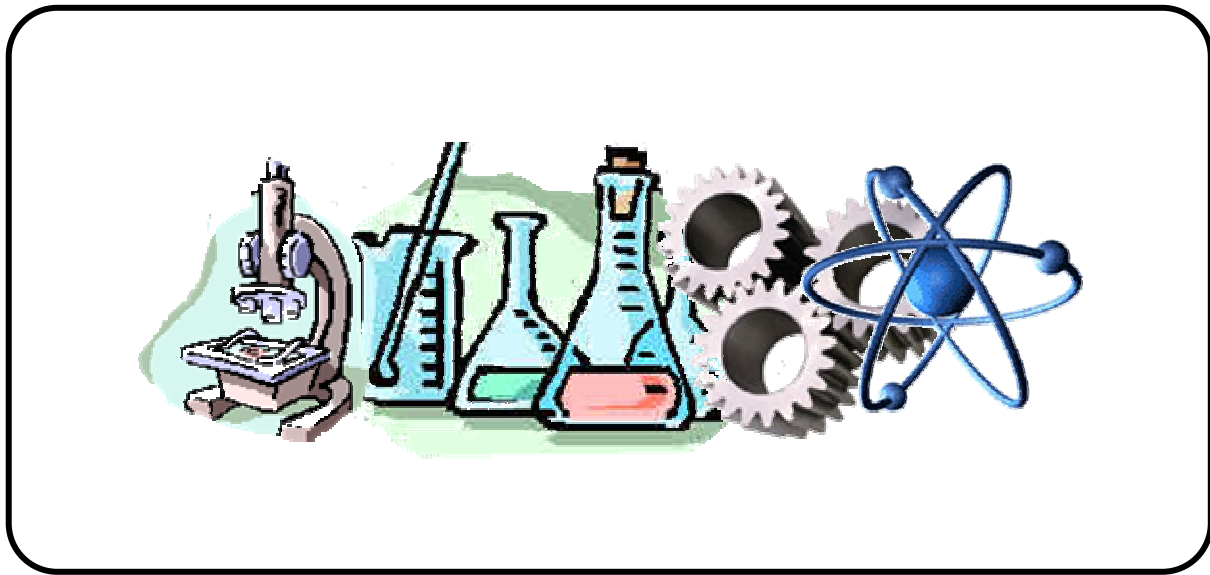


Project EASE

(Effective and Alternative Secondary Education)

INTEGRATED SCIENCE I



MODULE 10



BUREAU OF SECONDARY EDUCATION

Department of Education
DepED Complex, Meralco Avenue
Pasig City



Module 10

Can We Live Alone?



What this module is about?

You have just finished the module regarding the environment and the ecosystem. Did you enjoy it? If so, that's good! In This module you will learn more about the ecosystem. If you recall, the ecosystem has functional structures that were not discussed in detail in the last module. Now is your chance to be more familiar with these topics.

This module contains the following lessons:

- **Lesson 1 - Biotic Relationships**
- **Lesson 2 - Energy Flow**
- **Lesson 3 - The Cycles of Matter**



What are you expected to learn?

After going through this module, you are expected to:

1. explain how energy is transferred through a community;
2. illustrate the one-way flow of energy in an ecosystem;
3. identify the different biotic relationships that exist among living organisms in an ecosystem;
4. explain how organisms depend on other living organisms for survival; and
5. describe how materials in the ecosystem are reused in a continuous cycle.



How to learn from this module?

In order to achieve the objectives of this module successfully, you have to remember the following:

1. Read and follow the instructions carefully.
2. Answer the pre-test first to see how much you know about the lessons in this module.
3. Take down notes and record points for clarification.
4. Take the posttest and check your answers against the key to correction at the end of the module.
5. Remember to get at least 70% of the total number of items given.



What to do before (Pretest)

I. Multiple Choice. Encircle the letter of the correct answer.

1. A feeding relationship that proceeds from algae to fish, to a fisherman, and finally to a shark is best described as:
 - a. bad luck for the fisherman
 - b. food chain
 - c. food web
 - d. a and c above
2. Trophic levels can be described as:
 - a. hierarchy of energy transfers
 - b. structured feeding relationships
 - c. who eats who
 - d. any one of the above descriptions is appropriate
3. Disturbances to land ecosystems have the predictable effect of:
 - a. equalizing nutrient loss
 - b. increasing nutrient loss
 - c. lessening nutrient loss
 - d. stabilizing nutrient loss

4. Which of the following is a primary producer?
- dilis
 - seaweed
 - shark
 - whale
5. The herbivores that feed on phytoplanktons are called:
- autotrophs
 - primary consumers
 - secondary consumers
 - tertiary consumers
6. Which of the following gasses is more or less 79% of the atmospheric gas?
- argon
 - nitrogen
 - oxygen
 - sulfur
7. A network of crossing and interlinked food chains is called a
- food chain
 - food web
 - photosynthesis
 - trophic level
8. When clouds start to condense, the process is called
- accumulation
 - condensation
 - evaporation
 - precipitation
9. Which is a type of pyramid that represents the total number of organisms involved?
- food pyramid
 - pyramid of biomass
 - pyramid of energy
 - pyramid of number
10. Organisms that feed both on plants and animals are called:
- carnivores
 - detritivores

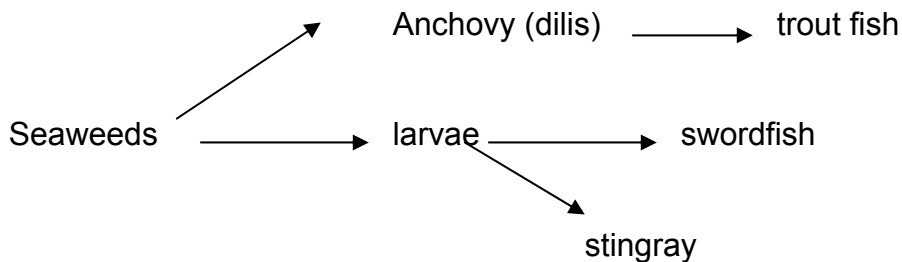
- c. herbivores
- d. omnivores

II. Classify the Following. Classify the following animals as producer, herbivore, carnivore or omnivore by placing them in the right column.

grass seaweeds lion deer goat frog
 shark rabbit sunflower whale hawk man

Producer	Omnivore	Carnivore	Herbivore

III. Consider this food web of organisms in the ocean given below:



- A. How many food chains can you identify from the food web?
- B. Write them as separate food chains.
- C. What will happen if a larvae is removed from the food web?

