

SOCIAL STUDIES 1205

MAN AND HIS ROLE IN THE ENVIRONMENT

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MAN AND HIS ROLE IN THE ENVIRONMENT

The world that God created was one of beauty and splendor. God told man, "Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth" (Genesis 1:28). Therefore, people today are the earth's stewards and keepers.

With the world population growing swiftly and with technological advances increasing rapidly, man has the potential to alter the vast global ecosystem of which he is a part. For example, the continual emission of air pollutants from smokestacks and vehicle exhausts has significant effects on the quality of the air.

Governments have passed various laws in an

effort to withstand the onslaught of pollution. Citizens must also do their part; for if pollution continues unchecked, not only will they make the environment unsafe for man and other living things, but also they will leave behind a contaminated world for future generations.

To maintain a safe, healthful environment, we must be aware of and informed about our total surroundings. In short, we need to develop an ecological consciousness. So let us accept the challenge of maintaining clean air, pure streams, and uncluttered landscapes. Clearly, the responsibility of keeping the earth clean and beautiful is totally up to man.

OBJECTIVES

Read these objectives. The objectives tell you what you should be able to do when you have successfully completed this LightUnit.

When you have finished this LightUnit, you should be able:

1. To explain the purpose, function, and objectives of the science of ecology.
2. To describe man's relationship to the ecosystems.
3. To identify the kinds of pollution and their properties.
4. To describe the damaging effects of pollution on all living organisms.
5. To explain man's role in his environment.
6. To develop an ecological consciousness.
7. To explain the economic and social implications of exhausting natural resources.
8. To describe the fundamentals of energy, its early history, and its sources.
9. To explain the social, economic, and political implications of energy shortages.
10. To outline the need for conservation.
11. To identify the alternate sources of energy.
12. To summarize the long-range implications of positive environmental action.

Survey the LightUnit. Ask yourself some questions about this study. Write your questions here.

I. MAN AND HIS ENVIRONMENT

As a steward of the earth, man needs to relate to his environment in a responsible manner. Natural resources are gifts from God; but instead of using them selfishly and recklessly, man must recognize that these resources are limited and

that the order in nature must be respected. In this section you will study ecology and its relationship to man. You will also study how pollution occurs and how it affects the ecological balance in man's environment.

SECTION OBJECTIVES

Read these objectives. When you have completed this section, you should be able:

1. To explain the purpose, function, and objectives of the science of ecology.
2. To describe man's relationship to the ecosystems.
3. To identify the kinds of pollution and their properties.
4. To describe the damaging effects of pollution on all living organisms.
5. To explain man's role in his environment.

VOCABULARY

Study these words to enhance your learning success in this section.

biogeochemical cycle

euphotic zones

biotic environment

thermal pollution



Note: All vocabulary words in this LightUnit appear in **boldface** print the first time they are used. If you are unsure of the meaning when you are reading, study the definitions given in the Glossary.

ECOLOGY

Ecology is the study of the effect of the environment upon the form, habits, and range of animals and plants and of their relation to each other. No living thing, plant or animal, lives alone. Every living thing depends in some way upon certain other living and nonliving things. Those organisms, whether seen or unseen in the world today, are the result of many years of interactions.

Meaning and significance of ecology. Animals and plants living in the same area, or community,

depend on each other in some way. Man's survival and well-being depends on these relationships. A community of plants and animals living together in a large geographic region having a certain climate is called a *biome*. The types of biomes are (1) aquatic (water regions), (2) deserts, (3) forests, (4) grasslands, and (5) tundras. A combination of communities, or biomes, and their **biotic environments** are known as *ecosystems*. An ecosystem is the most complex level or organization in nature. It is dependent upon elements such water, soil, and

climate.

People who study the environment are called ecologists. Ecologists study the activities and changes in the natural world. For example, they examine where plants and animals live together and how their biotic (biological) environments are related to each other and to the physical environment of the earth, water, air, and energy.

