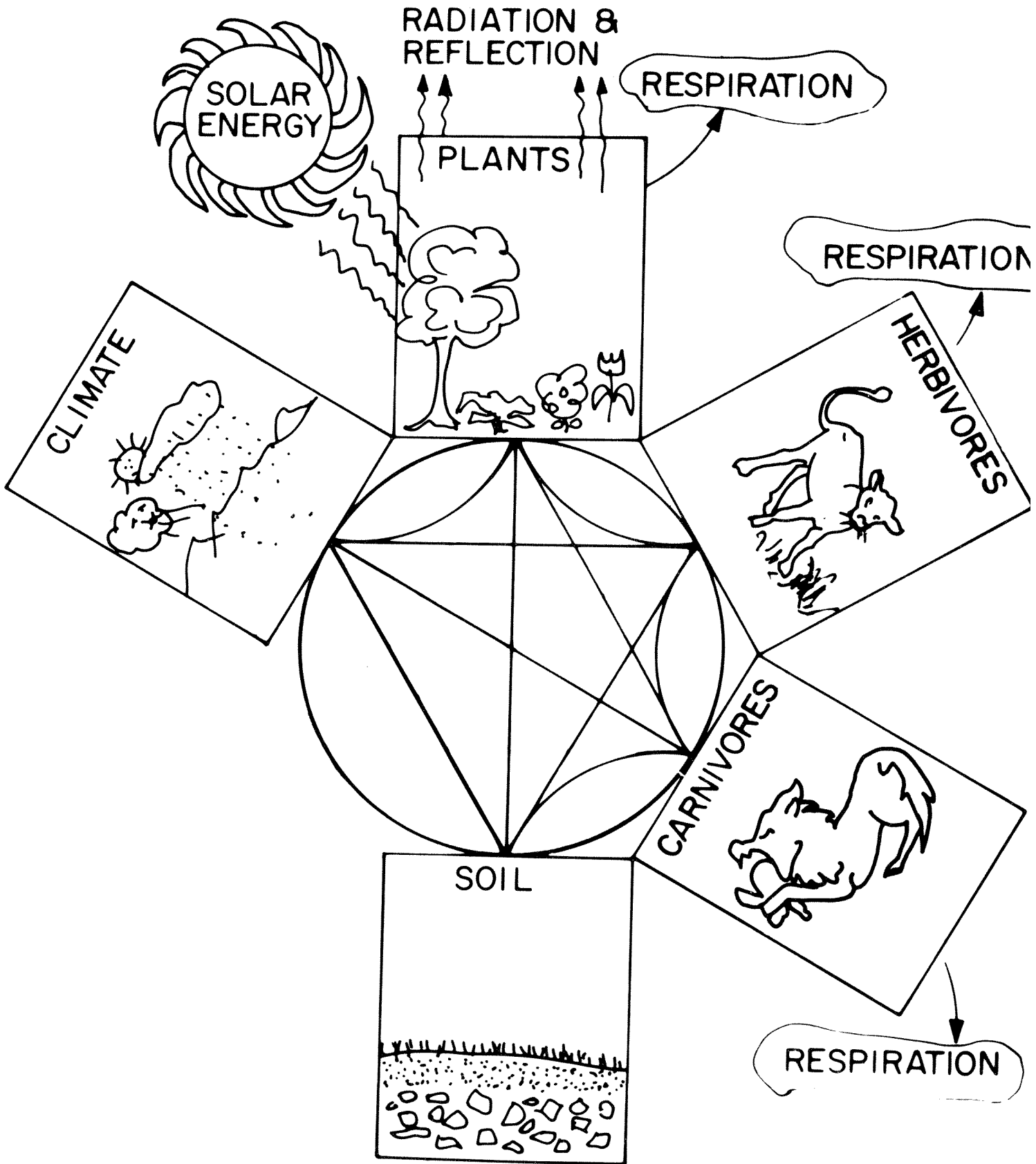
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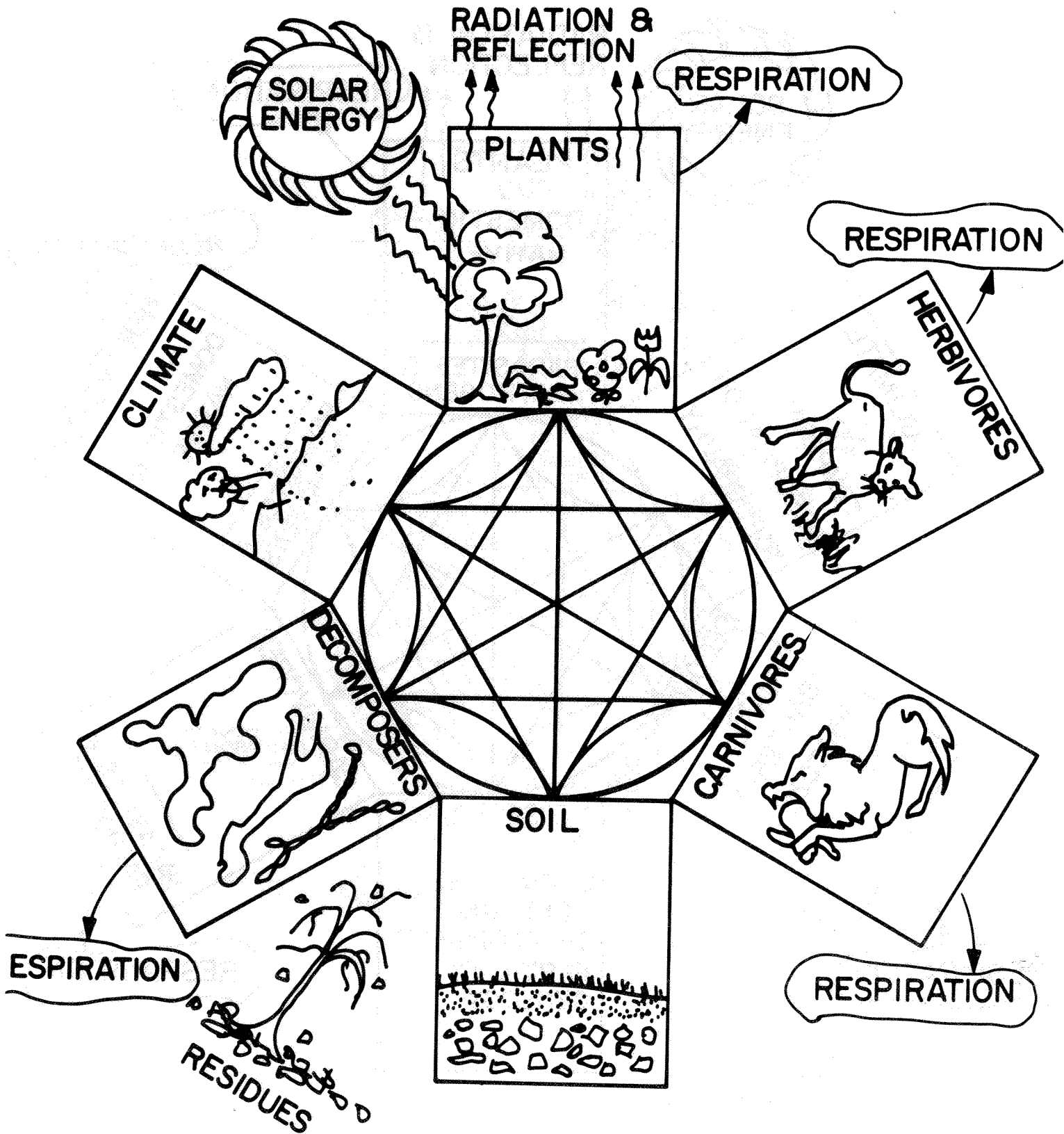
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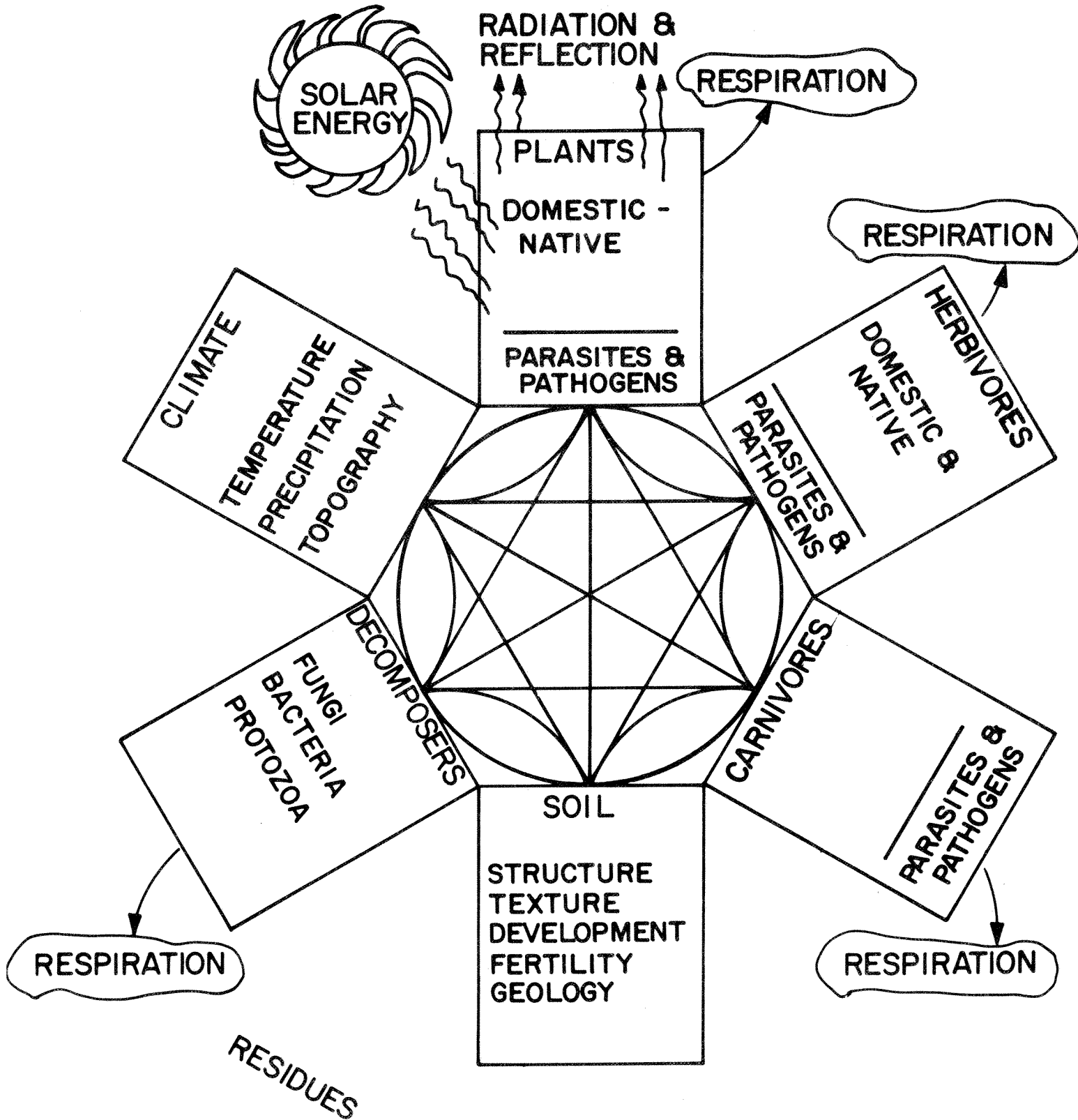