IV. Given the following organisms, construct a **food pyramid**.

seaweeds dilis
 lapu-lapu shark

V. Give the type of relationship that exists between the following organisms.

1. orchid and tree
2. plants and animals
3. shark and salmon
4. carabao and heron
5. ticks and dogs



Key to answers on page 25

Lesson 1 Biotic Relationships

Have you ever imagined life without your neighbors? Life could be very incomplete and boring. It is the interactions that you do with your neighbors that give life to your everyday activities. Organisms interact with one another in many ways. The relationships may benefit one and harm the other, benefit both or harm both. When organisms live in close association with one another, they are said to have a ***symbiotic relationship***.

Examine the diagram below. Have you ever seen this underwater? Well, if you live close to the sea, you must be familiar with this. Do you know of any relationship that exists between the organisms in this picture?



This picture shows the presence of corals and algae. Are you familiar with algae? They are commonly called as seaweeds. They belong to kingdom Protista, and are photosynthetic. In this type of relationship, the corals provide shelter for the algae that lives on the body of the polyps. The algae in return, give nourishment to the corals. This type of symbiotic relationship is called ***mutualism***. Individuals in this relationship all benefit from the association established. There is a close association with each other.

The picture next page shows a diagram of a leech sucking blood on the arm of man. Have you seen one like this before? Were you afraid? In the province it is common to see leeches attached to the skin of carabaos, cows and other animals.

Do you know the type of relationship that exists between the leech and the man in the picture? Which one is the parasite? Which one is the host? A parasite is an organism that depends on the host for food. In this case, which one is the parasite? Why do you say so? If your answer is leech you are right! Leeches are ectoparasites that depend on the host's blood for food. They produce an anticoagulant called ***hirudin*** that prevents clotting while blood is being sucked. In this case, man is the host and is harmed. The harm to the host maybe extreme or only slight.



Parasitism

Examine the next diagram. What do you see? Have you been to a place with this type of trees/plants? If you have experienced taking a walk in a forest, you must be familiar with this. The plant in the diagram is locally known as the bird's nest. It usually grows among the trunks of trees in thick forests. You will observe that many big trees are hosts to smaller plants like ferns, mosses and the like.



This figure illustrates **commensalism**, a symbiotic relationship where one individual benefits from another without causing harm to the other.

The type of relationship that exists between the ferns (or other plants) and the tree is called commensalism. The tree provides the support to the ferns, but it does not gain or lose anything. In this type of relationship, one individual benefits from the other without causing any harm to it.

Can you suggest other examples of this type of relationships? Have you seen a blue crab with a sea anemone on its back? This is also another example of commensalism. Here, the crab is the host and the guest is the sea anemone. In this case, the sea anemone gets a free ride from the crab and free food! Sea anemones are attached to a substrate and they are not mobile. This time, they get a free ride from the crab which moves from one place to another. Some scraps of food from the crab may also reach the sea anemone at the back.

The crab is neither harmed nor benefited in this case. This relationship is shown in the picture below.



A crab with sea anemone concealed at the back

Now, let us consider other biotic relationships that exist in nature.

Predation

Take a look at the picture below. Can you predict what will happen next?



A predator is usually a big animal

What type of relationship is this? Can you guess? The picture shows a shark going after the small fishes to eat them. The small fishes are helpless! In this type of relationship, the shark is the predator, much bigger and powerful, while the small fishes are the prey. They are directly attacked by the predator. This relationship is called **predation**. Do you know of other examples of this type of relationships?

I'm sure the diagram below is familiar to you. This is common even in your front and backyards. You see many plants live together. Can you imagine how they compete for food?



Competition for Resources

When organisms compete for the same resources, the association is called **competition**. For example, grasses may compete with other garden plants such as eggplant, palay, and onions, for the nutrients in the soil. This competition results to the depletion of the resources.

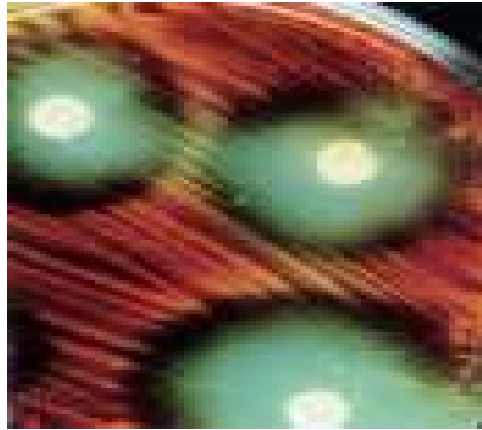
The barracuda and the shark may also compete for the same food such as the small fishes, and this is another example of competition. Competition is an example of a biotic relationship that is common among many biotic members of the ecosystem. Can you cite other examples of competition?

Amensalism

Do you know that there are organisms that may live together only for sometime because one species secrete a toxic or lethal substance that could kill the other species? Are you familiar with some of them? A certain species of **Artemisia** (damong maria) secrete a substance that can kill the grasses that may grow around them. This is an example of amensalism.

It has been found in laboratories that bacteria cannot be grown mixed with other species of fungi or mold which in this case emit substances that are lethal to the bacteria.

Look at the diagram below. This is an example of a bacterial culture with fungi. The two may live together for sometime. However, if the fungi will secrete toxic substances, eventually, no bacteria will survive and only the fungi will remain. This is called **allelopathy**. It involves the production and release of chemical substances by one species that inhibit the growth of another. Allelopathic substances range from acids to bases to simple organic compounds.



