

# CHAPTER 4

## ECOLOGY

- **THE LIVING ENVIRONMENT: KEY IDEA 3**  
*Individual organisms and species change over time.*
- **THE LIVING ENVIRONMENT : KEY IDEA 5**  
*Organisms maintain a dynamic equilibrium that sustains life.*
- **THE LIVING ENVIRONMENT : KEY IDEA 6**  
*Plants and animals depend on each other and their physical environments.*
- **THE LIVING ENVIRONMENT: KEY IDEA 7**  
*Human decisions and activities have had a profound impact on the physical and living environment.*

### Origin of the Living Environment

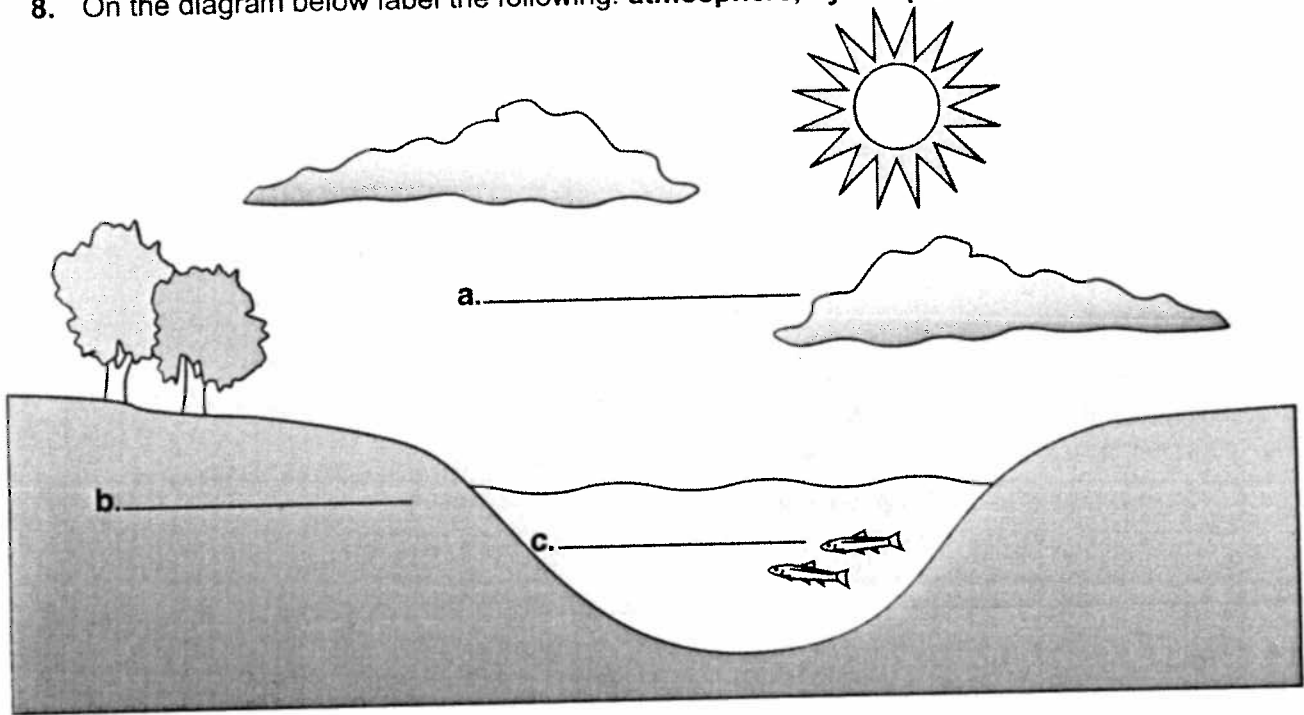
Living organisms depend on the **lithosphere** (rock and soil), the **hydrosphere** (water), and the **atmosphere** (air) of Earth. Throughout Earth's history these three areas have changed.

Earth's original atmosphere did not contain the gases, oxygen, and water vapor that life depends on. Volcanic eruptions released gases and water vapor from Earth's interior. As Earth cooled, water vapor condensed and precipitation filled the ocean and lake basins. This formed Earth's hydrosphere. Erosion of rock and soil added salts and minerals to the water. Photosynthesis by green plants, especially the algae in the oceans, removed the carbon dioxide from the atmosphere and released oxygen. The forces of weathering, erosion, volcanic activity, and crustal plate movement changed the shape of the land.

### Review Questions

1. \_\_\_\_\_ eruptions released many gases into the atmosphere.
2. As Earth cooled, \_\_\_\_\_ condensed to water droplets.
3. The ocean basins were filled with water by the process of \_\_\_\_\_.
4. The oceans, lakes, and rivers of Earth make up the \_\_\_\_\_.
5. The solid outer layer of Earth is the \_\_\_\_\_.
6. Nitrogen and oxygen are the main gases in the \_\_\_\_\_.
7. Oxygen in the atmosphere is produced by \_\_\_\_\_ by green plants.

8. On the diagram below label the following: **atmosphere, hydrosphere, lithosphere**



### Ecosystems

**Ecology** is the study of the interactions between organisms and the environment. Organisms depend on their physical environment. The survival of an organism is determined by its ability to sense and respond to the environment.

The number of organisms that an ecosystem can support depends on the resources that are available and the physical features of the area. There are two parts to an **ecosystem**: the living (biotic) factors and the non-living (abiotic) physical factors. Biotic factors are the living organisms. A **population** consists of the individuals of one species living in a location. For example, all the bullfrogs that live in a pond are a population. All the different populations in one location define a **community**. A pond community could include all the frogs, fish, and plants in the water.