Activities which ecologists study include the movement of energy, food, and other nutrients through an ecosystem. For example, the energy from the sun is converted by green plants into stored energy in the cells. As the plants are eaten, much of this stored energy is used; but some of the energy is stored in the bodies of the plant-eating animals, or *herbivores*. When a *carnivore*, or meat-eating animal, eats a herbivore, much of the energy stored in the herbivore is used by the carnivore to sustain its own life. Energy is also passed on to the scavengers, decomposers, and transformers (bacteria).

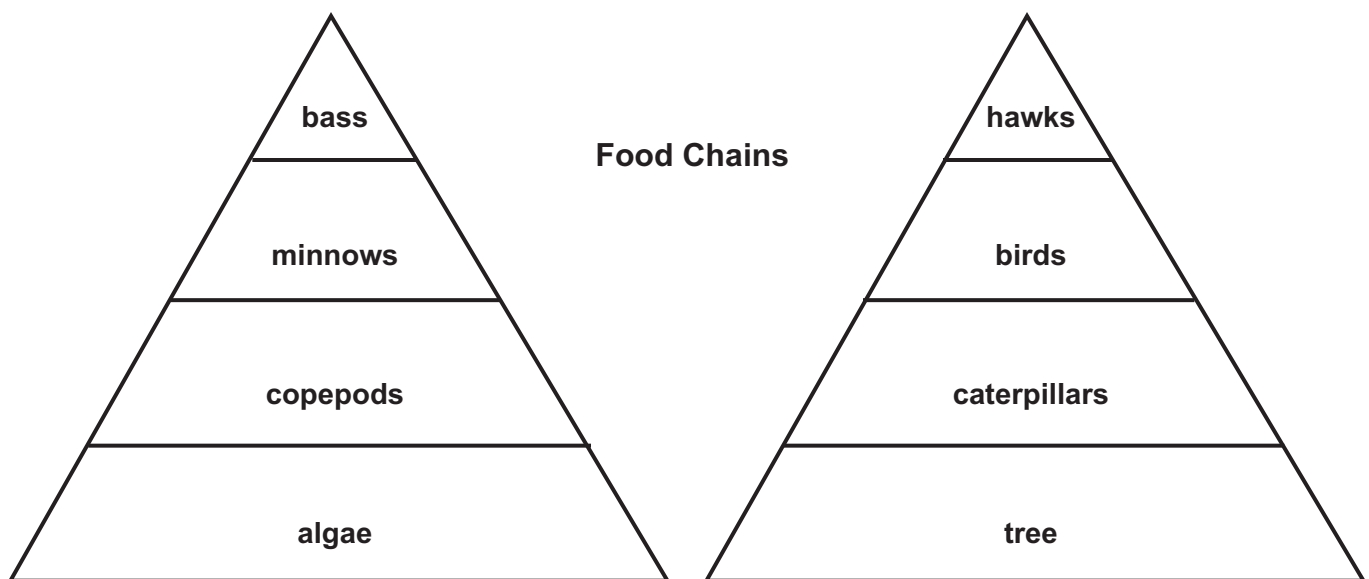
We should remember that not all the energy stored by a herbivore is stored by a carnivore. Much of the energy is used in the vital process of metabolism, locomotion, and reproduction. Only the excess energy is converted into fatty tissues that store the energy.

