Lesson 10 - Succession

Overview

Now that students have learned about the diversity of life and the complexity and differences in ecosystems and biomes, they will observe what happens when an ecosystem is disturbed by disasters, such as volcanoes and forest fires. Students will see that ecosystems are resilient, and that these disturbances often lead to healthier, more diverse communities. Disturbances and the regrowth of ecosystems are *natural* occurrences. In the Earth Systems Unit, students will investigate what happens to ecosystems that are disturbed by *human* activities.

TIME: 2 CLASS PERIODS

Students will:

- **Engage** by observing the area around Mount St. Helens before and after the volcano's eruption.
- **Explore** by examining the changes a forest experiences after a fire.
- **Explain** by reading about how ecosystems recover from natural disasters.
- **Elaborate** by debating whether forest fires should be extinguished, or allowed to burn.
- **Evaluate** by deciding whether natural disasters are truly disastrous for ecosystems.

Content Background

When ecosystems are disturbed by natural disasters, such as floods, fires, volcanoes or storms, the community of organisms will go through specific stages of recovery. The end result of these stages will be a diverse, balanced ecosystem.

Let's take a major forest fire as an example. After the fire, the forest will look destroyed. However, there will always be some survivors. The roots of grasses and small plants are often still viable, and, as a result, plants will begin to grow. The soil is now rich with nutrients from all of the organisms that died and decomposed as a result of the fire. In addition, the wind, birds, insects and other animals will carry seeds in from other areas. Soon, the area will become full of grasses and wildflowers. Small mammals, birds and insects will live among the grasses.

Shrubs will begin to grow, and will eventually shade the grasses, causing many grasses to die, as they cannot adequately compete for sunlight. Young trees will begin to take root, which, as they grow, will shade out the shrubs. The same process happens in the next stages. As taller trees grow, they shade smaller trees and shrubs and those plants die without necessary sunlight. New animals move into the area during each stage.

These changes happen slowly. It can take hundreds of years for an ecosystem to return to the way it was before a natural disaster. The change begins with very few grasses and other plants and ends with a diverse community of living things. This slow change in the communities of organisms is called **succession**. The last stage of succession forms a **climax community**, a community that will stay until another natural disaster disturbs the environment. In a Deciduous Forest, the climax community includes many tall trees such as oak, beech and hickory. This forest is a diverse community of organisms. They include organisms from the different branches of the Tree of Life.

Other ecosystems also go through the process of succession after a disaster. Their stages and climax communities are different, but the process is quite similar.

Misconception Alert:

In common speech, we talk about fires, floods and the like as 'natural disasters' that 'destroy' ecosystems. In fact, occasional disruptions do not destroy them completely. 'Disasters' often result in an ecosystem that is healthier and more resilient. Another misconception often held by students is that ecosystems do not recover on their own. Students tend to believe that humans must somehow help ecosystems to recover. Be sure to stress to students that succession is a natural process in ecosystems. The debate activity in the **Elaborate** section of this lesson is aimed at dispelling these misconceptions.

Aim:

How do ecosystems change over time?

Objectives:

Students will be able to:

- ✓ Describe the process of succession that results from damage to an ecosystem.
- ✓ Determine the proper sequence of stages in ecological succession.
- ✓ Evaluate whether natural disasters are truly disastrous for ecosystems.

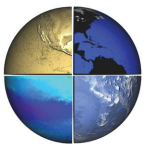
Engage

Ask:

Sometimes there is a very abrupt change to an ecosystem. What are some natural events that can change ecosystems very quickly?

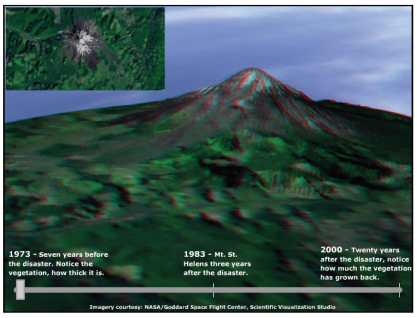
Fires, volcanoes, floods, hurricanes, etc.

◊ List some answers on the board.