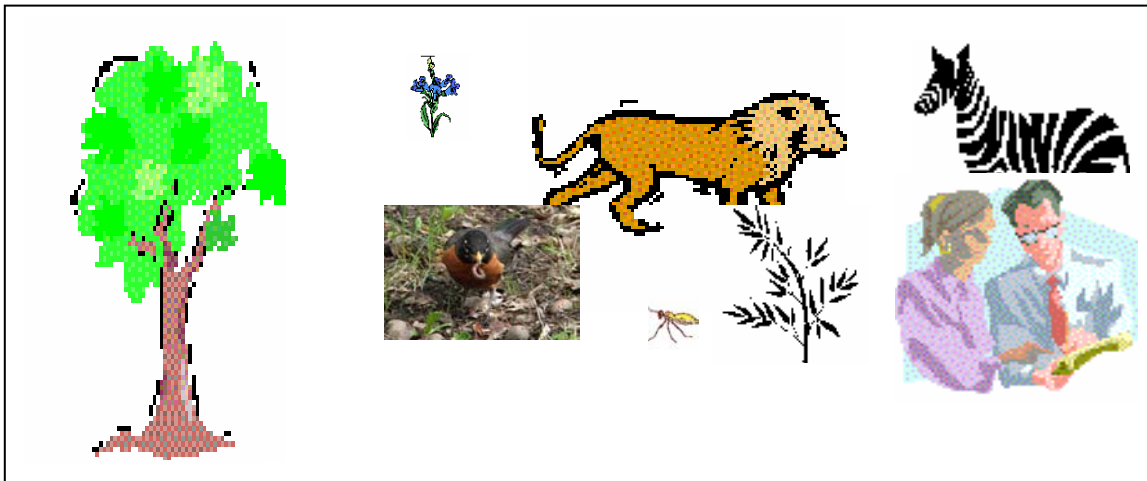
An example of Allelopathy

Neutralism

This is the last biotic relationship that will be discussed. It is the most common type of interspecific interaction. This is an interaction involving two different species. Neither population directly affects the other. The interactions that occur are slight and indirect. The simple presence of the two species should not directly affect the population level of either species. An example of neutralism would be the interaction between yourself and the cats.



What you will do Self-Test 1.1



A. From this drawing, enumerate as many relationships as you can derive and give the particular organisms involved in each relationship.


Association	Organism A	Organism B
1.		
2.		
3.		
4.		

B. Based on the picture below, answer the following questions:



Questions:

1. What type of relationship is shown in the drawing?
 2. Why do you say so?
 3. Can you remember any Filipino saying that can be inferred from the same picture?
- C. Gather pictures of the different biotic relationships and make a collage out of them. A collage is any artistic composition / representation of any subject matter.

 Key to answers on page 26

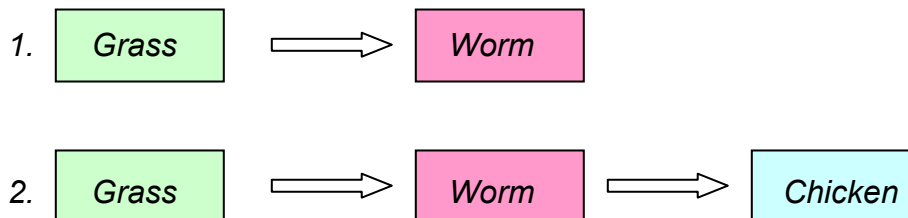
Lesson 2 Energy Flow in the Ecosystem

Food Chains

Are you familiar with a food chain? Why do you think it is called a chain? Chain would simply mean connection or connectivity of one to the other. Are you a member of the food chain? Well, all of us are members of the food chain. We all belong to the same trophic level. As members of the food chain, you should know more about it. Get ready and start to explore what it is.

Green plants are the only organisms that make their own food. Animals that eat green plants make the next link to the chain. Other animals often eat them. This sequence of eating and being eaten is called a **food chain**. Each organism is a link in the food chain. When plants and animals die, they become food for scavengers and decomposers such as the bacteria and fungi that in turn are responsible for the organisms' decay and cause the minerals to return to the soil.

Examine these two diagrams: The first diagram (1) shows the interaction between the grass and the worm. The arrow points from the producer (grass) to the consumers (worm). The worm eats the grass or the worm feeds on the grass.



The second diagram (2) shows the additional box for the chicken. This shows that the chicken feeds on the worm. This is another example of a food chain. Below is another example of a food chain with a diagram

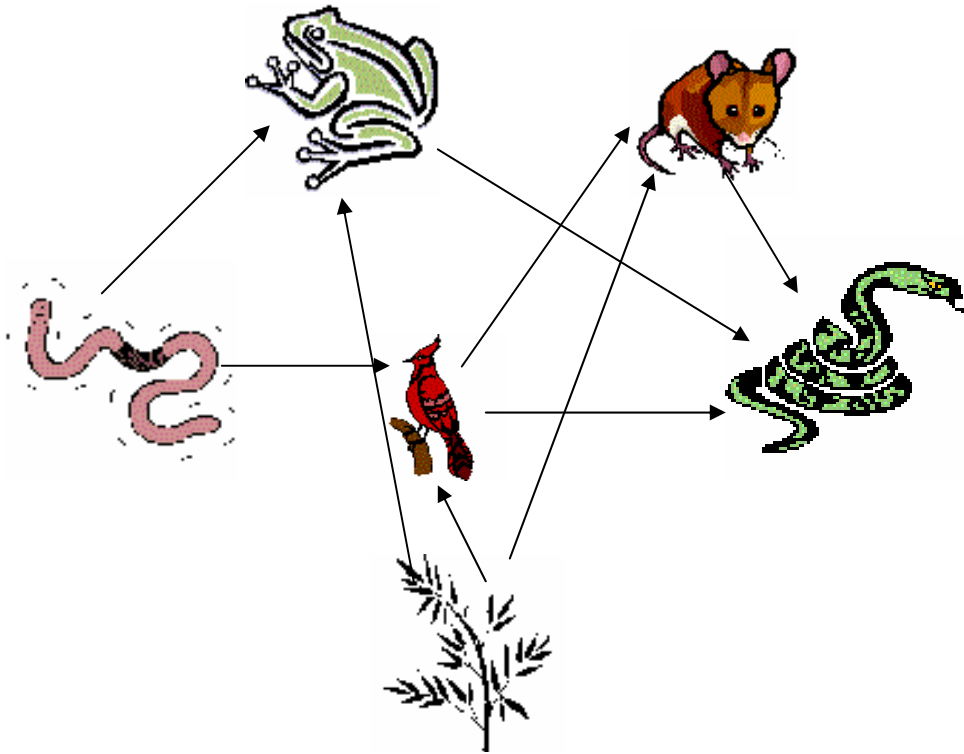
Birds are not the only consumers that feed on plant seeds. Mice and other rodents also feed on them. Snakes like the python feed on mice. Plant seeds, mouse, and snake form another food chain.



Is everything clear? I hope so. Now get ready for a new topic, a topic that is related to food chain - the food web. Get set go!

Food Web

Examine the diagram below. How many food chains can be derived from the illustration? There are several of them.