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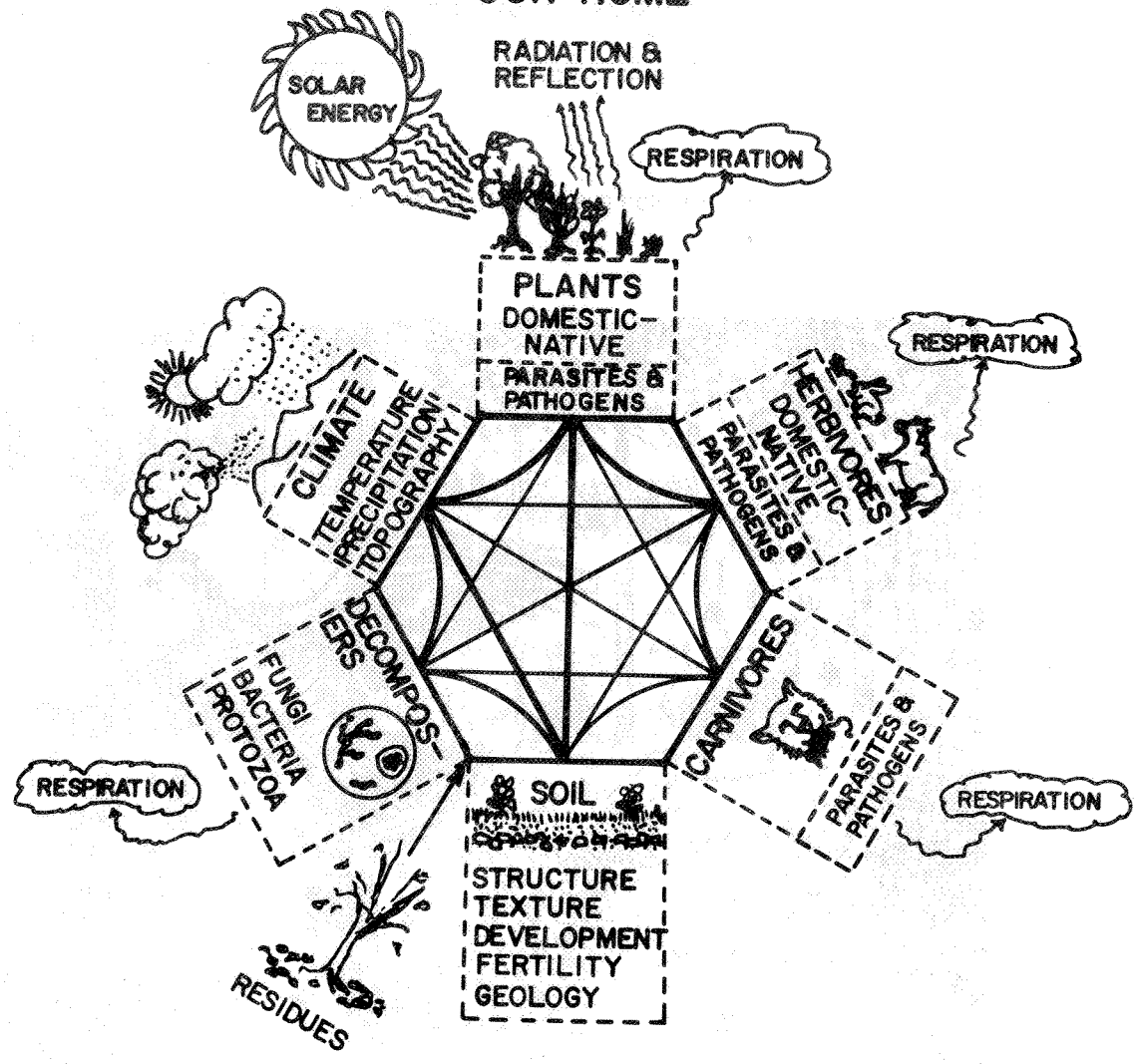
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THE ECOSYSTEM OUR HOME