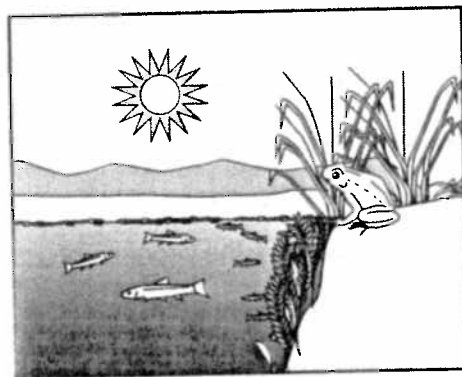


FIGURE 1. POND ECOSYSTEM

Some of the non-living factors in an ecosystem are temperature, light, soil, air, and water. Energy enters the ecosystem as sunlight. Energy and matter flow from one organism to another. Energy is eventually lost from the ecosystem to the environment mainly as heat.

Given enough resources and a lack of disease or predators, populations increase. Factors such as lack of resources, habitat destruction, predators, or a change in climate will limit the growth of some populations in an ecosystem. The environment may contain dangerous levels of substances called **pollutants**, which are harmful to organisms. For example, mercury in the water or carbon monoxide in the air can be harmful to organisms.

### Review Questions

9. All the organisms in a forest will \_\_\_\_\_ with one another.
10. Classify the following parts of an ecosystem as (A) abiotic or (B) biotic:
  - a. water \_\_\_\_\_
  - b. green plants \_\_\_\_\_
  - c. ants \_\_\_\_\_
  - d. sunlight \_\_\_\_\_
  - e. soil \_\_\_\_\_
  - f. bacteria \_\_\_\_\_
11. All the mountain gorillas in a rainforest are called a \_\_\_\_\_.
12. Communities are the different \_\_\_\_\_ of organisms in a location.
13. If there are adequate resources and no predators or disease, then populations will \_\_\_\_\_ in size.
14. The main source of energy for an ecosystem is \_\_\_\_\_.
15. Energy is lost from a system mainly in the form of \_\_\_\_\_.
16. Harmful substances in the environment are called \_\_\_\_\_.

### Relationships Among Organisms

The organisms in an environment interact with one another. These interactions are classified as competitive, harmful, or beneficial.

#### INTERACTIONS BETWEEN ORGANISMS

TYPE OF INTERACTION	DESCRIPTION	EXAMPLE
Competitive	Organisms with the same needs compete for the same resources such as food and space	Foxes and hawks both eat rabbits
Harmful	One organism is harmed while the other benefits	Tapeworm in the human intestine
Beneficial	One or both organisms gain from the relationship while neither is harmed	Bacteria in the human intestine

Some species have adapted to be dependent upon each other with the result that neither could survive without the other. Some microorganisms are essential for the survival of living things. Humans could not survive if they did not have beneficial bacteria in their intestines. Bacteria live in the roots of pea plants where they convert nitrogen in the air to a useable form for the plant.

## Review Questions

17. In an ecosystem, organisms will \_\_\_\_\_ with each other.
18. The interaction between a flea and a dog is classified as \_\_\_\_\_.
19. A snake and a hawk will \_\_\_\_\_ with each other for the same food.
20. Some species have adapted to be \_\_\_\_\_ upon each other for survival.
21. Some \_\_\_\_\_ are necessary for the survival of living organisms.

## Feeding Relationships

In ecosystems two major types of nutrition occur: autotrophic and heterotrophic. Autotrophs or **producers** are organisms that make their own food. They convert light energy from the Sun into the chemical energy found in food. By the process of photosynthesis, autotrophic green plants produce sugar and oxygen from the water and carbon dioxide they absorb. They provide nutrients for all other organisms that cannot make their own food. All green plants are producers for ecosystems.

Heterotrophs or **consumers** cannot make their own food. They eat energy-rich food made by the producers. **Herbivores**, such as cows and rabbits, obtain energy by feeding on plants. **Carnivores**, such as lions and hawks, obtain energy by feeding on other animals. **Omnivores** are consumers that obtain energy by eating both plants and animals. Humans and bears are omnivores.

**Decomposers** obtain energy by consuming wastes and dead organisms. Bacteria and fungi are important decomposers in ecosystems. They break down the remains of dead organisms and return substances to the environment that can be reused by other organisms. This activity recycles substances for the ecosystem. For example, when leaves decay, the nutrients in the leaves are returned to the soil for plants to use for growth.

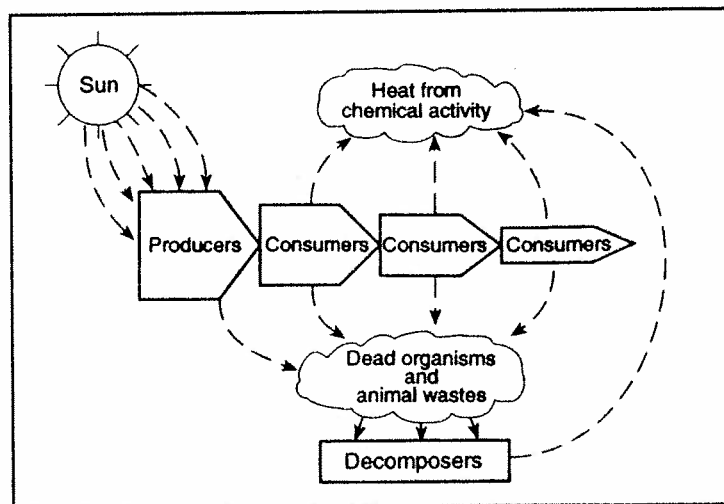


FIGURE 2. FEEDING RELATIONSHIPS

## Review Questions

22. All organisms need \_\_\_\_\_ to survive.
23. Autotrophs \_\_\_\_\_ their own food.
24. \_\_\_\_\_ do not make their own food.
25. Substances in the ecosystem are recycled by the \_\_\_\_\_.
26. Complete the chart.