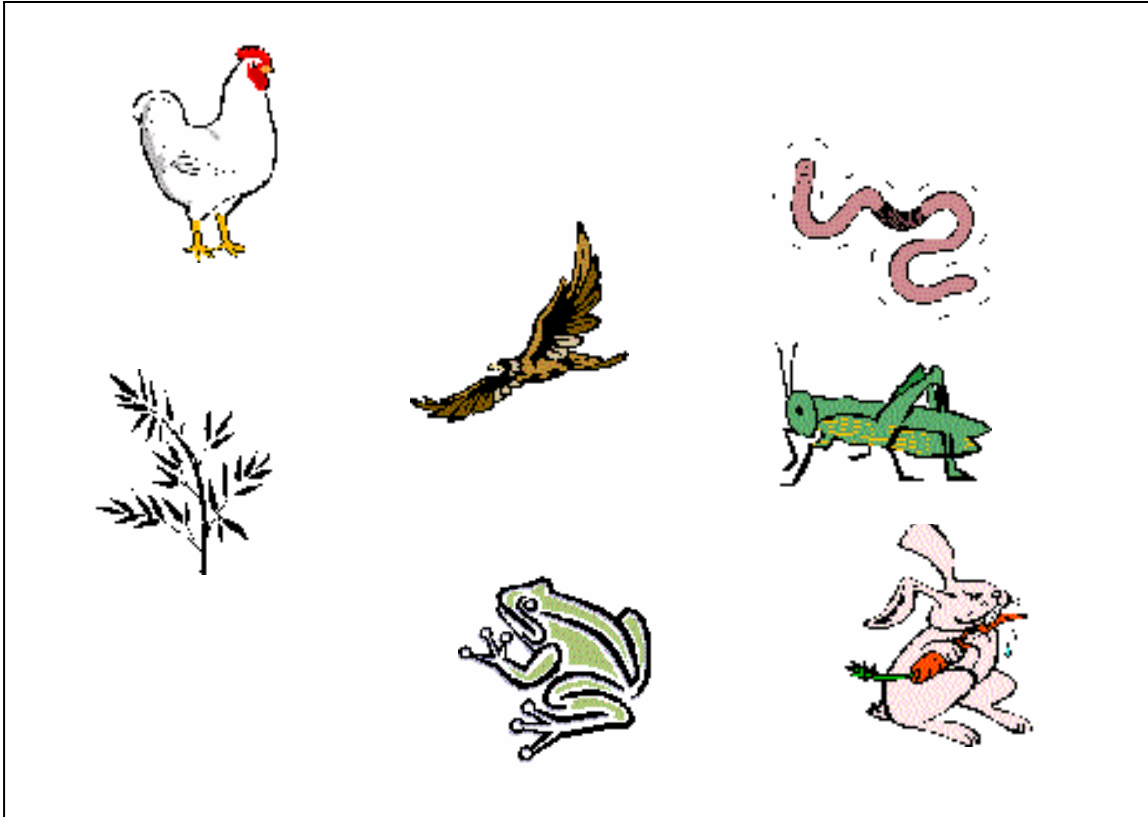
Write on a piece of paper the food chains that you can see in the diagram. How do food chains differ from food web? The diagram appears to be more complicated than a food chain. A **food web** is a series of interrelated **food chains** which provides a more accurate picture of the feeding relationships in an ecosystem, as more than one organism will usually eat a particular species or food. Therefore, food chains can **overlap, cross or interlock** forming a **network**. Do not be confused with the arrows. Just follow where the arrow originates and it will tell you which one eats what. For example, many organisms such as mice, worm, frog and the birds. From these primary consumers will feed different secondary consumers, and from these different secondary consumers will feed different tertiary consumers forming an interlocking pattern.

Now, on your own, construct a food web using the diagram below.



What you will do Activity 2.1

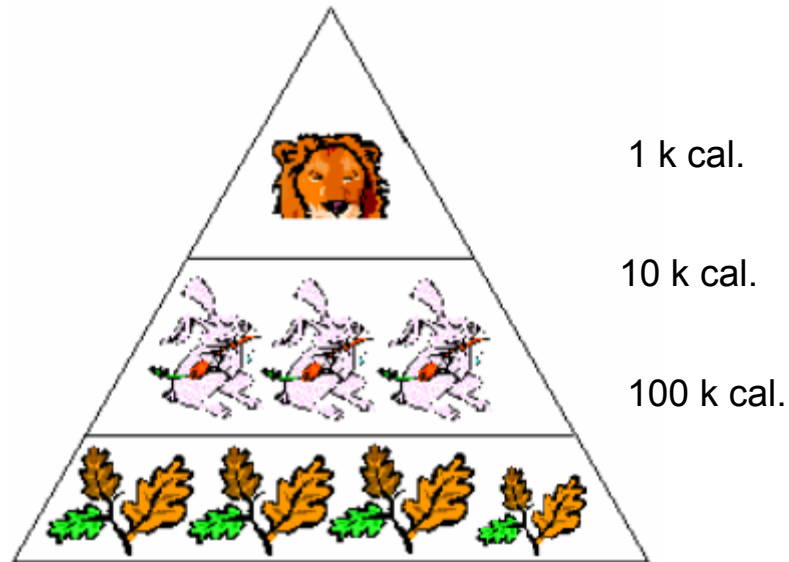
Below are some pictures of organisms that can be connected into a food web. See if you can decide how to connect the pictures to show the energy flow correctly! Good luck!



Did you find the activity enjoyable? I'm sure you did! Congratulations and more power!



Key to answers on page 27

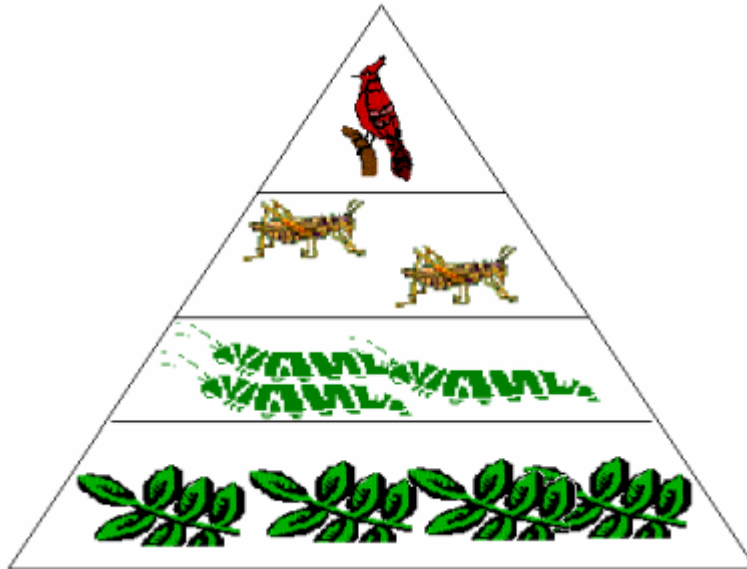


Notice that there are more producers than herbivores, and many more herbivores than carnivores. Why do you think this is so? It appears that less energy is available at each level of the pyramid as you move towards the top. Only about **10%** of the energy in the grass seed is available to the rabbits and only 10% of energy stored in the rabbits are available to the lion, and so. This means that the animals at the top of the pyramid depend on very large populations of producers and herbivores to stay alive. Don't forget that less energy is available at each level of the pyramid as you move toward the top.