3D-VIEW

- Launch the 3D-VIEW menu by double-clicking on the desktop icon.
- Click on: Biosphere.
- Click on: Lesson 10 - Succesion.
- Click on the ***3D Mount St. Helens Animation.***



Mount St. Helens Animation
Credit: NASA/GSFC Scientific Visualization Studio

◊ View the ***3D Mount St. Helens Animation***. Use the slider to observe the changes in vegetation before and after the 1980 eruption.

Ask:

What did you observe in this animation?

Prior to the eruption, the area around the volcano was very green. Soon after, the area appeared to be very bare. Years later, the green (vegetation) was coming back.

Say:

"The images we just saw show how the ecosystem around Mount St. Helens recovered after the eruption in 1980.

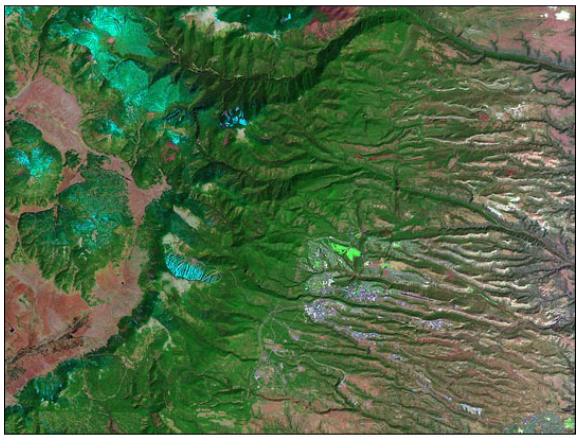
It is very common for ecosystems to be disrupted. Now, let's see how ecosystems are able to recover from large-scale natural changes."

Teacher Tip: If possible, allow students to explore this animation sequence in pairs.

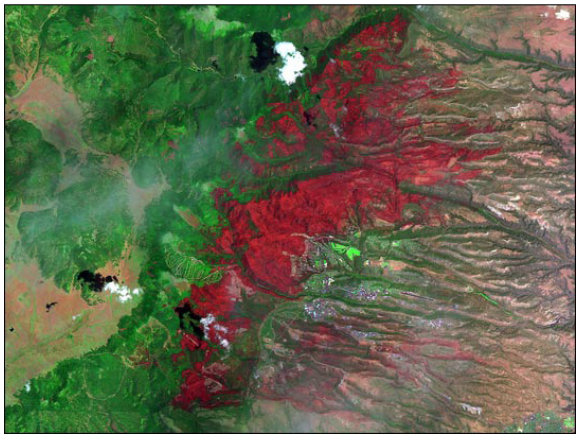
Explore

◊ Show students the following set of 'enhanced' images showing an area before and after a fire.

April 14, 2000



June 17, 2000



These are false-color images where vegetation appears as bright to dark green. Forested areas are generally dark green while other vegetation is light green. The areas recently burned appear bright red.
Credit: USGS EROS Data Center, Robert Simmon/NASA GSFC.

What could make these areas look differently?

A forest fire has burned a large area of trees as seen in the imagery.

In the second satellite image, notice the area that has been burned. It is a large area.

The following pictures show the changes in plant life after a forest fire.

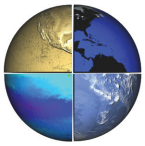
August 2000

August 2001

July 2002

Credit: Mountain Research Station, Fire Sciences Lab

◊ Explore the ***3D Succession Animation*** to see how ecosystems change over time. The animation shows the recovery of a Deciduous Forest after a forest fire.



3D-VIEW

- Launch the 3D-VIEW menu by double-clicking on the desktop icon.
- Click on: Biosphere.
- Click on: Lesson 10 - Succesion.
- Click on the ***3D Succession Animation.***

3D Succession Animation

Explain

After viewing the animation, answer the questions below:

Teacher Tip: If students have difficulty with these questions, review them as a class.

1. How could a forest fire begin naturally (not by a human)?

If lightning strikes trees during the dry season, it can ignite a forest fire.

2. In the boxes below, draw the different stages of change that you see in the animation. Label each box.

					
Destroyed Vegetation	*Grass*	*Shrubs*	*Small Trees*	*Evergreens (Pine Trees)*	*Deciduous Trees*

With your partner, think about and answer the following questions:

3. The first community that began to form after the fire included grasses. If everything was burned, how did the grasses get there?