Nutrition Type	Producer or Consumer?	Description	Example
Autotroph	a.	b.	c.
Herbivore	d.	Feeds on plants	e.
Carnivore	Consumer	f.	g.
h.	i.	Feeds on plants and animals	j.
Decomposer	k.	l.	m.

### Energy Flow in the Ecosystem

Matter is transferred from one organism to another and between organisms and the physical environment. Water, nitrogen, carbon dioxide, and oxygen are examples of substances cycled between the living and non-living environment. Green plants remove carbon dioxide from the air. The carbon is passed on to consumers in the form of sugar. The plants release oxygen and water vapor to the air.

**Food chains** illustrate the flow of energy and matter through an ecosystem. The energy flows in one direction and usually starts from the Sun. Food chains begin with producers. Energy passes from the producers to the consumers. Decomposers return the energy to the ecosystem. There are many types of organisms at each feeding level. There are many food chains in an ecosystem.

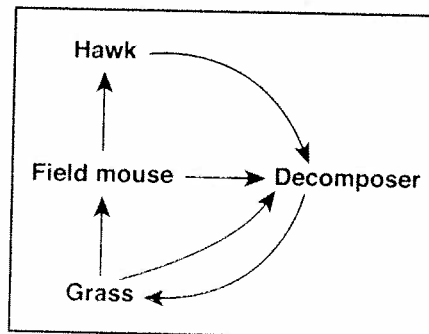


FIGURE 3. FOOD CHAIN

Food chains are interconnected at various points forming a **food web**. Food webs identify all of the feeding relationships among the producers, consumers, and decomposers in the ecosystem. The final organism in a food web is always a decomposer.

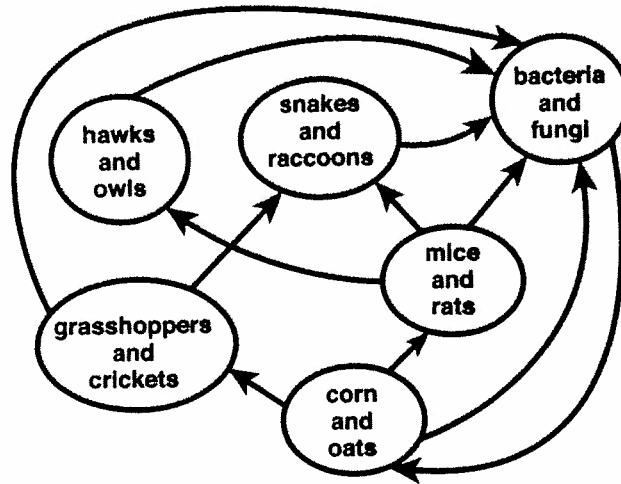


FIGURE 4. FOOD WEB

**Energy pyramids** show the amount of energy available in the ecosystem from one organism to the next. The greatest amount of energy is present in producers which are at the bottom of the pyramid. An ecosystem needs a large number of plants to support the other organisms. Producer plants are eaten by primary consumers known as herbivores. Herbivores are eaten by secondary consumers or carnivores.

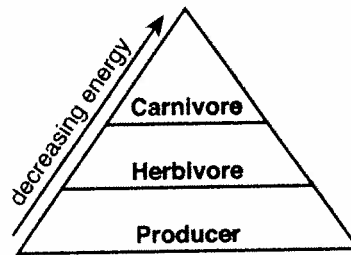
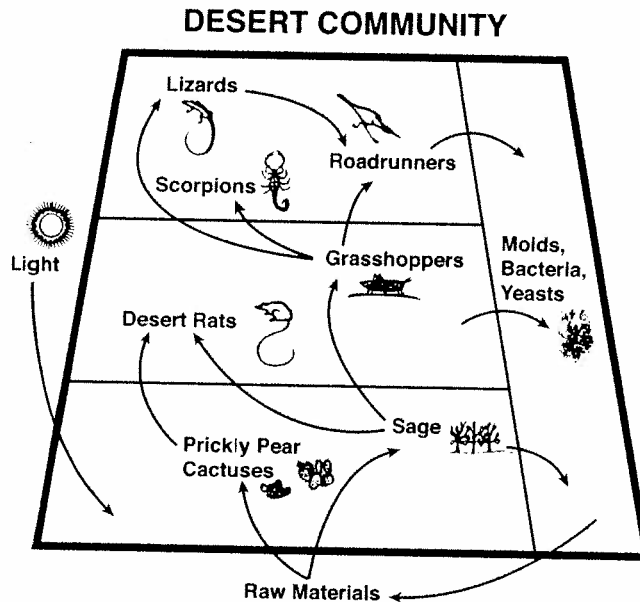


FIGURE 5. ENERGY PYRAMID

Energy is passed on and used in the food chain. Yet some energy is wasted and lost from one level to the next. The energy available decreases as one moves to the upper levels of the energy pyramid. Therefore the total mass of living organisms that can be supported at each level decreases.