In the three topics - food chain, food web, and energy pyramid are related to each other since energy is involved. These relationships are based on the flow of energy that is transferred from one organism to the next.



What you will do
Self-Test 2.1



Analyze the pyramid above and answer the following questions.

1. Which of these organisms will receive the highest amount of energy?
a. bird
b. praying mantis
c. caterpillar
d. plants
2. How many trophic levels are shown in the diagram?
a. 1
b. 2
c. 3
d. 4
3. What do you call the plants in this pyramid?
a. producers
b. consumers
c. decomposers
d. herbivores
4. How many consumer levels are there?
a. 1
b. 2
c. 3
d. 4
5. Which among these organisms will receive the least amount of energy?
a. bird
b. plants
c. caterpillar
d. grasshoppers



Key to answers on page 27

Lesson 3 Cycles of Matter

You already learned the importance of the biotic components and their interactions and interrelationships in an ecosystem. Energy is needed for the organisms to survive. Organisms need food in order to live. Aside from food, other substances must be present in the ecosystem for organisms to function properly. There are four elements required: **hydrogen, oxygen, carbon dioxide** and **nitrogen**. These elements should continuously be recycled within an ecosystem to sustain life.

Let us see what happens, and how it happens in a cycle.

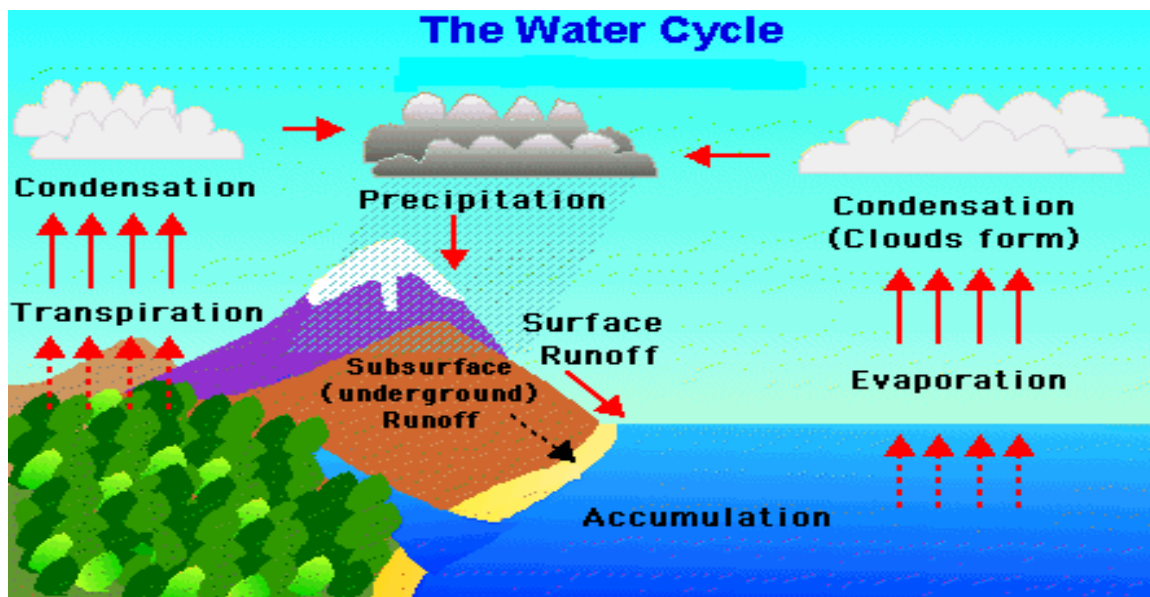


Carbon Dioxide – Oxygen Cycle

Looking at the picture, plants use carbon dioxide in the air together with water and other elements from the soil plus solar energy to manufacture their own food. The process is called **photosynthesis**. As a result of the process, plants produce glucose (starch) as stored food, and **oxygen** as a by-product. In respiration, consumers eat some of this stored food, and inhale oxygen. They transform and use this food to obtain energy and release **carbon dioxide** as a by-product. Carbon dioxide may also come from fossil fuels like those seen in the diagram. The release of carbon dioxide into the atmosphere during respiration completes the **carbon dioxide – oxygen cycle**.

The Water Cycle

Water moves from the atmosphere to the surface and back to the atmosphere in a process called the **water cycle**. When heavy clouds form, starts to change from a gaseous state to liquid form through a process called **condensation**. Water falls from the atmosphere to the earth through **precipitation** in the form of rain, drizzle, hail or snow. It goes back to the atmosphere through **evaporation**, when some of the water on the surface becomes gas. Some of the water that falls to the earth reaches the ground and as run off water, it travels to become part of a lake, river or ocean. Some water may also come out from the body of plants and animals in the process called **transpiration**. Some of the water goes deep underground and becomes ground water. Underground water also finds its way to lakes and rivers and eventually joins the oceans where evaporation takes place, completing the water cycle.