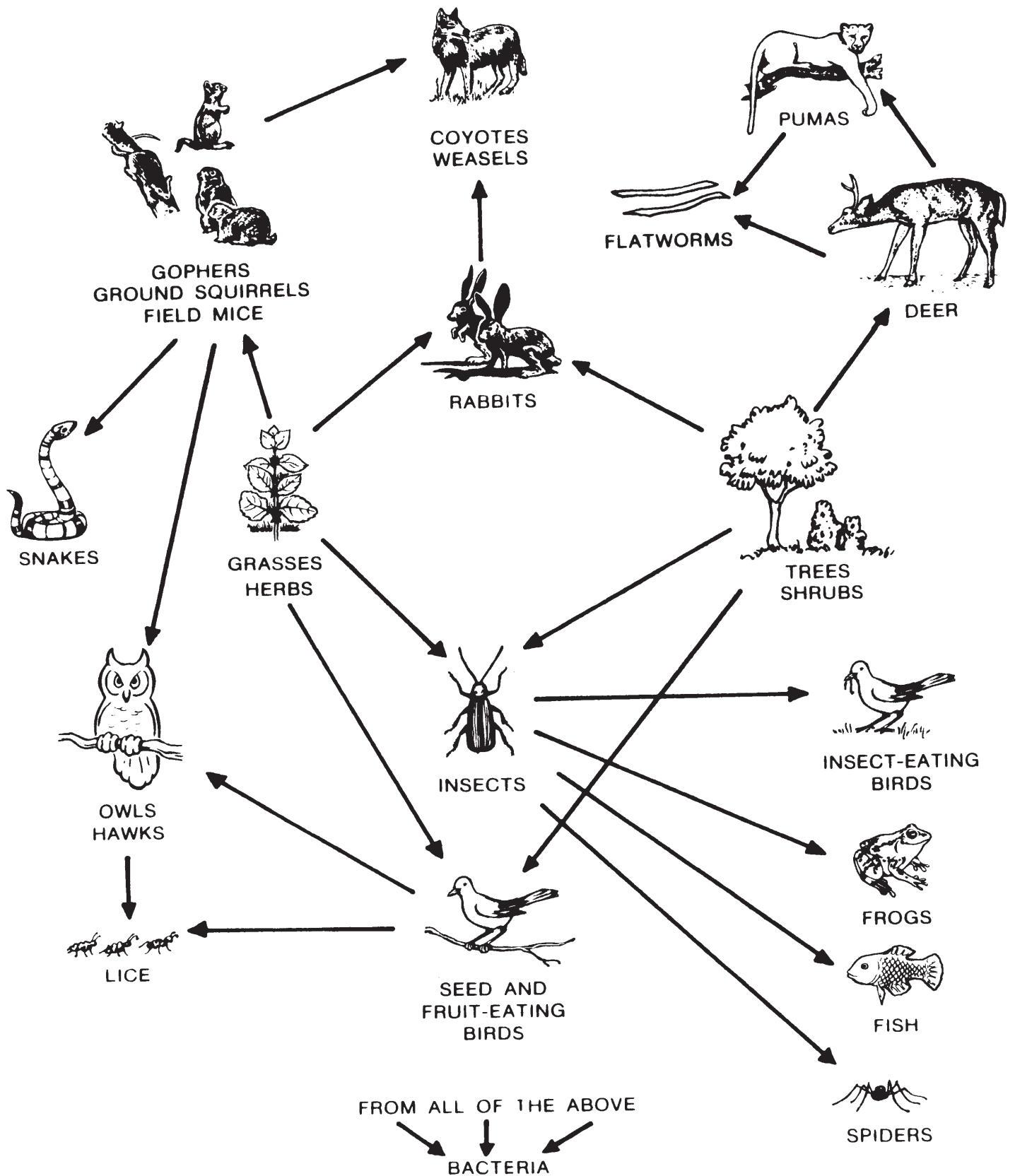
For example, in a lake there is an energy

transfer. Energy passes from algae to the copepod, to the minnow, to the bluegill, and to the bass. If there is no predator for the bass, then it is the top carnivore and someday will provide the crayfish with food when he dies. Within the lake are numerous other food chains in operation at the same time. A bullfrog could possibly eat the crayfish and a raccoon might eat the bullfrog; or the frog might eat the crayfish or minnow and then be eaten himself by a snake. If the conditions are right, the snake could possibly be consumed by the bass. Thus the cycle goes on and on.

Food chains in an ecosystem are often represented as a pyramid, with the lower food producers at the bottom and the superior carnivore at the apex or top of the pyramid.