## Review Questions

27. Energy flows through the ecosystem in one \_\_\_\_\_.
28. The energy in the ecosystem begins with the \_\_\_\_\_.
29. The final organism in a food web or chain is always a \_\_\_\_\_.
30. Examples of substances cycled between living and non-living environment are water, \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_.
31. The greatest amount of energy in the pyramid is present at the \_\_\_\_\_ level.
32. Large numbers of \_\_\_\_\_ are consumed by smaller numbers of consumers.
33. The energy available in the pyramid \_\_\_\_\_ towards the top.
34. Refer to the diagram of a desert community.



- a. This diagram represents a food \_\_\_\_\_.
- b. Name one producer \_\_\_\_\_.
- c. Name a carnivore \_\_\_\_\_.
- d. Molds are classified as \_\_\_\_\_.
- e. Name a "raw material" \_\_\_\_\_.
- f. Complete this food chain:

\_\_\_\_\_ → \_\_\_\_\_ → scorpion

## Changes in Ecosystems

For an ecosystem to remain unchanged, there must be a constant source of energy. There must be organisms which use this energy to produce food. These are producers such as green plants. There must also be a cycling of materials between the living organisms and the environment. This is done by decomposers.

Ecosystems change over time. The environment may be altered through the activities of organisms or by forces of nature. Natural events such as volcanoes, floods, and forest fires can change environments. As the environment changes some species may replace others. This results in a gradual change called **ecological succession**. The original organisms in an ecosystem are replaced with other types. A new community replaces the old community. For example, over time a pond of fish and snails may become a swamp of frogs and large plants.

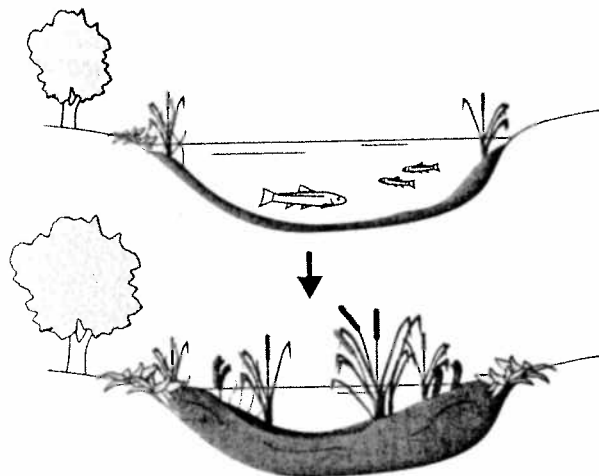


FIGURE 6. ECOLOGICAL SUCCESSION

An organism will survive only if it can adapt to its changing environment. Species that cannot adapt become **extinct**, or die out. This happens when something that is essential for the organism to survive is removed. Causes of extinction include changes in climate, natural disasters such as asteroid impacts, habitat invasion by predators, and hunting by humans. Pollution in the water can lead to a loss of habitat resulting in extinction of certain types of fish.

Evidence for extinction is found in fossils in sedimentary rock. Many organisms which lived in the past are no longer found on Earth. The dinosaur which was very abundant 70 million years ago, no longer exists.

### Review Questions

35. Ecosystems will be unchanged if there is a constant source of \_\_\_\_\_.
36. Decomposers \_\_\_\_\_ material between living organisms and the environment.
37. A gradual change in the ecosystem of an area is called \_\_\_\_\_.
38. An organism will survive only if it can \_\_\_\_\_ to changes in its environment.
39. Evidence for extinction is found by studying \_\_\_\_\_ in sedimentary rock.



## Human Effects on Ecosystems

The survival of living organisms on Earth depends on the conservation and protection of Earth's natural resources. **Non-renewable resources** are Earth materials which cannot be replaced by natural processes. For example, as we continue to remove and use copper ore from rocks, the amount of copper available to us becomes less. Recycling of metals can lessen this effect.

**Renewable resources** are replaced by natural processes within a period of time. Soil is replenished with nutrients by decomposition of plant and animal matter. Water is recycled by nature. Overuse and not allowing time for replenishment threatens renewable resources.

Overpopulation by any species affects the environment due to increased use of resources. Human activities have caused environmental degradation through resource acquisition and the use of non-renewable resources. **Urban** growth, that is the spreading of cities by humans, has caused habitat destruction as forests and wetlands have been destroyed. Land use decisions and waste disposal by humans have changed ecosystems.

Human activities have caused major pollution of the air, water, and soil. Since the start of the Industrial Revolution this impact has increased dramatically. The burning of fossil fuels for energy production and the use of Earth's natural resources in manufacturing have affected ecosystems. Pollution has had a cumulative and global impact. Acid rain, global warming, and ozone depletion impact many ecosystems worldwide.

### Review Questions

40. The survival of organisms on Earth depends on the protection and \_\_\_\_\_ of natural resources.
41. \_\_\_\_\_ resources cannot be replaced in our lifetime.
42. Water is an example of a \_\_\_\_\_ resource.
43. Human activities have resulted in air, water, and soil \_\_\_\_\_.
44. The negative impact of human activities on ecosystems has increased since the \_\_\_\_\_ began.