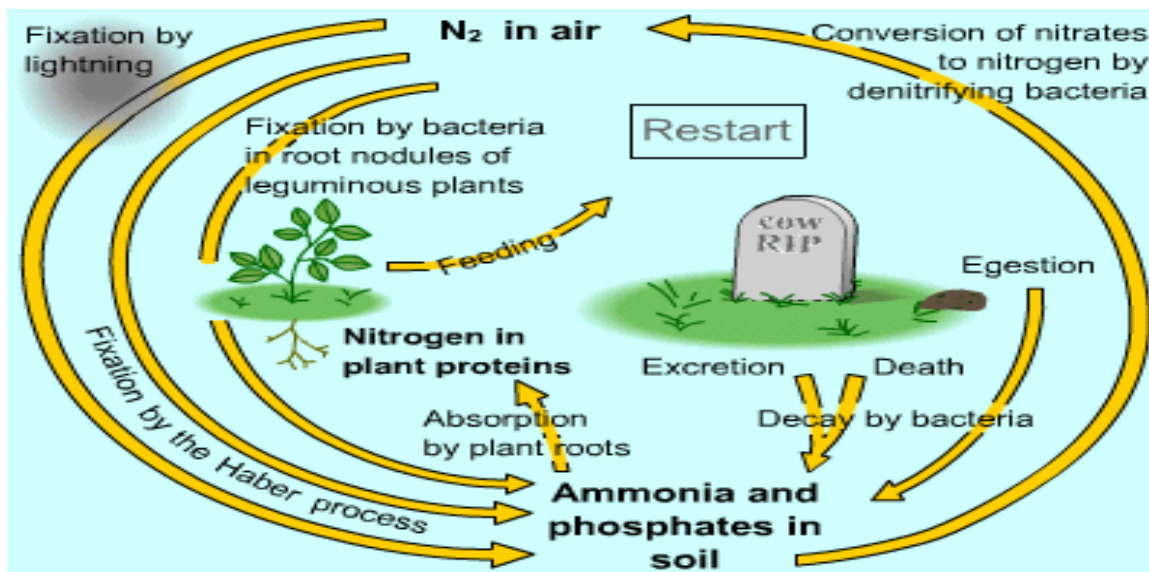


Water Cycle

The Nitrogen Cycle

Nitrogen is the most abundant element in the atmosphere, making up 79% of it. But free nitrogen must first be converted into nitrates before plants can use them. The process by which nitrogen passes from the atmosphere to the organisms and back is called the **nitrogen cycle**. During a thunderstorm, nitrogen is converted into nitrates by lightning. The process of converting atmospheric nitrogen into compounds such as **ammonia**, **nitrites** or **nitrates** by natural processes is called **nitrogen fixation**. These nitrates are brought to the ground during precipitation and are then absorbed and used by plants.

Nitrogen can also be converted into nitrates directly from the air.



Nitrogen Cycle

This is done by nitrogen-fixing bacteria, which are found in the leguminous plants. Examples of these legumes are mungo, beans, peanuts, and peas.

Dead and decaying matter contain nitrogen, which is converted into ammonia by bacteria. This process is called **ammonification**. Other bacteria oxidize the ammonia to form nitrites. Eventually, other bacteria change the nitrates to ammonia to form nitrites. This process of converting ammonia and nitrites into nitrates is called **nitrification**.

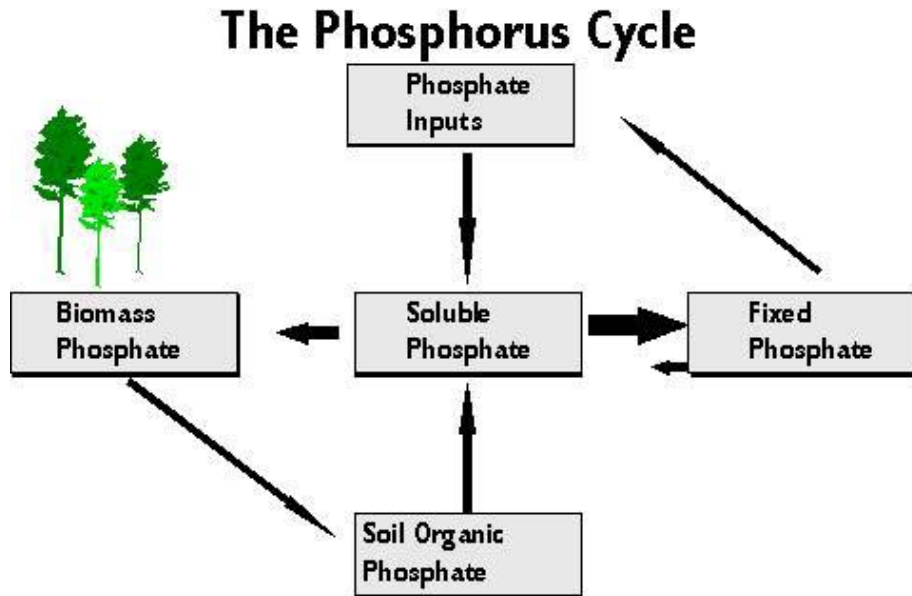
Some organisms, called denitrifying bacteria, convert nitrates, and ammonia in the soil and decaying matter back into free nitrogen. This process is called **denitrification**. The free nitrogen is then released into the atmosphere and the cycle continues.


Phosphorus Cycle

Another cycle that you have to be familiar with is the phosphorus cycle. Where do phosphates come from? Initially, phosphate weathers from rocks. The small losses in a terrestrial system caused by leaching through the action of rain are balanced in the gains from weathering rocks. In soil, phosphate is absorbed on clay surfaces and organic matter particles and becomes incorporated (immobilized). Plants dissolve ionized forms of phosphate. Herbivores obtain phosphorus by eating plants, and carnivores by eating herbivores. Herbivores and carnivores excrete phosphorus as a waste product in urine and feces. Phosphorus is released back to the soil when plants or animal matter decomposes and the cycle repeats.

Another pathway of phosphorus cycle occurs when phosphorus moves from land to sediments in the seas and then back to land again. The main storage for phosphorus is in the earth's crust. On land, phosphorus is usually found in the form of phosphates. By the

process of weathering and erosion phosphates enter rivers and streams that transport them to the ocean. Once in the ocean the phosphorus accumulates on continental shelves in the form of insoluble deposits. After millions of years, the crustal plates rise from the sea floor and expose the phosphates on land. After more time, weathering will release them from rock and the cycle's geochemical phase begins again.



 *What you will do*
Self-Test 3.1

Multiple Choice. Encircle the best answer.

1. Which of the following would you consider as the main reservoir of water?

a. rivers	c. atmosphere
b. ocean	d. soil

2. All of the following gives off carbon dioxide **except**:

a. carabao	c. birds
b. sunflower	d. crocodile

3. The usable form of nitrogen is

a. urea	c. uric acid
b. nitrate	d. nitrous oxide

4. Nitrogen is _____% of the atmospheric gas.
- a. 79%
 - b. 99%
 - c. 69%
 - d. 89%
5. Fossil fuel is one of the primary sources of
- a. oxygen
 - b. nitrogen
 - c. carbon dioxide
 - d. phosphorus
6. The primary source of phosphorus is:
- a. Plants
 - b. Animals
 - c. rocks
 - d. sun
7. The process whereby water is converted from a gaseous state to a liquid state is called
- a. precipitation
 - b. evaporation
 - c. condensation
 - d. sublimation
8. What is the process of releasing free nitrogen in the air?
- a. nitrification
 - b. evaporation
 - c. denitrification
 - d. ammonification
9. Which of the following could be a good source of organic phosphate?
- a. water
 - b. stones
 - c. animals
 - d. sun
10. In photosynthesis, plants give off:
- a. Carbon dioxide
 - b. oxygen
 - c. hydrogen
 - d. carbon