# THE ECOSYSTEM OUR HOME



# BIOLOGICAL SYSTEMS



## BIOLOGICAL SYSTEMS

The ecosystem is composed of organisms that live in their environment in an organized fashion. Thus, the ecosystem in a sense is a living entity of biological origin. Each organism is cellular in structure. An organism may be a single cell or composed of many kinds of cells. The various kinds of cells may be grouped together to form organs or parts of the organism that perform various functions.

### Basic Concepts

1. All living things originate from previously existing organisms.
2. All living organisms are composed of cells.
3. Microscopic study increases the knowledge of the structure and functioning of cells.

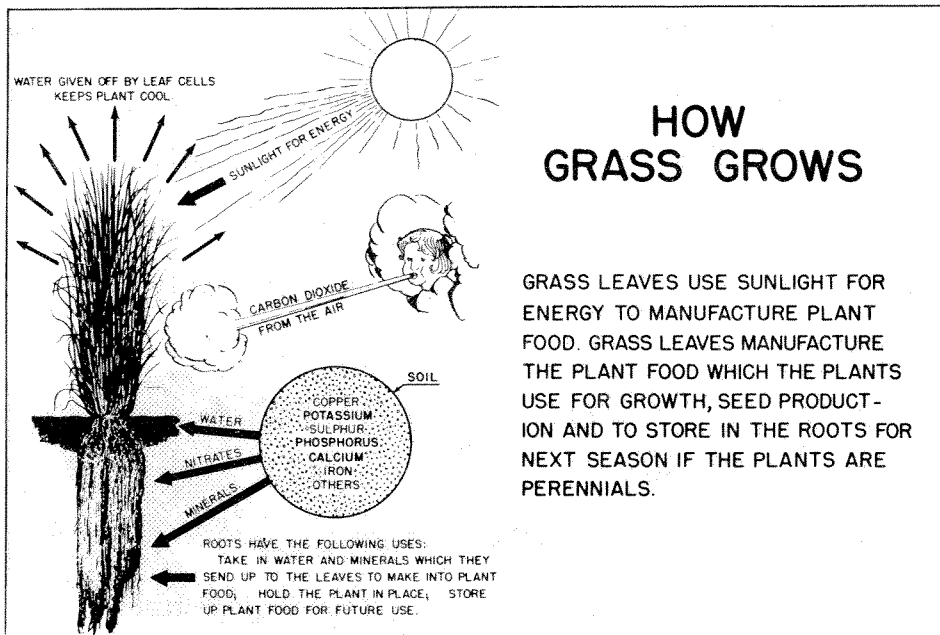
Different ecosystems or homes for plants and animals are formed by the hills and valleys of the earth's surface. These geologic variations are caused by various catastrophies that the earth has been exposed to over the millions of years that it has existed.

### Basic Concepts

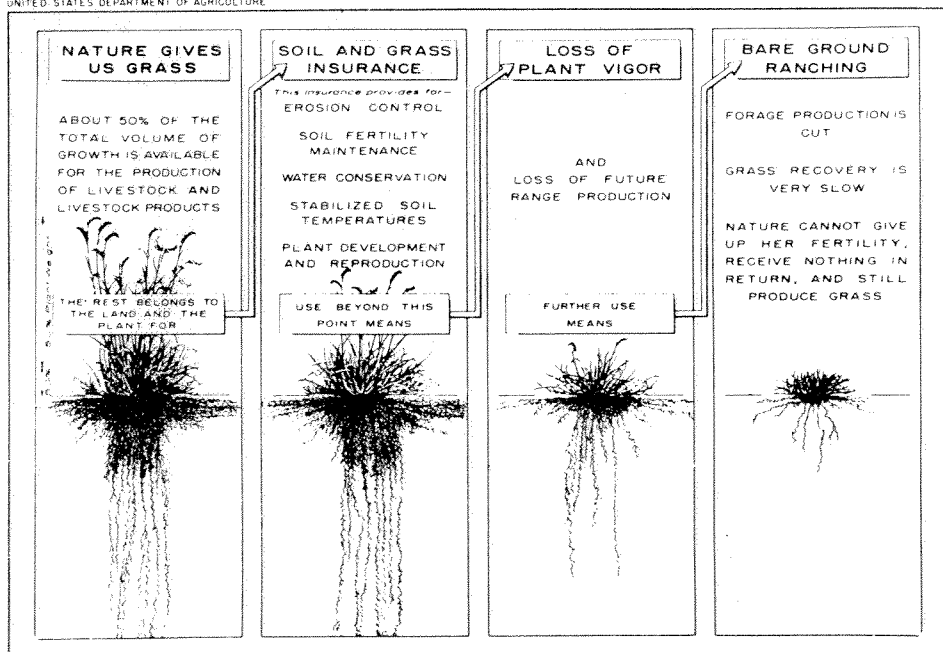
1. The history of the earth can be understood through the study of rocks and fossils.
2. The environment differed greatly during the various geological eras.
3. The particular types of plant and animal life found in each era is a product of evolution or the ability to adjust to changing environmental conditions over time.

