Changes in Ecosystems

Strand	Ecosystems	
Topic	Investigating eutrophication and catastrophic disturbances	
Primary SOL	LS.10	The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic, change over time, and respond to daily, seasonal, and long-term changes in their environment. Key concepts include c) eutrophication, climate changes, and catastrophic disturbances.
	LS.1	The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which f) dependent variables, independent variables, and constants are identified.
Related SOL	LS.8	The student will investigate and understand interactions among populations in a biological community. Key concepts include a) the relationships among producers, consumers, and decomposers in food webs; b) the relationship between predators and prey; c) competition and cooperation; d) symbiotic relationships; and e) niches.

Background Information

Humans have significant effects on the environment, both positive and negative. One common negative example is water pollution caused by run-off from farms, sewage-treatment plants, and lawns. This run-off often carries large quantities of nutrients, such as nitrogen and phosphorus, into bodies of water, thus increasing the concentration of dissolved nutrients in the water. This enrichment of the water stimulates the growth of aquatic plant life, usually resulting in the depletion of dissolved oxygen. This process is called *eutrophication*. Furthermore, the excess nutrients can cause algae blooms. When the algae die off, the decomposers in the water use large amounts of oxygen as they break down the decaying matter, thus decreasing the amount of oxygen in the water even more. Lack of oxygen then kills fish and other organisms that use the water as their habitat.

Nature can also bring about ecosystem change. Hurricanes, tornadoes, fires, floods, drought, blights, earthquakes, and volcanic eruptions are just some of the ways nature can change ecosystems. Such natural changes are neither inherently positive nor negative, but they can be perceived as one or the other by humans. After a major natural change occurs, a natural process called *succession* takes place.

Materials

- Liquid fertilizer
- Graduated cylinder

- Aquarium water
- Marker
- Tap water that has been allowed to sit for at least three days
- Four glass jars with lids
- Eutrophication Lab Sheet (attached)
- Note Taking Sheet for Catastrophic Disturbance Research (attached)
- Resource materials for research

Vocabulary

algae, catastrophic disturbance, eutrophication, fertilizer, nitrogen, phosphorus, pollution

Student/Teacher Actions (what students and teachers should be doing to facilitate learning)

The first part of this lesson is an experiment that will last two weeks. After initially setting up the experiment, students will make daily observations. Students will also conduct research on catastrophic disturbances.

1. Give each student a copy of the "Eutrophication Lab Sheet." Students will need to keep this sheet for the duration of this experiment (two weeks).
2. Label four jars — A, B, C, and D — and fill each jar halfway with the three-day-old tap water.
3. Add aquarium water to each jar until the jar is about three quarters full.
4. Using the graduated cylinder for measuring the liquid fertilizer, add the following amounts: 4 mL to jar B, 8 mL to jar C, and 12mL to jar D. Jar A will not receive any fertilizer.
5. Place the lids loosely on each jar and set all four jars where they will all receive the same amount of direct sunlight.
6. Observe the jars every day for two weeks. Have students complete the lab sheet for the experiment.
7. Divide students into groups to do research on natural disturbances. Give each individual or group a copy of the note taking sheet. Using various resources, have students gather information.
8. Allow students to develop a final product (e.g., poster, oral presentation, electronic slideshow, brochure) and present their information to the class.

Assessment

- **Questions**
  - What did you observe in each of the jars at the end of the two weeks?
  - What caused the water to change?
  - What would have happened if fish or other microorganisms were living in the water in the jars?
  - How do natural disasters affect an organism's environment?
- **Journal/Writing Prompts**
  - Write a letter to a farmer about the use of fertilizer on their fields and the effect that it has on nearby water supplies and other organisms.

- A land developer is planning to build a very large housing development near a lake that is used for fishing and swimming. Describe what problems could occur in the lake. What precautions could the land developer take to protect the lake?

Extensions and Connections (for all students)

- Contact your local Soil and Water Conservation Office for further resources and demonstrations.

Strategies for Differentiation

- Have students write out the steps in which eutrophication could occur in a pond.
- Have students illustrate the steps in which eutrophication occurs.
- Have students draw a diagram showing the progression of pioneer plants to complex plants after a forest fire.

Eutrophication Lab Sheet

Name: _____ **Date:** _____

Materials Needed

- Liquid fertilizer
- Graduated cylinder
- Aquarium water
- Marker
- Tap water that has been allowed to sit for at least three days
- Four glass jars with lids

Procedure

1. Label the four jars A, B, C, and D.
2. Add the tap water until each jar is half full.
3. Add aquarium water until each jar is three-fourths full.
4. Do not add any fertilizer to jar A.
5. Use the graduated cylinder to add fertilizer to the other jars. Add these amounts:
   4 mL to jar B 8mL to jar C 12mL to jar D
6. Loosely put the lids on all the jars. Set the jars in a sunny location.
7. Make a prediction of what you will observe over the next two weeks.
8. Observe the jars every day for the next two weeks. Record your observations in the chart.

Day	Jar A (no fertilizer)	Jar B (4 mL fertilizer)	Jar C (8mL fertilizer)	Jar D (12 mL fertilizer)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Eutrophication Lab Follow-Up Questions

1. What is the independent variable?

2. What is the dependent variable?

3. What is the control?

4. How did the color of the jars change over the two weeks?

5. What did you notice for each jar?

6. What organisms were responsible for the color change?

7. What would have happened if the jars were in the dark instead of sunlight?

Catastrophic Disturbance Research Sheet

Name: _____ **Date:** _____

Write your notes in the boxes below.

Questions	Notes
Where does it occur?	
What harm will it cause?	
How will the environment change?	
What organisms can it harm?	
What are some examples of how organisms might adapt to the change?	
How will the environment recover? How long might it take to recover?	