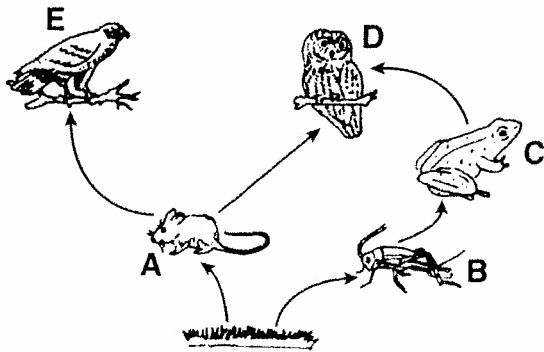
11. Bacteria of decay (decomposers) are important components of an ecosystem because they
- |                             |                     |
|-----------------------------|---------------------|
| (1) recycle organic matter  | (3) absorb sunlight |
| (2) carry on photosynthesis | (4) produce oxygen  |
12. As a member of the ecological community, humans are classified as
- |               |                 |               |                |
|---------------|-----------------|---------------|----------------|
| (1) producers | (2) decomposers | (3) consumers | (4) autotrophs |
|---------------|-----------------|---------------|----------------|
13. Solar energy enters food chains through the life processes of
- |               |                 |                |               |
|---------------|-----------------|----------------|---------------|
| (1) omnivores | (2) decomposers | (3) carnivores | (4) producers |
|---------------|-----------------|----------------|---------------|
14. The decomposers that decay plant and animal matter in an ecosystem include
- |                            |                           |
|----------------------------|---------------------------|
| (1) grasses and bacteria   | (3) grasses and insects   |
| (2) bacteria and mushrooms | (4) grasses and mushrooms |
15. The typical sequence for a food chain is
- |  |
|--|
| (1) green plants → carnivores → herbivores |
| (2) green plants → herbivores → carnivores |
| (3) herbivores → green plants → carnivores |
| (4) herbivores → carnivores → green plants |

16. An incomplete food chain is shown below

algae → minnow → trout → X

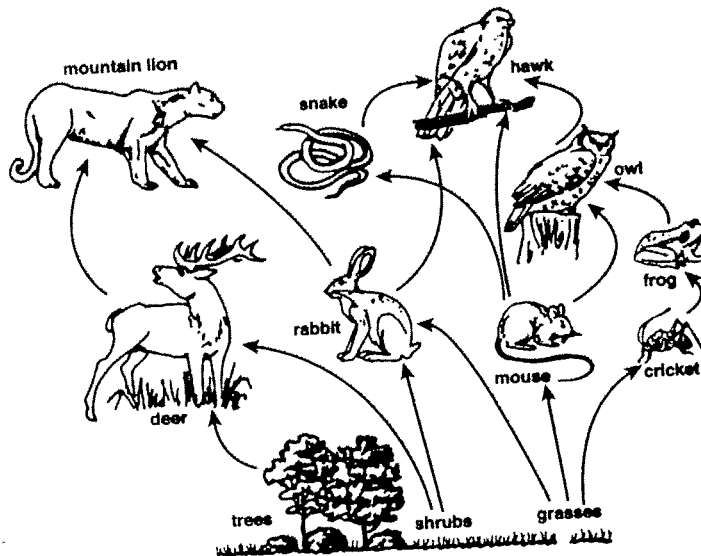
What organism could be represented by the X ?

- |           |               |               |         |
|-----------|---------------|---------------|---------|
| (1) human | (2) jellyfish | (3) pine tree | (4) cow |
|-----------|---------------|---------------|---------|
17. In a food web, the greatest amount of chemical energy is provided by
- |                 |                         |
|-----------------|-------------------------|
| (1) producers   | (3) primary consumers   |
| (2) decomposers | (4) secondary consumers |
18. The diagram shows a food web. Which organisms are most likely competitors?



- |             |
|-------------|
| (1) A and C |
| (2) B and C |
| (3) B and D |
| (4) D and E |

Base your answers to questions 19-24 on the food web diagram below.



19. Which is a food chain in this web?
  - (1) trees, mountain lion, snake, and hawk
  - (2) trees, rabbit, deer, and shrubs
  - (3) grasses, cricket, frog, and mouse
  - (4) grasses, mouse, snake, and hawk
  
20. What is the primary source of energy for this food web?
 

(1) Sun	(2) grasses	(3) snake	(4) wind
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21. Two herbivores (primary consumers) are the
 

(1) deer and mountain lion	(3) rabbit and mouse
(2) owl and snake	(4) cricket and frog
  
22. Which organisms not shown in this food web are important in all ecosystems?
 

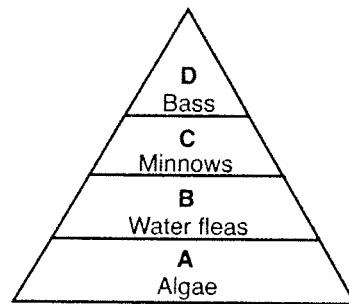
(1) decomposers	(2) consumers	(3) producers	(4) predators
-----------------	---------------	---------------	---------------
  
23. The snake is classified as a(n)
 

(1) herbivore	(2) carnivore	(3) decomposer	(4) omnivore
---------------	---------------	----------------	--------------
  
24. If a pesticide was sprayed that killed all the crickets, how would the food web be affected?
  - (1) the grasses would die
  - (2) the frog population would decrease
  - (3) the mountain lion would migrate
  - (4) the deer population would increase

25. Overpopulation of deer in an area will most likely cause
- (1) a decrease in the number of predators of the deer
  - (2) a decrease in disease among the deer
  - (3) an increase in the amount of plants available for food
  - (4) an increase in competition among the deer
26. In an abandoned field, the grasses were slowly replaced by small bushes and then years later by a forest of trees. This is known as
- (1) conservation of energy
  - (2) ecological succession
  - (3) competition
  - (4) predation
27. Which activity has a *negative* effect on the environment?
- (1) recycling aluminum cans
  - (2) controlling air pollution
  - (3) establishing a wildlife preserve
  - (4) use of chemical pesticides

Base your answers to **questions 28-31** on the following statement:

The food pyramid below represents a pond community.