Key to answers on page 28



Let's summarize

1. Organisms may form close associations with one another. Such associations may occur between individuals of the same species (intraspecific) or between individuals of different species (interspecific).
2. Parasitism is an association between two organisms in which one, the parasite, lives temporarily or permanently in or on the other, the host, deriving benefit from it and causing harm to it.
3. Commensalism is an association between two organisms, where a commensal gains while the host neither loses nor gains.
4. Mutualism is an association that is mutually beneficial to both participants. This is one of the common associations between organisms.
5. Energy cannot be recycled. Only matter can be recycled.
6. Energy moves in one direction. A food chain is the pathway that matter and energy take as they are transferred from one feeding level to the next.
7. The pattern of food chains that interlock and form a network is called a food web.
8. There are advantages of living in a complex food web where there are several sources of food.
9. An energy pyramid is a diagram that explains the energy flow from one feeding level to another.
10. Living things are related to each other by their food relationships. These relationships are based on the flow of energy that is transferred from one organism to the next.
11. The biosphere is a closed system.
12. Recycling is the using and reusing of materials. The water, minerals, oxygen, nitrogen, carbon and other chemicals necessary for life in the biosphere must be recycled again and again for life to continue.
13. The processes of photosynthesis and respiration recycle carbon and oxygen
14. Bacteria aid in the recycling of nitrogen.
15. The three most important cycles needed for life are water cycle, carbon-oxygen cycle, and nitrogen cycle.
16. Water cycle is the movement of water from the atmosphere to the lithosphere and hydrosphere and then back to the atmosphere.



Posttest

I. Multiple Choice. Encircle the letter of the correct answer.

1. Which of the following gasses is more or less 79% of the atmospheric gas?
 - a. argon
 - b. nitrogen
 - c. oxygen
 - d. sulfur
2. A network of crossing and interlinked food chains is called
 - a. food chain
 - b. food web
 - c. photosynthesis
 - d. trophic level
3. When water is converted to water vapor, the process is called as:
 - a. accumulation
 - b. condensation
 - c. evaporation
 - d. precipitation
4. What do you call a type of pyramid that represents the total number of organisms involved?
 - a. food pyramid
 - b. pyramid of biomass
 - c. pyramid of energy
 - d. pyramid of number
5. Organisms that feed both on plants and animals are called:
 - a. carnivores
 - b. detritivores
 - c. herbivores
 - d. omnivores
6. A feeding relationship that proceeds from algae to fish, then to a fisherman and finally to a shark is best described as:
 - a. food chain
 - b. food web
 - c. predation
 - d. a and c above

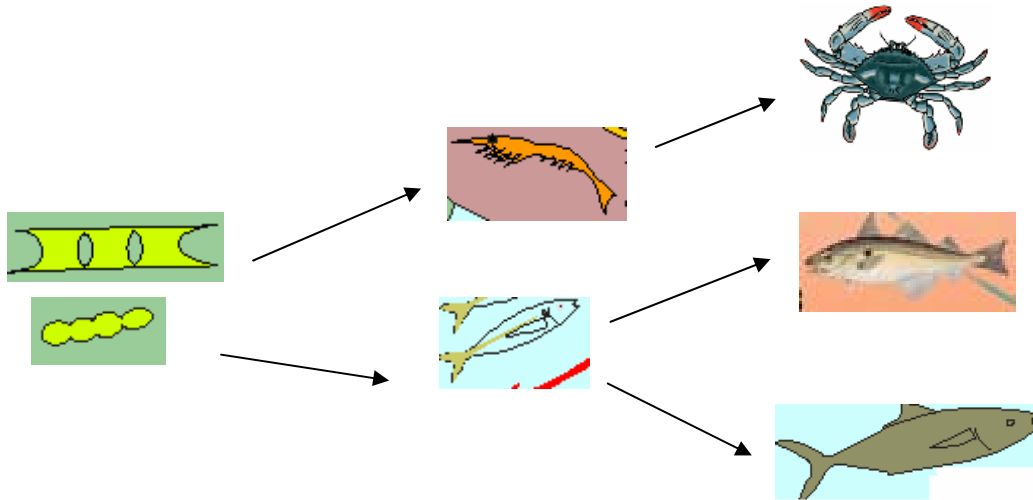
7. Trophic levels can be described as:
- hierarchy of energy transfers
 - structured feeding relationships
 - who eats who
 - any one of the above descriptions is appropriate
8. The primary source of phosphorus is:
- air
 - plants
 - rocks
 - water
9. Which of the following is a primary producer?
- dilis
 - seaweeds
 - shark
 - whales
10. The herbivores that feed on phytoplanktons are called as:
- autotrophs
 - primary consumers
 - secondary consumers
 - tertiary consumers
 -

II. Classify the following. Given the following animals below, classify them as producer, herbivore, carnivore or omnivore by placing them in the right column.

grass seaweeds lion deer goat frog
 shark rabbit sunflower whale hawk man

Producer	Omnivore	Carnivore	Herbivore

III. Consider the following organisms in the ocean.



- How many food chains can you identify from the food web?
- Write them as separate food chains.
- What will happen if the small fish is removed from the food web?

IV. Given the following organisms, construct a food pyramid.

seaweeds

dilis

lapu-lapu

shark

V. Give the type of relationship that exists between the following organisms.

- orchid and tree
- plants and animals
- shark and salmon
- carabao and heron
- ticks and dogs



Key to answers on page 28



Key to answers

Pretest

I.

- 1. b
- 2. d
- 3. b
- 4. c
- 5. b
- 6. c
- 7. b
- 8. d
- 9. b
- 10. d

II.

Producer	Omnivore	Carnivore	Herbivore
Grass	man	lion	deer
seaweed	frog	shark	goat
sunflower	hawk	whale	rabbit

III.

A. 3

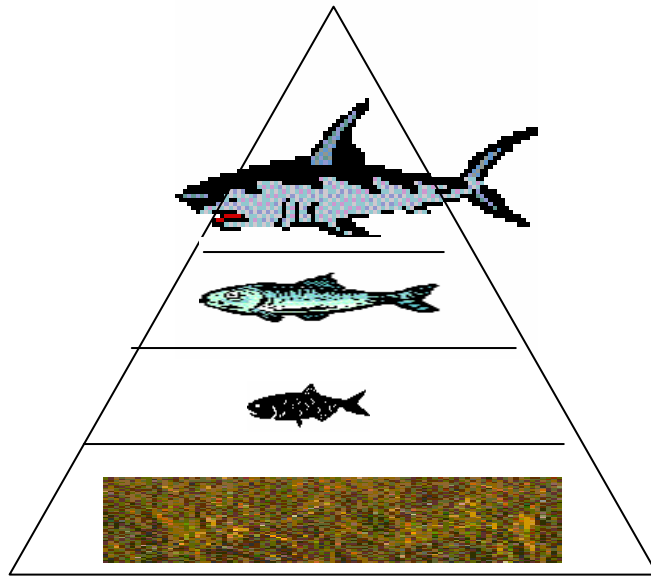
B.