Some seeds and roots may have survived the fire and remained in the soil. Other seeds may have been carried by the wind, birds, or insects and dropped into the area affected by the fire.

4. What types of animals probably live in the grassland seen in this image? Explain your answer.

Birds and insects, some small rodents, such as rabbits and mice. These organisms feed on seeds, roots and small plants.

5. How might these animals help the next types of plants to move into the area?

These animals will carry the fruits and seeds of the shrubs, small trees and other plants in from other areas. Seeds and nutrients pass through an animal's digestive system as waste. New materials are deposited in new places. Animals can also carry some seeds in their fur after rubbing up against a plant.

◊ Review these questions with the class.

Say:
"Now that we explored the ***3D Succession Animation***, let's read more about what happens when an ecosystem is destroyed by a natural disaster."

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Read the following passage:

Whole ecosystems can be destroyed by natural disasters. Volcanoes, fires and floods are natural events that can do this. After a fire, for example, a large area will look black and lifeless. Just below the Earth's surface, in the soil, however, organisms are ready to spring 'back' to life! Bacteria and fungi break down the burned organisms and return nutrients to the soil. With soil high in nutrients, plant roots and seeds that survive the fire will begin to grow. Seeds are carried by the wind from other areas, and also begin to grow.

After a fire, a large area will look black and lifeless.

As grasses sprout, insects come to eat.

As the grasses and other plants sprout, insects, birds and rodents from other communities come into the area to eat the plants. These animals often carry with them seeds and fruits of shrubs and trees. The shrubs, short plants and bushes begin to grow. These plants shade the grasses, and many of the grasses begin to die. The result is a new community of shrubs, replacing the grasses. The process continues.

The next stages of the process look like this: as taller trees grow, they shade smaller trees and shrubs. Those plants die without necessary sunlight. New animals move into the area during each stage. These changes happen slowly. So, it can take hundreds of years for an ecosystem to return to the way it was before a natural disaster. The changes begin with very few grasses and other plants, and they end with a diverse community of living things. This slow change in the communities of organisms is called **succession**.

The last stage of succession forms a community that will live until another natural disaster disturbs the environment. This final community before the natural disaster is called a **climax community**. In a Deciduous Forest, the climax community includes many tall trees such as oak, beech and hickory. This forest is a diverse community of organisms from many different branches of the Tree of Life.

Healthy ecosystems with a lot of biodiversity can survive natural disasters because there will always be species that are able to somehow live through the change. The fact that select organisms can live through the disaster is another reason why biodiversity is so important.

Ask:

Do you think that forest ecosystems are the only ones that go through succession?

No. Any ecosystem can be disturbed, and will go through stages in its recovery.

What would you expect to happen if an area of the Tropical Rainforest biome were destroyed?

Over time, it would slowly recover in the same way.

In the Project 3D-VIEW story, *Full Circle*, a fire burns on the grassland. The book says, "Fires were also a part of balancing nature…" (p. 33). What does the author mean by this statement?

Fires and other disturbances are necessary to keep ecosystems healthy. Nutrients are returned to the soil, dead grass is gotten rid of, etc.

Elaborate

◊ Students should work in groups of four for this activity. They will read the article about the positive and negative impacts of forest fires, and then apply their findings to a real-life scenario.

Read the information about forest fires, and then follow the directions below with your group.

Put Out the Fire or Let it Burn?

When forest fires begin to burn, people rush to put them out. Firefighters try to save lives and property, such as houses and cars. Wildfires, however, can be very important to the balance of ecosystems. If left alone, the fires will eventually burn out.

In a typical healthy forest, dead leaves, plants and trees fall to the ground and form a layer of 'leaf litter'. Leaf litter is very slow to decompose. Sometimes leaf litter gets so deep that plants cannot grow through it; no new plants can grow. Forest fires can actually help plant growth by burning away this layer of leaf litter and returning all of the nutrients from these plants to the ground. Because all of these nutrients are quickly added to the soil, the soil is very fertile after the fire, and plants can easily grow. The new plants are often more nutritious for the animals that eat them.