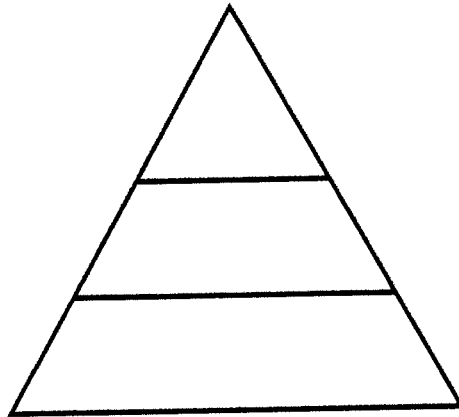


28. Which level contains the greatest amount of energy and biomass?
- (1) A
  - (2) B
  - (3) C
  - (4) D
29. A carnivore is found at level(s)?
- (1) C only
  - (2) D only
  - (3) B and C
  - (4) C and D
30. From level **A** to **D**, the amount of energy will
- (1) decrease
  - (2) increase
  - (3) remain the same
31. Acid rain causes the algae to die in the pond. As a result the water flea population
- (1) decreases
  - (2) increases
  - (3) remains the same

## EXTENDED RESPONSE

32. Place these organisms in the correct sequence in the energy pyramid.

*Hawk    Seeds    Sparrow*



33. The characteristics of some organisms are listed below.

Trout .....	carnivorous fish
Minnow .....	herbivorous fish
Algae .....	green plant
Osprey .....	large carnivorous bird
Bacteria .....	decomposer

Arrange these organisms in a food chain.



34. Aphids are insects that feed on and destroy crops. To control these pests, farmers place ladybugs in the farm fields. Ladybugs are natural predators of aphids.

a. The aphid is a (carnivore) (herbivore) (producer)

b. The ladybug is a (carnivore) (herbivore) (producer)

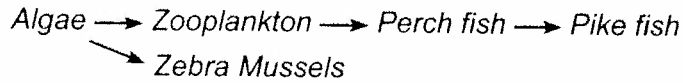
c. State one advantage of using this method of pest control. \_\_\_\_\_

\_\_\_\_\_

d. State one possible danger of using this method of pest control.

\_\_\_\_\_

35. The diagram below shows a food web in a lake.



a. State the organism that is most affected by changes in sunlight. \_\_\_\_\_

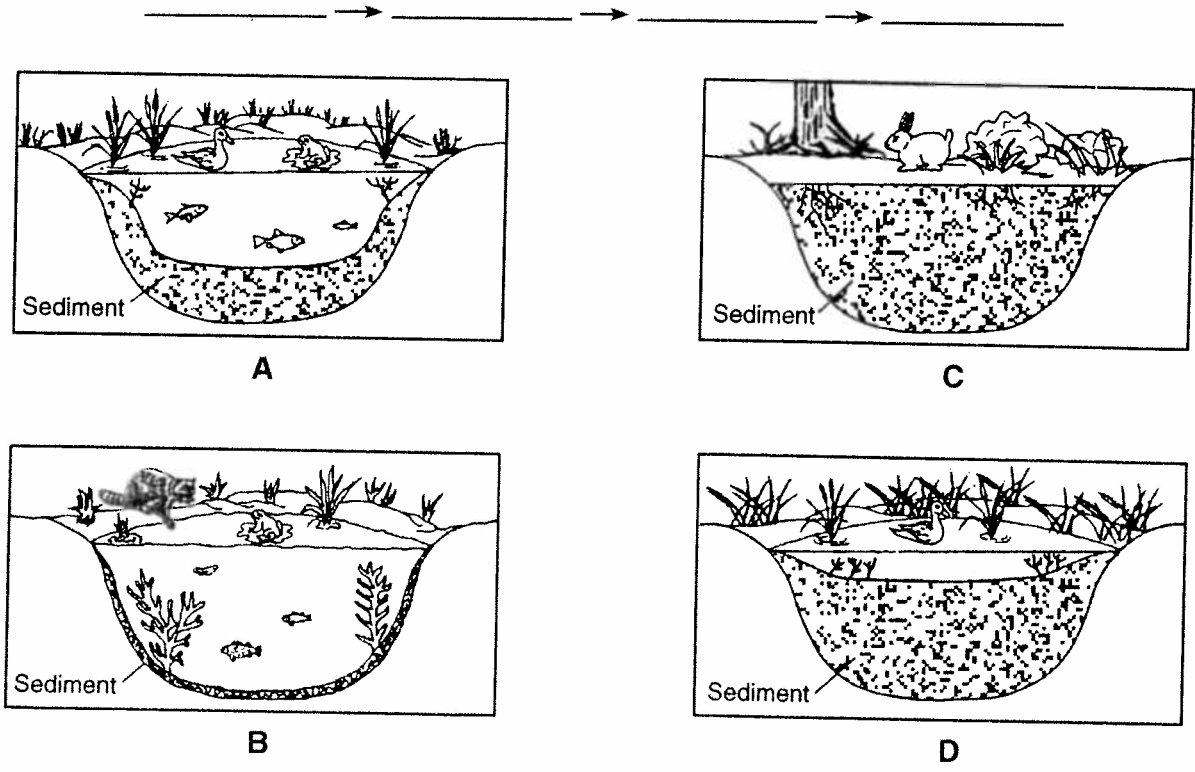
b. Name the TWO organisms that are in competition for the same food.