4. A study of the solar system shows the earth's position in the universe.
5. The sun is essential to life on earth.

# PLANTS



UNITED STATES DEPARTMENT OF AGRICULTURE



## PLANTS

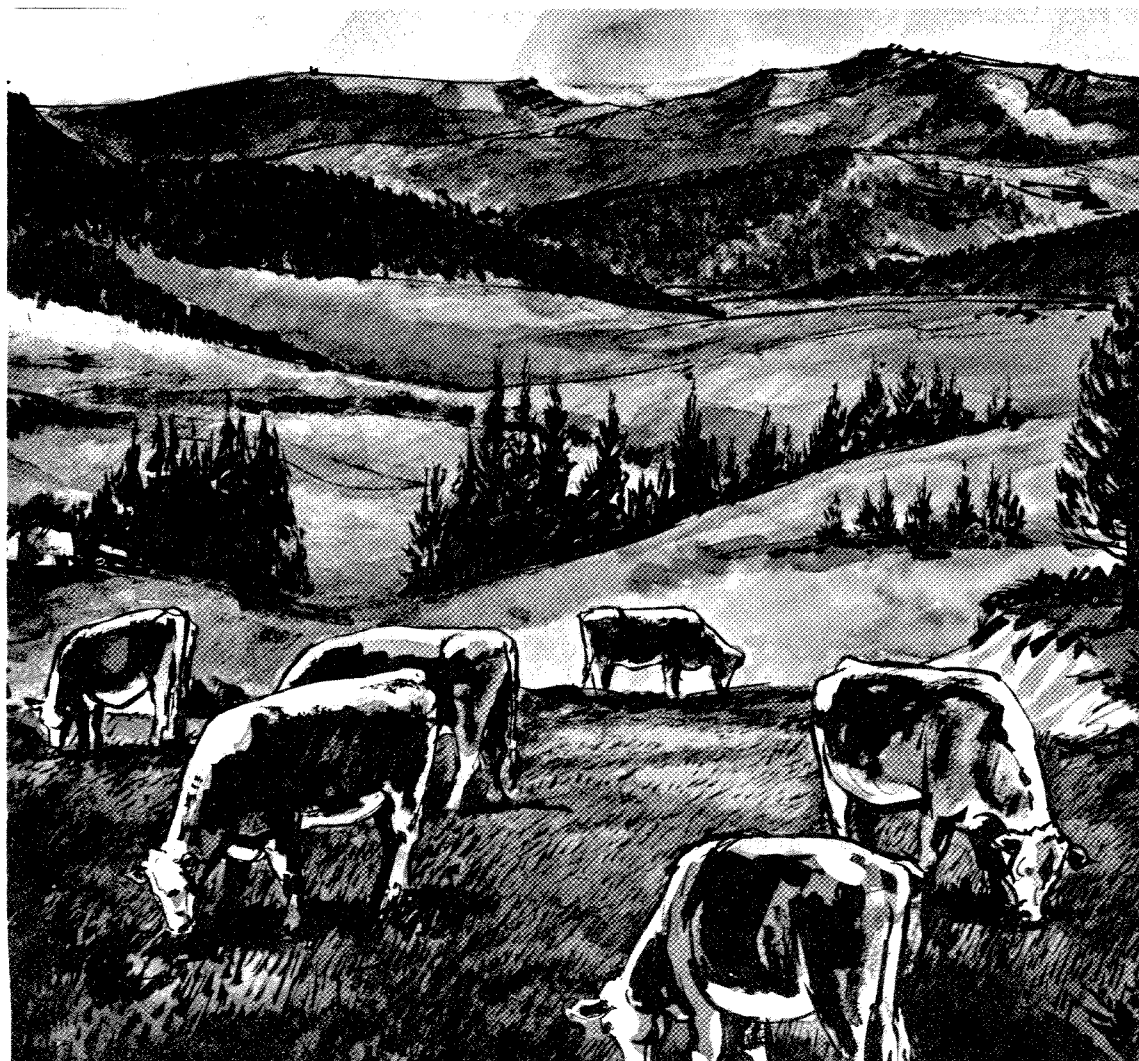
Plants are primary producers because they take energy from the sun's rays and form food by combining carbon, hydrogen, oxygen, nitrogen, and minerals into life-sustaining nutrients. The presence of chlorophyll in the cells of plants make possible photosynthesis, in which light energy is used to build plant food such as sugar (glucose) from simple compounds such as carbon dioxide from the air and water from the soil.

Plants of any community are dependent on their environment (animals, soil, water, temperature, other plants) to meet their daily needs.

### Basic Concepts

1. Plants convert solar energy or sunlight into food for all life on earth.
2. All organisms receive their food from plants.
3. Plants and animals growing together form communities. Each member of the community influences the other.
4. There are many different kinds of plants. Each kind of flowering plant has its own type of roots, stems, branches, and leaves. These special characteristics assist the plant in adapting to a particular environment.
5. There is an interdependence among plants, animals, soil, and climate.
6. Plants aid in purifying the air and balancing nature by using carbon dioxide that is given off by animals.
7. Plants produce oxygen for animals to breathe.
8. Each part of the plant performs a special function.

# ANIMALS



## ANIMALS

### HERBIVORES

Herbivores are animals that feed chiefly on plants. Animals are consumers because they depend upon plants for food and shelter. If plants are killed by disease, destroyed by fire, or are eaten too closely by animals, the entire ecosystem is thrown out of balance and both plants and animals must adjust and start to work toward attaining balance or stability again.

### CARNIVORES

Some animals do not eat plants but rather eat other animals. These animals are called meat-eaters or carnivores. Thus, they are termed the third food level in the food chain. First are the plants, second are the plant-eaters or herbivores, and third are the meat-eaters or carnivores. Some animals such as man eat both plants and animals and are known as omnivores, but they are still dependent upon plants to manufacture food.

Animals, like plants, interact and are interdependent with one another and with their environment.

