NAME _________________________  CLASS ________________  DATE ____________

CHAPTER 19
Cycles in Nature

SECTION 2
Ecological Succession

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do communities of living things form?
- Why do the type of organisms in a community change over time?

What Is Succession?

In the spring of 1988, much of Yellowstone National Park was a forest. The trees grew close together. Large areas were in shade, and few plants grew under the trees. That summer, fires burned much of the forest and left a blanket of gray ash on the forest floor. Most of the trees were dead, though some of them were still standing.

The following spring, the forest floor was green. Some of the dead trees had fallen over, and many small, green plants, such as grasses, were growing.

Why were grasses the first things to grow? After the fire, the forest floor was sunny and empty. Nonliving parts of ecosystems, such as water, light, and space, are called abiotic factors. When the trees were dead, grasses had the abiotic factors they needed, and their populations grew quickly.

In a few years, larger plants began growing in some areas, and the grasses could not grow without sunlight. Within 10 years, the trees were starting to grow back. The trees began to shade out those plants.

When one type of community replaces another type of community, this is called succession. The grasses and other species that are the first to live or grow in an area are called pioneer species.

National Science Education Standards
LS 1a, 4d

STUDY TIP
Organize As you read, make a table comparing primary succession and secondary succession.

Math Focus
1. Calculate Percentages The fires in Yellowstone National Park in 1988 burned 739,000 acres. The park has 2.2 million acres total. What percentage of the park burned?

READING CHECK
2. Define What is a pioneer species?
PRIMARY SUCCESSION

Sometimes, a small community starts to grow in an area where living things have never grown before. The area is only bare rock and there is no soil. Over a very long time, a community can develop. The change from bare rock to a community of organisms is called primary succession.

Lichens are pioneer species on bare rock. A lichen’s structure allows it to function on bare rock. Lichens don’t have roots, and they get their water from the air. This means they do not need soil. Most other organisms, however, cannot move into the area without soil.

Lichens produce acid that breaks down the rock they are living on. The rock particles, mixed with the remains of dead lichens, become the first soil.

After many years, there is enough soil for mosses to grow. The mosses eventually replace the lichens. Tiny organisms and insects begin to live there. When they die, their remains add to the soil.

Over time, the soil gets deeper, and ferns replace mosses. The ferns may be replaced later by grasses and wildflowers. If there is enough soil, shrubs and small trees may grow. After hundreds of years, the soil may be deep enough and rich enough to support a forest community.

Remember that a community is made up of all the living things in an area. It includes the plants that can live with the abiotic factors there at the time. It also includes the animals that can use the resources there at the time.

When the abiotic factors and resources change, so does the community. For example, a population of cottontail rabbits will get bigger as more small plants grow in the soil over the rock. Later, there will be fewer small plants, when more trees grow and block the sun. Then, there will be fewer rabbits. However, the populations of animals that need trees, such as squirrels, will increase.
SECONDARY SUCCESSION

Sometimes, a community is destroyed by a natural disaster, such as a flood or fire. Sometimes, humans or animals alter an environment. For example, a farmer may stop growing crops in a field. In either case, if there is soil and the area is left alone, the natural community can grow back. The plant species change in a series of stages called secondary succession. Secondary succession happens in areas where living things already exist.

The figure below shows secondary succession in a farm field that used to be a forest.

First Year  Weeds start to grow.

Second Year  New weeds appear. Their seeds may have been blown to the field by the wind, or insects may have carried them.

In 5 to 15 Years  Small conifer trees, such as pines and firs, grow among the weeds. After about 100 years, the weeds are gone and a forest has formed.

After 100 Years or More  As older conifer trees die, they may be replaced by hardwood trees. Oak and maple will grow if the temperature and precipitation are right.