(1) \_\_\_\_\_ (2) \_\_\_\_\_

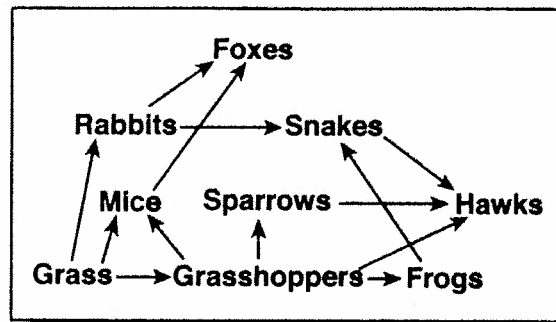
c. Describe one effect on the food web if the *Perch fish* population increases for the next two years.

\_\_\_\_\_

36. The diagrams below show the changes that have occurred in the ecosystem of a location. Write the letters in the correct sequence of ecological succession.



37. Refer to the diagram below of a food web.



a. Select one organism and explain how its removal could affect the other species.

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b. Name a herbivore. \_\_\_\_\_

c. Name a producer. \_\_\_\_\_

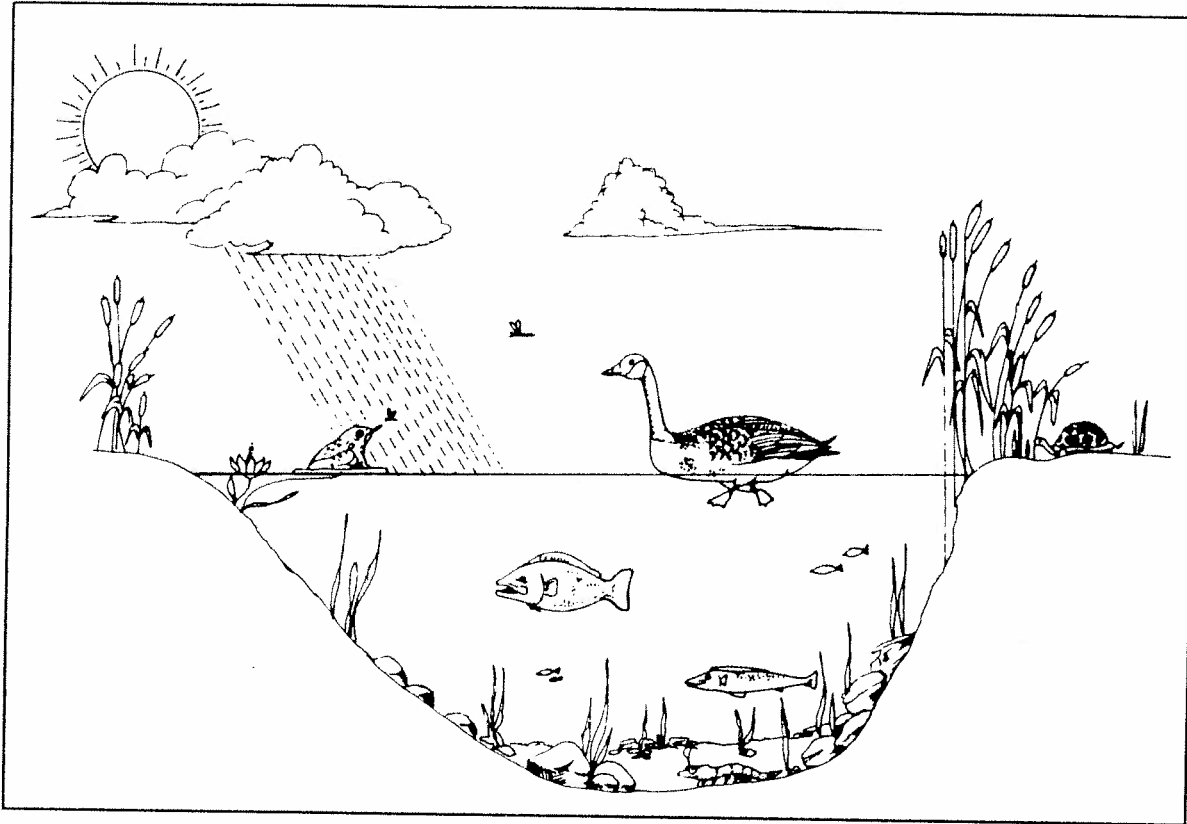
d. Name an omnivore. \_\_\_\_\_

e. Name one organism that converts light energy to chemical energy. \_\_\_\_\_

f. Name the important organism missing from the food web. \_\_\_\_\_



38. The diagram illustrates a pond ecosystem.



a. Name TWO biotic (living) factors. (1) \_\_\_\_\_ (2) \_\_\_\_\_

b. Name TWO abiotic (non-living) factors. (1) \_\_\_\_\_ (2) \_\_\_\_\_

c. Energy for this ecosystem is from the \_\_\_\_\_

d. Carbon dioxide is removed from the water by \_\_\_\_\_

e. The oxygen content of the water is provided by \_\_\_\_\_

f. Bacteria in the pond are important decomposers. Explain their function in this ecosystem.

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39. Read the following passage.