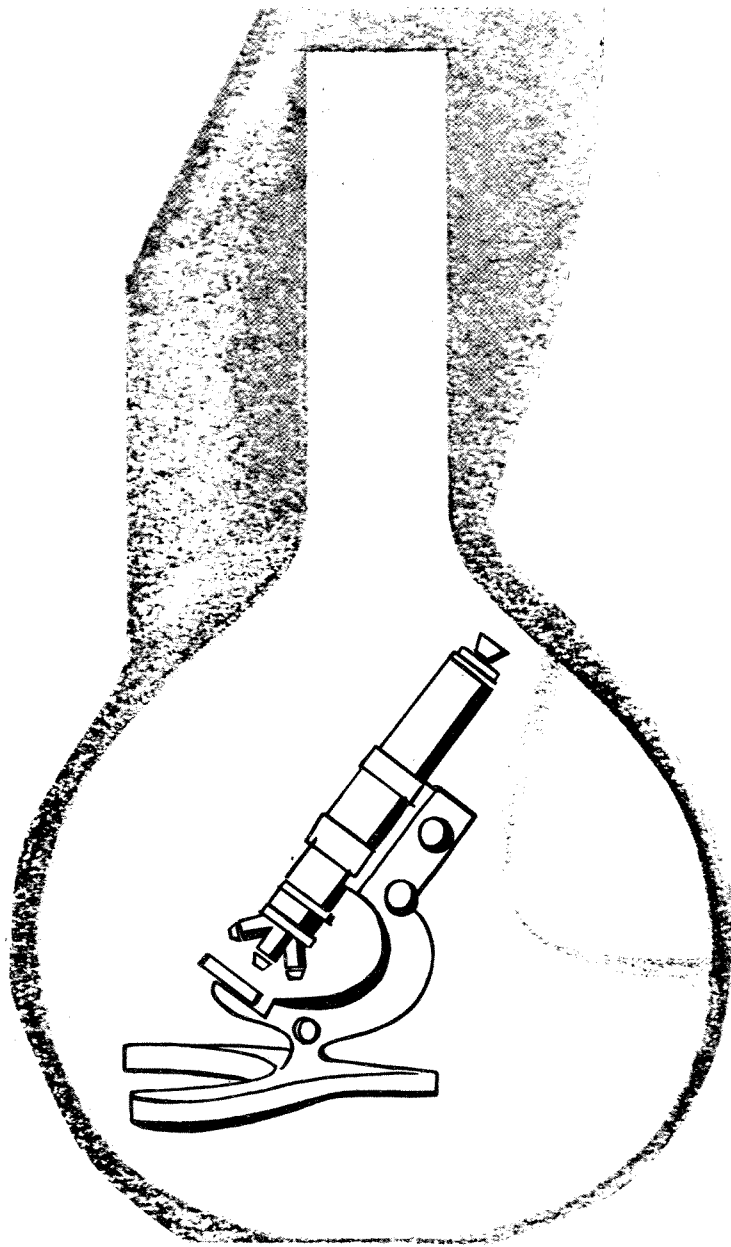
#### Basic Concepts

1. Man is an animal and is obliged to live in the ecosystem with many organisms.
2. Many different animals live successfully together in the same area.
3. An animal's body is adapted for the place where it lives. The food it eats and its protection are provided by this adaptation.



4. Animals which eat plants are called herbivores.
5. Animals which eat other animals are called carnivores.
6. Animals which eat both plants and animals are called omnivores.

# DECOMPOSERS



## DECOMPOSERS

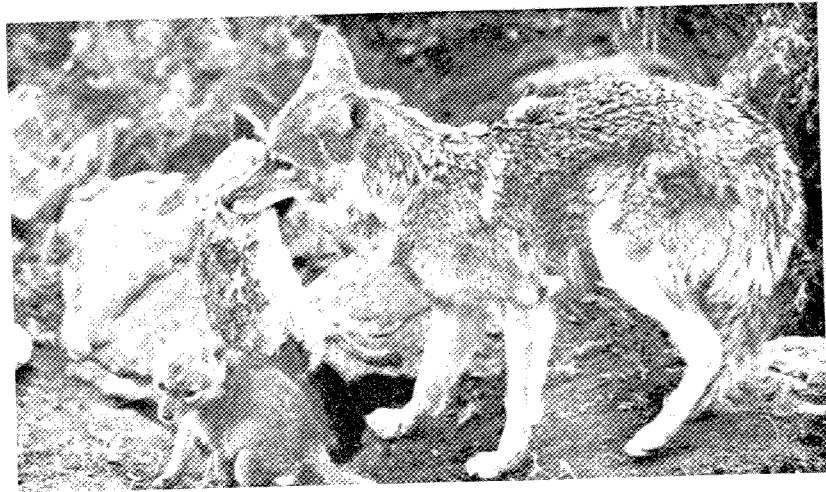
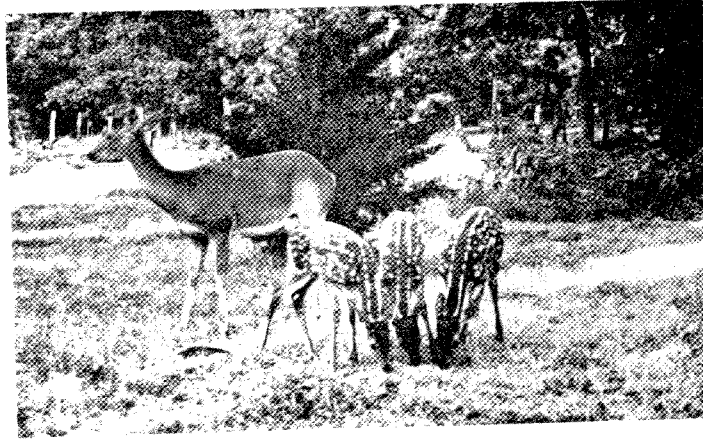
Uneaten plant material and dead animals along with their excreta are decomposed by small organisms (fungi, bacteria, protozoa) at or near the soil surface. Fungi are one of the groups of small organisms which include mildews, molds, mushrooms, rusts, and toadstools that have no leaves or flowers or green color and reproduce by spores. Bacteria are typically one-celled microorganisms which have no chlorophyll, multiply by simple division and can be seen only with a microscope. Protozoa are one-celled animals which are usually microscopic and belong to the lowest division of the animal kingdom. These organisms are needed for proper function of the ecosystem. If they were not present the plant and animal residues would accumulate and the minerals would not be returned to the soil to be utilized again by plants and the ecosystem would cease to function properly.

Decomposer organisms feed upon dead organic matter. This material is broken down and forms humus in the soil. Humus is important for soil structure so that moisture can infiltrate and roots of plants can grow.

### Basic Concepts

1. These decomposer organisms are another trophic level in the food chain.
2. Decomposers release minerals to be recirculated in the ecosystem through plants and animals and back to decomposers again.
3. Decomposers break down dead organic matter into humus for soil fertility and plant growth.
4. Decomposers consist of both animal and plant organisms.