MATURE COMMUNITIES AND BIODIVERSITY

As succession goes on, a community can end up having one well-adapted plant species. This is called a climax species. However, in many places, a community is more likely to include many species. The variety of species that live in an area is called its biodiversity.
Section 2 Review

SECTION VOCABULARY

<table>
<thead>
<tr>
<th>pioneer species</th>
<th>a species that colonizes an uninhabited area and that starts a process of succession</th>
</tr>
</thead>
<tbody>
<tr>
<td>succession</td>
<td>the replacement of one type of community by another at a single location over a period of time</td>
</tr>
</tbody>
</table>

1. Define  What are abiotic factors? Give three examples.

2. Compare  What is the difference between primary and secondary succession?

3. Apply Concepts  Secondary succession generally happens faster than primary succession. Why do you think this happens?

4. Apply Ideas  Consider a species of animal that eats grass and a species of animal that eats nuts. Which species do you think would have a larger population in a mature forest? Explain your answer.

5. Analyze  Why, in general, can’t tall trees be pioneer species?

6. Define  What is biodiversity?

7. Describe  When soil first forms over bare rock, what is it made of?
5. Nitrogen fixation is the process in which bacteria in soil change nitrogen gas into a form that plants can use.

6. molecules that contain carbon

**SECTION 2 ECOLOGICAL SUCCESSION**

1. 34%
2. the first species to live or grow in an area
3. Lichens don’t have roots. They get their water from the air, so they do not need soil.
4. tall trees
5. in places where living things already exist
6. weeds
7. conifers

**Review**

1. Abiotic factors are the nonliving parts of the environment. They include water, light, and space.
2. Primary succession is the change from bare rock to a community of organisms. Secondary succession is a change in a community where other living things already exist.
3. In secondary succession, there is already soil for new plants to use. In primary succession, soil has to develop before species other than lichens can grow.
4. There is little grass in a mature forest, because the tall trees prevent the light from reaching the ground. Nuts grow on many kinds of trees. Therefore, there would be more nut eaters than grass eaters.
5. Tall trees need deep soil. Pioneer species are the first species to live or grow in an area. There usually would not be soil in an area where no living things had been before.
6. the variety of species that live in an area
7. pieces of rock that have been broken down and remains of dead lichens

**Chapter 20 The Earth’s Ecosystems**

**SECTION 1 LAND BIOMES**

1. Biomes are made of many related ecosystems.
2. Africa, South America
3. plenty of rain, moderate temperatures
4. deciduous trees and shrubs
5. in cones

6. The evergreen conifers shade the forest floor, but the deciduous trees of the temperate forest allow light to reach the ground.

7. Coniferous forests get less rainfall than some other biomes.

8. Most of the animals are found in the trees.

9. The plants grow above the ground to get sunlight, which is lacking on the forest floor.

10. camouflage, hiding in burrows

11. The savanna gets about twice as much rain.

12. escaping the heat and hiding from predators

13. $25 \text{ cm} \div 2.54 \text{ cm/in.} = \text{ about 10 in.}$

14. Growing close to the ground helps protect the plants from the cold and wind.

15. They are both large herbivores (consumers).

**Review**

1. Tundras, like deserts, receive little rainfall. Tundra is not hot like most deserts, so it is a “frozen desert.”

2. |                  | Temperate grassland | Savanna |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Abiotic factors</td>
<td>warm summers and cold winters</td>
<td>constant warmth with seasonal rains</td>
</tr>
<tr>
<td>Types of producers</td>
<td>grass with a few trees</td>
<td>grass with a few trees</td>
</tr>
<tr>
<td>Types of consumers</td>
<td>herbivores such as prairie dogs and bison; predators such as coyotes</td>
<td>herbivores such as elephants, giraffes, zebras, and wildebeest; predators such as lions</td>
</tr>
</tbody>
</table>

3. Some plants have special spreading roots to gather rainfall before it evaporates. Many desert plants can store water in their stems or roots.

4. Alpine tundra is found at the tops of tall mountains; polar tundra is found at or near the poles.

**SECTION 2 MARINE ECOSYSTEMS**

1. near the equator
2. about $10^\circ \text{C}$
3. depth, sunlight, and temperature
4. The whale is the consumer, and the plankton is the producer.
5. The intertidal zone is regularly exposed to air.
6. phytoplankton and seaweed
7. They need sunlight for photosynthesis.
8. They eat each other and material that sinks from surface waters.
9. cold temperatures, no light, high pressure