The *primary producers* in the food chain are grass and plants, which get their energy from the sun. A rodent that eats the plants becomes the *primary consumer*. A *secondary consumer* such as a weasel eats the rodent. An eagle, a *tertiary* (third) *consumer*, eats the weasel. When the last animal in the food chain dies, *decomposers* (bacteria and fungi) break the body down into simple nutrients which go back into the soil. A network of food chains is called a *food web*. The more complicated the food web, the more stable or unchanging the ecosystem.





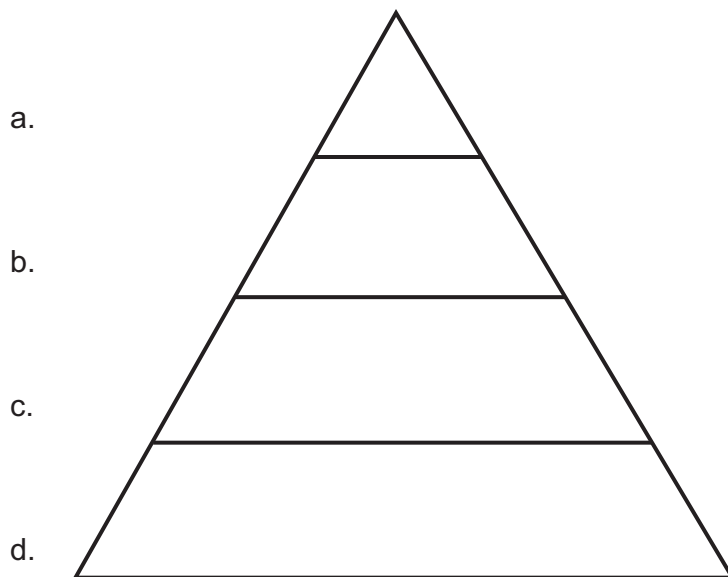
FOOD WEB



Complete these activities.

- 1.1 Define the study of ecology. _____

- 1.2 What is an ecosystem? _____
- 1.3 In a _____, energy in food passes from one living thing to another.
- 1.4 A community of plants and animals living together is called a _____.
- 1.5 List the five types of biomes.
- a. _____ d. _____
b. _____ e. _____
c. _____
- 1.6 Give an example of each of the following categories concerning the food web.
- a. primary producer _____
b. primary consumer _____
c. secondary consumer _____
d. tertiary consumer _____
e. decomposers _____
- 1.7 Complete the following pyramid in relation to a lake or pond and the food cycle.



Cycles of chemical elements. An ecologist also studies the cycling and exchange of the chemical elements. For example, it is known that without phosphorus, organisms cannot live. Most nutrients, like phosphorus, move through the food chain over and over. Because phosphorus does not return naturally to its origin in the soil, the cycle is referred

to as an *imperfect cycle*. Carbon, on the other hand, undergoes a *perfect cycle*. Carbon is stored in the atmosphere in the form of carbon dioxide. Through the process of photosynthesis, plants use water and carbon dioxide to make sugar and release pure oxygen into the air. Humans and animals breathe the oxygen and eat plants for food.

The reaction of sunlight with green plants is the most significant chemical reaction on earth. This cycling and recycling of carbon and oxygen is perfect or complete.

Changes in natural systems occur daily or gradually over the years. Day-to-day changes of the nutrient cycles help an ecosystem to remain stable. This stability among plants and animals and their environment is referred to as the *balance of nature*.

An ecological succession occurs very slowly when a new system replaces an old one. The organisms living in an area go through an orderly pattern of gradual changes, and it may take

hundreds of years for a succession to be completed. Factors such as sunlight, wind, and soil determine the kinds of plants and animals that live in an area. The kinds of organisms change with their surroundings; and as they change, the environment changes. The final stage of succession is called the *climax* and may last hundreds or thousands of years. For example, after a forest fire, the ecological succession begins with grasses and flowers; then come the birches, oaks, maples, and other trees. Scientists refer to a mature forest as a *climax community*.



Complete these activities.