# INTERACTION OF PLANTS AND ANIMALS



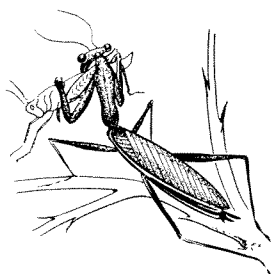
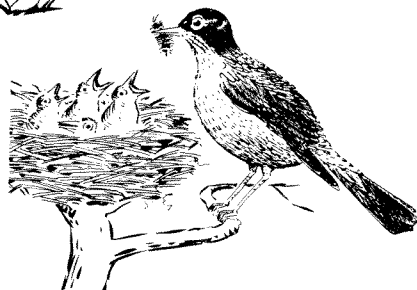
## INTERACTION OF PLANTS AND ANIMALS

Plants may be complimentary toward one another or they may be competitive to each other. Complimentary plants living together would be where one takes nutrients from the soil and the other manufactures the food, a symbiotic relationship. Plants that are competitive compete with each other for the same nutrients and water and give nothing to each other in return. Some plants are directly dependent on other plants and are called parasites. Animals, like plants, may be complimentary and contribute to the welfare of each, such as a prairie dog sharing his burrow or home with a snake. Some snakes cannot dig burrows and therefore would not have a home. Most meat-eating animals are considered predators to plant-eating animals. The rabbit may be eaten by the fox and the field mouse by the owl. Relationships between plants and animals are called interactions.

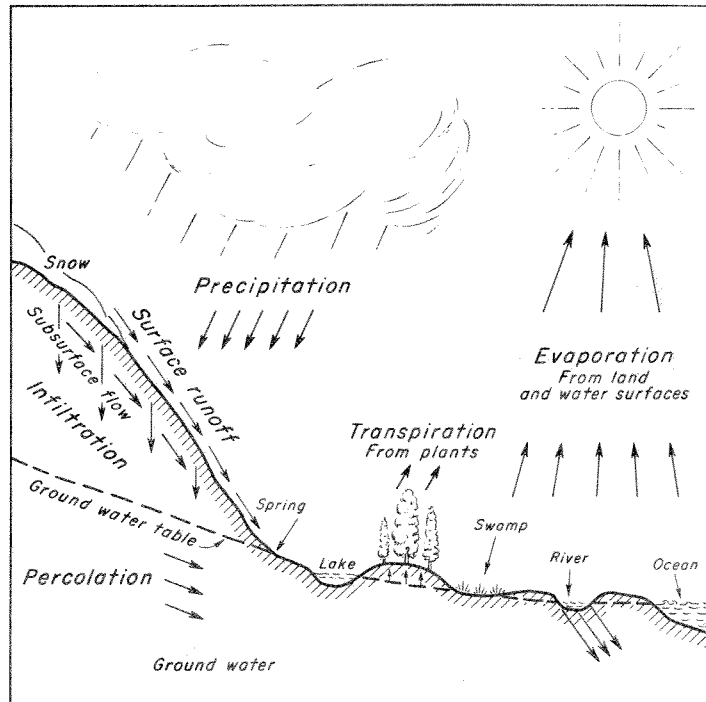
### Basic Concepts

1. Many organisms live together to the benefit of each other (symbiosis).
2. Some organisms are dependent upon other organisms and are detrimental to their general welfare.
3. Organisms that have similar food habitats may compete for food.
4. Plants may be utilized to an excessive degree by animals and thus die.
5. Plants may compete with each other for sunlight, water, and soil nutrients.

6. Adaptations to environmental changes are important for reproduction and survival.
7. Nature is constantly renewing itself.
8. Nature changes widely from year to year directly affecting ecosystem dynamics.
9. Natural conditions may change rather dramatically over time.



# SOIL AND CLIMATE



The hydrologic cycle.



These two samples of soil were taken only 25 feet apart. The one on the left from a cultivated field; the one on the right from an undisturbed fence row. Tests show the crumbly soil takes in water 20 times faster than the other.



## SOIL AND CLIMATE

The non-living parts of the ecosystem are called abiotic factors. These include soil, wind, rain, temperature, mountains, rocks, and sunshine. The process of minerals being taken from the soil by plant roots and utilized by plants, then passed on to animals and returned to the soil for reuse is known as mineral or nutrient cycling. Plant and animal residues are found in the soils in various stages of deterioration and aid in giving the soil tilth and structure so that plants can grow. Soil tilth relates to the physical condition of a soil and demonstrates its ease of tillage in its preparation for planting seed. Moisture and temperature are necessary for plant growth. Variation in topography represented by valleys, slopes, and hills present various site conditions that produce many different plant and animal species that adapt themselves to the area.

### Basic Concepts

1. Climate affects the presence and behavior of plants and animals.
2. Warm temperature and sunlight are necessary for food manufacture by plants.
3. The wind is both harmful and beneficial. Climate is the weather pattern of an area over a long period of time.
4. Weather conditions change as the temperature changes.
5. We can anticipate weather changes by observing the sky.
6. Changing temperature affects wind.
7. Weather maps may be used to predict the kind of weather that may occur.

For years scientists have cited the importance of climate, soil, and plant life for man's existence. It must be remembered that all are equally important and all are interdependent. Soil and plants develop together but they do so in limits of climatic conditions. Weather may be harmful as well as beneficial. An overabundance of rain will cause floods and high winds may cause property damage and loss of life.

#### Basic Concepts

1. Soil consists of crumbled or worn-down rock along with humus. Minerals in the rock are transferred to the soil.
2. Plants and animals that die and decay make up the humus in the soil. Soils need humus to produce soil structure and grow plants.
3. Plants use minerals in the soil and these need to be replenished.
4. Water can help build soil but also can be destructive.
5. The earth is composed of many kinds of soil.
6. Water is made available to living things by a cycle of evaporation, condensation, and distribution.
7. All living things need water to live.
8. Some living things make their homes in water.
9. Wise use of our water resources helps to assure its future availability.
10. Man has devised ways of holding water for later use.