*The panther is the state mammal of Florida. This large wild cat once roamed the woodlands and swamps of the southeastern states. Today this native cat of the Southeast numbers less than eighty in population and is on the endangered species list. There seems little chance that its population will increase. As more people have made Florida their home, the panther population has decreased. The forests and swamps of the South are developed for homes, hotels, malls, and golf courses. What was once home to the panther is now called home by Florida's increasing human population. The continued urban development of Florida will keep the panther on the endangered species list.*

a. State the reason an organism is placed on the "Endangered Species List."

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b. Name one human activity that threatens the panther's survival in Florida.

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c. Propose one solution that will help preserve the state mammal of Florida.

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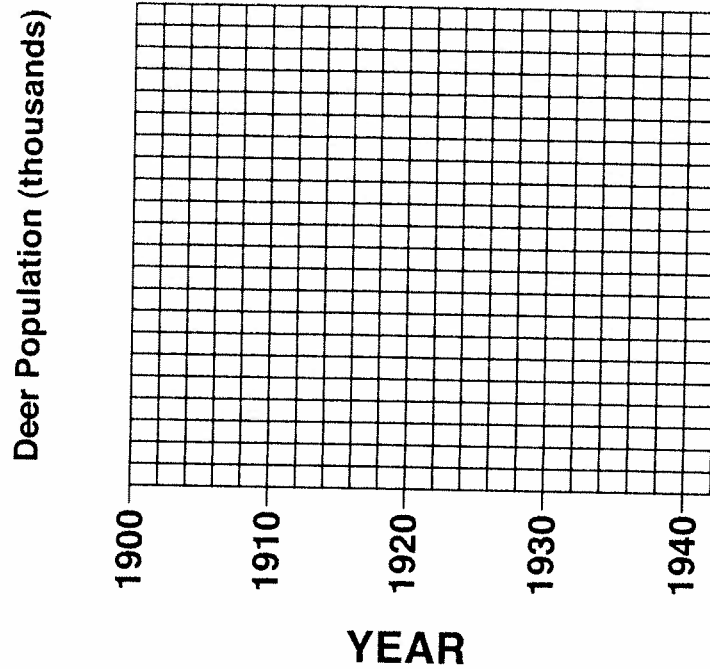
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40. The deer population in a region of Montana had been studied from 1900 to 1940. During this time, hunting and ranching activities increased in this area.

**DATA TABLE**

Year	Deer Population (thousands)
1900	3.0
1910	9.5
1920	65.0
1924	100.0
1926	40.0
1930	25.0
1940	10.0



- Set up the y - axis.
- Construct a line graph of this data. Plot the data points using an "X"
- The dependent (responding) variable for this study is the \_\_\_\_\_.
- Write a title for this graph. \_\_\_\_\_
- Write a sentence to describe how the deer population changed during this time.

\_\_\_\_\_

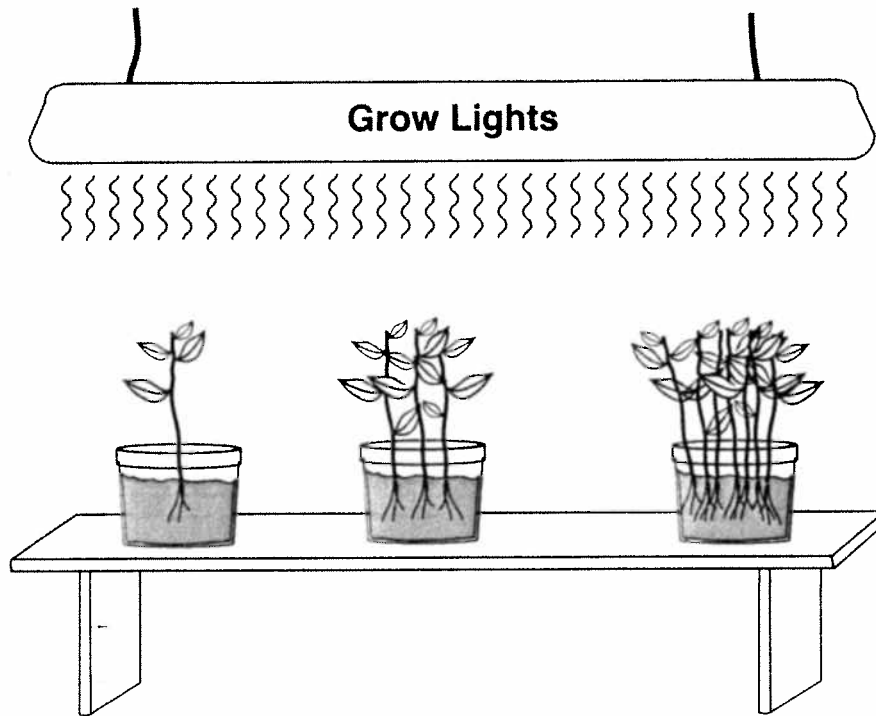
\_\_\_\_\_

- Propose a reason for the decrease in the deer population from 1930 to 1940.

\_\_\_\_\_

\_\_\_\_\_

41. A student sets up the following experiment using tomato plants in potting soil.



a. State the manipulated variable. \_\_\_\_\_

b. Write the question for which the student is trying to find the answer.

\_\_\_\_\_

\_\_\_\_\_

c. Name THREE factors that should be kept the same during this experiment.

(1) \_\_\_\_\_ (2) \_\_\_\_\_ (3) \_\_\_\_\_