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Some plant seeds cannot even grow *until* a forest fire happens. Many evergreen trees, for example, have their seeds inside cones. The cones do not release the seeds until they are heated to a high temperature by fire.

Cones often do not release seeds until they are heated.

Fire will also remove diseased and weak trees and plants, so that the stronger ones survive. Large trees with thick bark, for example, are usually burned a bit on the outside, but the inside of the tree will often survive the intense heat. Since the weaker trees do not survive, and fall to the ground, sunlight can now reach through to the forest floor, and new plants will grow. These new plants are food for consumers ready to move back into the area.

There are, of course, negative effects of wildfires as well. Many forest organisms are killed by the heat and smoke. Even if they survive, their habitats may be destroyed or there may be no food left for them to eat. Wildfires can grow quickly out of control, so much so that firefighters are unable to put them out on their own. The burning may spread to areas where people live. The fire then becomes very dangerous. People can lose their homes and even their lives. Pets and farm animals can be hurt or killed, because these animals are held inside fences and may be unable to escape.

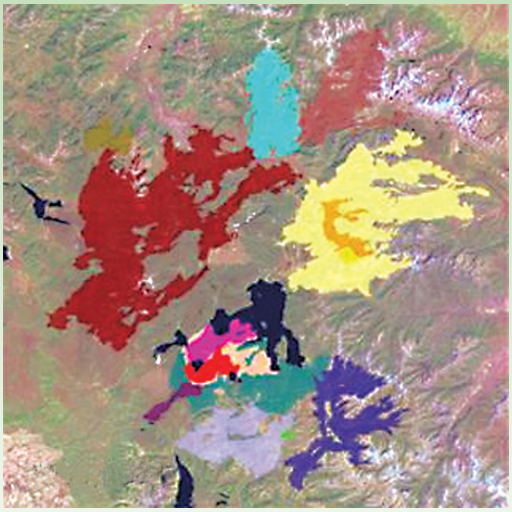
New plant growth.

Fighting the fires can become a very expensive job. Because of the large and far away areas of these fires, much of the firefighting is done by plane and helicopter. It can cost millions of dollars and months of time to put out a fire.

Fires at Yellowstone National Park

In the summer of 1988, the area around Yellowstone National Park was experiencing very dry ground conditions along with high winds. Several fires began, some sparked by lightning, others by humans. The fires burned huge areas of forest and grasslands. The burning was inside and outside of the Park.

The fires were allowed to burn. Eventually they went out on their own because of the arrival of snow and rain. Many people, however, were angry. They believed that the fires should have been put out earlier to save animals and prevent damage to people and property.



1988 Yellowstone Fires. Each color shows a separate fire that burned. In total, 2,200 square miles burned.
Credit: NASA/GSFC Scientific Visualization Studio

6. With your group, discuss this case.

a. List two reasons to let the fire burn until it goes out naturally.

Possible answers include: to return nutrients to the soil, so new plants can grow.

b. List two reasons to put the fire out.

Possible answers: to save lives, houses and other property, including farm animals.

7. Be prepared to discuss the issue with your class. Which do you think is the best policy, and why?

Once the groups have written their points, bring students back to a whole group discussion. You may choose to have students debate the issue, or simply discuss it as a class.

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Evaluate

(May be completed for homework)

1. How does succession begin after a disturbance such as a forest fire?

The dead organisms are broken down by decomposers. Then, grasses begin to grow. Some roots may have survived, or seeds may have been carried by the wind or animals.

2. Number the following images from 1-5 to show how the ecosystem would change over time. Then write a sentence that tells what is happening in each picture.

5

1

3

4

2

1. *Grasses are returning after a disaster.*
2. *Small shrubs have appeared.*
3. *Larger shrubs grow, along with small trees.*
4. *Trees begin to shade out other plants and shrubs.*
5. *The climax community is in place.*

3. Are natural disasters 'disastrous' for ecosystems? Explain your answer.

No, there are benefits to forest fires, such as burning off a thick leaf layer, in order for new plants to grow. Some trees need fires to open their seeds. Fires are a healthy part of ecosystems.