- 1. seaweeds → anchovy → trout fish
- 2. seaweeds → larvae → swordfish
- 3. seaweeds → larvae → stingray

C.

- 1. Two of the food chains will be disturbed since the food supply for the swordfish and stingray will decrease.

IV. Food Pyramid



V.

- a. commensalism
- b. mutualism
- c. predation
- d. mutualism
- e. parasitism

Answer Key for the Activity

Self-Test 1.1

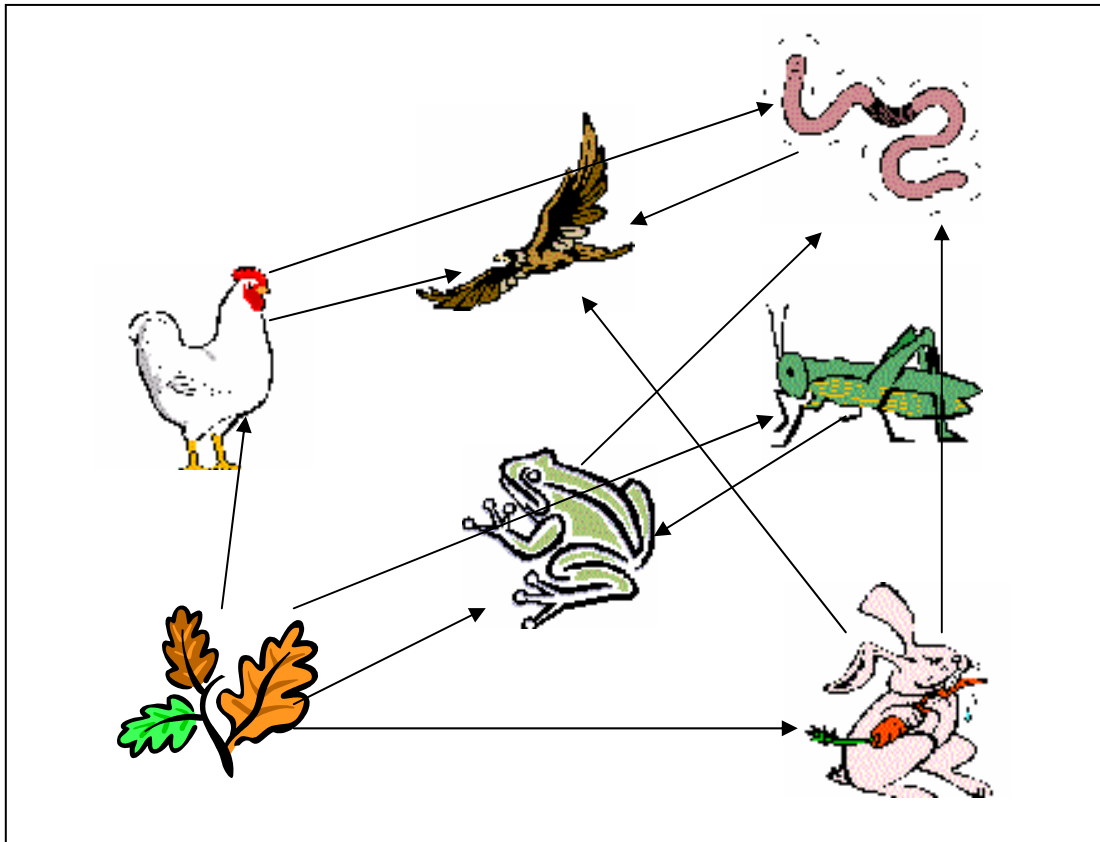
A.

Association	Organism A	Organism B
1. predation	lion	zebra
2. predation	bird	worm
3. mutualism	ants	tree
4. mutualism	man	plants
5. commensalism	tree	orchid

B.

1. Predation
2. Because the bird (predator) attacked the worm directly. They are bigger and more powerful than the worms.
3. "The early bird catches the early worm"

Activity 2.1



Self-Test 2.1

1. d
2. d
3. a
4. c
5. a

Self-Test 3.1

1. b
2. b
3. b
4. a
5. c
6. c
7. a
8. c
9. c
10. b

Answer Key for the Post-test

Posttest

I.

1. c
2. a
3. a
4. b
5. b
6. a
7. d
8. c
9. d
10. d

II.

Producer	Omnivore	Carnivore	Herbivore
Grass seaweed sunflower	man frog hawk	lion shark whale	deer goat rabbit

III.

A. 3

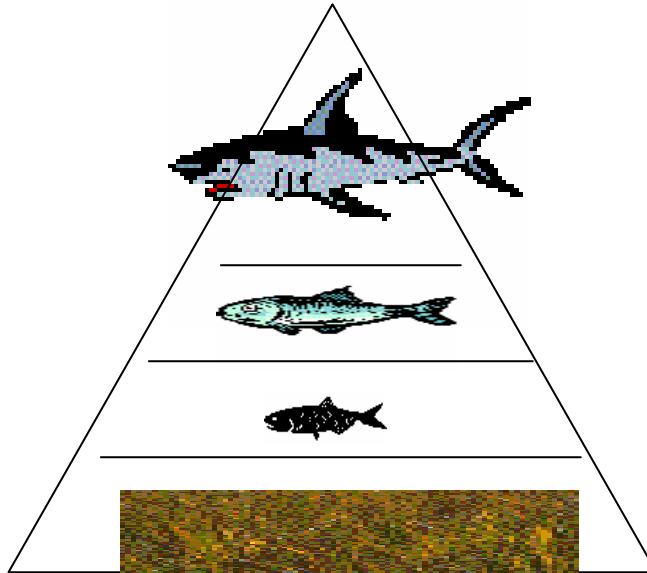
B.

1. aquatic plants → larvae → crab
2. aquatic plants → small fish → trout fish
3. aquatic plants → small fish → blue marlin

C.

1. Two of the food chains will be disturbed since the food supply for the big fishes will decrease.

IV.



V.

- a. commensalism
- b. mutualism
- c. predation
- d. mutualism
- e. parasitism

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