# INTERACTION OF LIVING AND NON-LIVING PARTS



## INTERACTION OF LIVING AND NON-LIVING PARTS

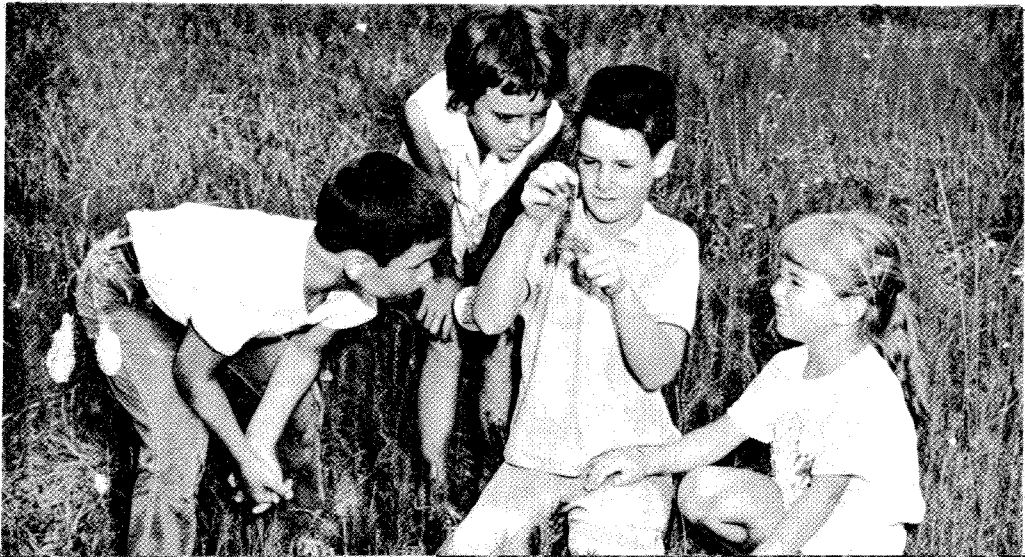
There are also relationships between plants and animals and the non-living parts of the ecosystem. Plants will not grow without water, or when it is too hot or too cold. Animals may die during blizzards or in the hot deserts without water. When it does not rain, plants may die, or grow only a small amount and thus animals will starve. If rain does not come, the plants may be eaten too heavily by animals who are trying to obtain food and thus, both plants and animals will die. When rains return both plants and animals will try to grow again and restore the ecosystem. Recovery may take many years, even as many as 100 or more.

Some soils will not develop and grow trees if first they are not inhabited by smaller, simpler plants. Stages of plant change and soil development are referred to as succession. Plants, in early successional stages, modify their habitat making it better adapted to other species. Soil changes are significant during successional stages. Soils in early successional stages have very little organic matter, but during late successional stages soil organic matter may be abundant.

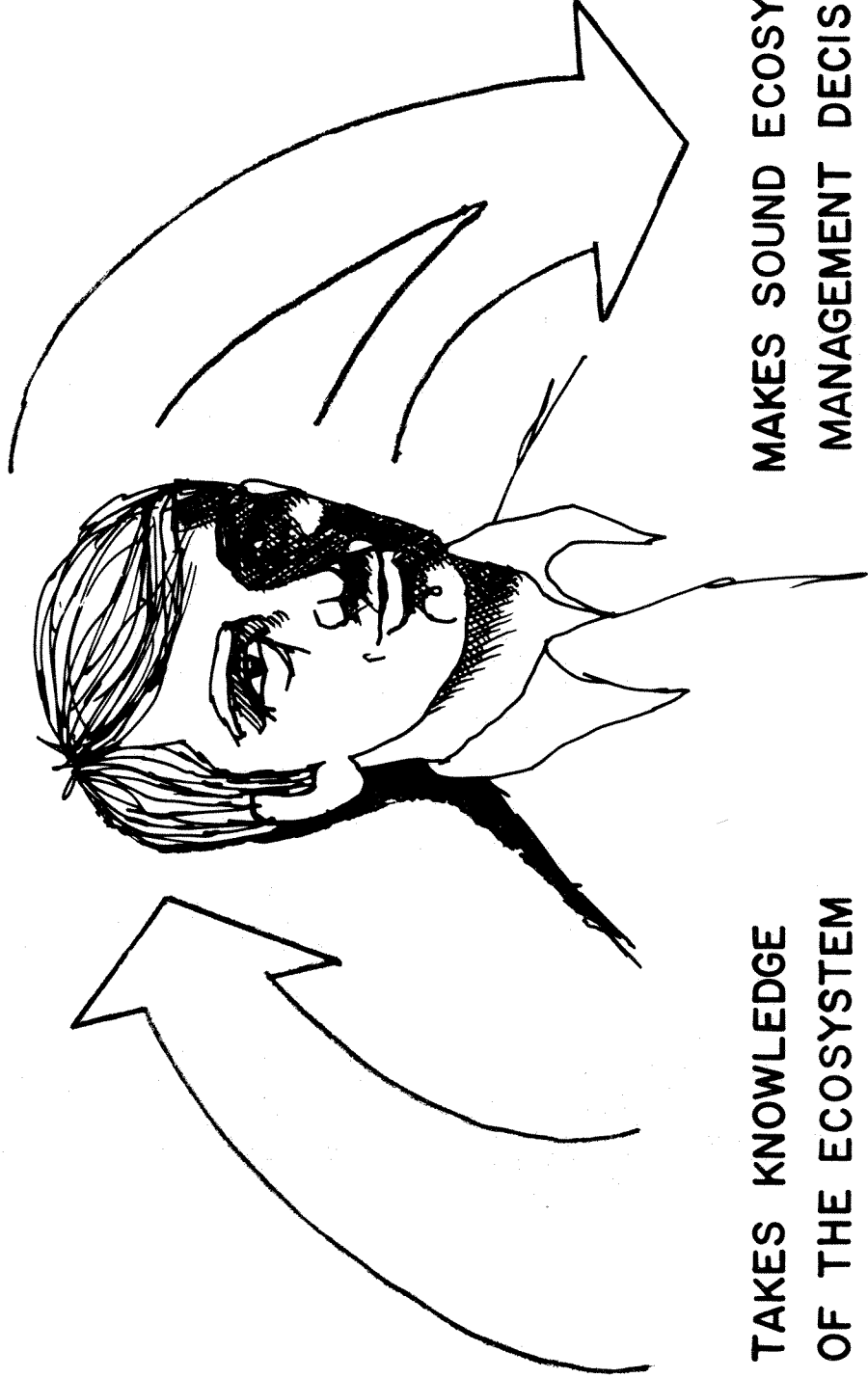
### Basic Concepts

1. The behavior of plants and animals is affected by the seasons.
2. Animals adapt to the changing season.
3. Plants grow and mature according to the seasons of the year.
4. Most of the food supply of all living things is produced during favorable growing periods of the year.
5. The number and kinds of living things that we see change with the seasons.
6. Some plants and animals do not survive the winter. Some plants may be dormant while some animals may hibernate or migrate.

# MAN



# MAN AS PART OF THE ECOSYSTEM



TAKES KNOWLEDGE  
OF THE ECOSYSTEM

MAKES SOUND ECOSYSTEM  
MANAGEMENT DECISIONS  
BASED ON KNOWLEDGE

## MAN

Man is a part of the ecosystem. Man is smarter than other organisms of the ecosystem and therefore he may change the kinds of plants or animals to his liking. He may change them for better food or for their beauty around his home. Man must be careful when he changes the ecosystem or he may destroy the soil and cause undesirable plant and animal life to invade the area. Some changes may be good but some may be very bad. Some, such as overgrazing, may nearly destroy the ecosystem so that it would require nature many hundreds of years to replace the soil, plants, and animals. Man is closely bound to the natural world and needs to develop an appreciation for an awareness of its importance for sustaining life. It is important for us to know how to use and care for our natural resources.