- 1.8 Explain how photosynthesis in plants occurs. _____
 - 1.9 The stability of plants and animals living together in an ecosystem is called the _____.
 - 1.10 True or False: You could expect to observe an ecological succession on an island destroyed by a volcanic eruption. _____
 - 1.11 A fully developed system such as a mature forest is called a _____.
-

Life-sustaining elements. You have seen that ecology is concerned with living things in their physical environment and their interactions. Certain elements are necessary to sustain life and are basic to its survival. These basic needs of life are air, water, and sunlight. We read in Genesis 1 that God created all of the components necessary to maintain life on earth.

The thin envelope of air that surrounds the earth is known as the atmosphere, which is fifty miles thick. The layer of atmosphere closest to the earth, called the *biosphere*, is the part of the earth where life can exist. Nitrogen and oxygen constitute the largest volume of the biosphere: nitrogen, 78 percent; and oxygen, 21 percent. The biosphere also contains small amounts of argon (0.93 percent) and carbon dioxide (0.03 percent), along with water vapor ranging from 1 to 3 percent by

volume. All these gases except argon are essential to life.

More than 79 percent of the earth's surface is covered by water. Water is changed into vapor when the heat from the sun evaporates it. This moisture is later released from the atmosphere as rain, snow, or sleet. All living things consume and give off water in a continuous process called the **biogeochemical cycle**.

The ultimate source of energy for biological processes is the sun. However, much solar energy is lost in the atmosphere or on the earth. Less than 1 percent of this energy is involved in the process of photosynthesis, which was discussed earlier. Sunlight is essential in controlling environmental temperatures, and it affects the existence and distribution of life. Without sunlight, life as we know it would end.

Man and the ecosystem. The focus of this study so far has been on defining ecology and understanding some of the fundamentals, concepts, principles, and terms relating to ecological concerns. We will now consider man and his role in nature. Man, a member of almost all ecosystems, has the ability to modify his environment enough to survive a great variety of conditions. In fact, man has the power to destroy many forms of life on the planet on which he lives. It is ironical that in man's ambition for economic prosperity, he is overusing some of the very resources on which his prosperity depends.

Growing population and food shortages. Since the time of Noah, man's population has increased from eight people to over six billion. There are many reasons for this dramatic growth in population. Among them are the domestication of plants and animals, or the agricultural revolution, which has increased food sources; and the elimination of disease through advanced scientific and medical knowledge, resulting in longer life expectancies and lower infant mortality rates.

The growth in population has made increasing demands on the existing ecosystems. To obtain more food, man has interfered with the natural

patterns of nutrient cycling and has used new substances, such as pesticides, to control crop pests. For example, in the 1940s, people began using DDT to kill harmful insects, but it was later discovered that DDT also destroyed birds and fish. In 1973 the United States banned most uses of DDT. Pesticides and other pollutants are discussed in more detail later in this LightUnit.

As nations, especially those in Asia, Africa, and South America, continue to increase in population, man must find new food sources and better methods of food distribution. If programs are to be successful, they must be managed by individuals who exercise intelligent judgment and dedicated concern. Fortunately, there are many people who are already concerned and are looking for solutions and alternative sources of food.

One potential as a new food source is the sea. However, much needs to be done before man can economically practice *mariculture*, or large-scale ocean farming. Small-scale farming of the ocean has been done with food delicacies such as clams, oysters, lobsters, and shrimp; but these delicacies are inadequate to feed large populations. Other promising ways to relieve the food crisis are irrigation of arid lands and bigger crop yields.



Complete these sentences.

- 1.12 The layer of air closest to the earth where life can exist is the _____.
- 1.13 The gases which comprise the largest volume of the biosphere are a. _____ and b. _____.
- 1.14 About _____ percent of the earth's surface is covered by water.
- 1.15 The main source of energy for life is the _____.
- 1.16 Less than 1 percent of the sun's energy is involved in the process of _____.



Complete these activities.

- 1.17 List two reasons for the increase in the world population.
 - a. _____
 - b. _____
- 1.18 What are two steps man must take in order to keep up with the world's increasing demands for food?
 - a. _____
 - b. _____