### Basic Concepts

1. There is, to a degree, a balance of nature in our ecosystem and man can either upset or help maintain that balance.
2. The ecosystem furnishes food, shelter, and contentment.
3. Our natural resources will be abundant only as long as man properly cares for them.
4. Our lives and those of future generations depend on the wise use of our natural resources.
5. Pollution of the environment (air, soil, and water) destroys or contaminates those elements essential to the life of man, and those things upon which he is dependent.

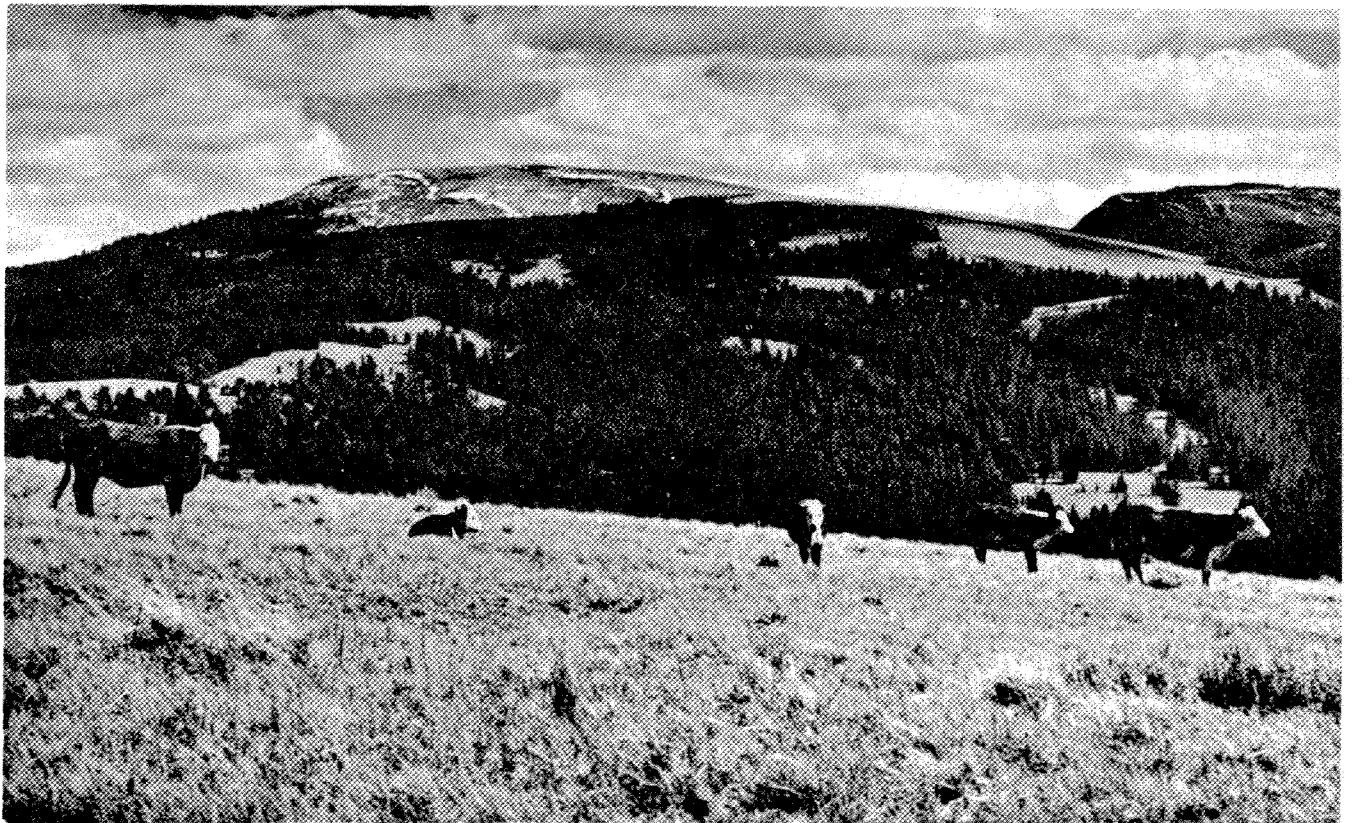
Every habitable area contains certain characteristics which man looks for in seeking a place to settle. Man may enjoy crowded urban areas or he may prefer to be alone in a quiet rural community.

### Basic Concepts

1. Different groups of men settled along the foothills of the eastern slope of Colorado while others settled in the mountains and plains.
2. Different homesites and communities have different characteristics.
3. The contribution of racial groups are important in the development of a community.
4. Communities are shaped by the contributions of ethnic and political groups.
5. The rivers in Colorado River Basin played an important part in the exploration and development of the area.
6. Man's life is based primarily upon patterns he has observed in nature.
7. Mechanization has increased man's leisure time and man's opportunity to appreciate and gain respect for his environment.



# WISE USE



## WISE USE OF ECOSYSTEMS

The efficiency of the use of our ecosystems depends upon man's wise manipulation of the ecosystem such as conversion of land to more productive plants, improving natural areas to enhance wildlife and increase red-meat production, preservation of aesthetic areas and planned use without general degradation of resources. The efficient use of solar energy conversion within the ecosystem is of great importance because all life in the system is dependent upon it. The existence of the ecosystem is dependent upon the management man applies.

As mentioned previously, plants manufacture food from the sun's rays. Animal life is dependent upon this process. This involves a plant-animal interaction. In turn, some animals are dependent upon other animals for their food. This involves an animal-animal interaction.

Biological efficiency of the ecosystem is based upon: 1) the amount of food formed in plants and, 2) the amount of plant food that is transformed into animal product for man's food.

In order to increase the biological efficiency of the ecosystem man might plan the land and plant different forage species. This might produce more forage and more nutrients for game animals and livestock. Man might add fertilizers to obtain more growth of plants. He might control small herbivores such as rodents and insects so that the large meat-producing herbivores could have more feed. Most important man should control grazing so that plants remain vigorous and highly productive. It must be remembered that plants are living organisms and also require food. Therefore, some of the food that is produced by the plants must be used

by the plants in order for them to live. Thus, plants must continue to grow and produce leaves for food formation or they will die and reduce the biological efficiency of the ecosystem. Grazing animals, if not managed properly, may eat the plants too closely thus preventing them from manufacturing food.

Misuse of the resources and pollution of the environment destroys the elements essential to the life of man and those things upon which he is dependent.

#### Basic Concepts

1. If man upsets the balance of nature, plant and animal communities are usually altered or destroyed.
2. Pollution may destroy the natural beauty that is considered necessary for man's relaxation and recreation.
3. Technology alone will not solve environmental problems. Man's attitudes and values must be directed toward the concept of a quality environment.
4. Man and nature can work together beneficially.

