Throughout the guide, teaching tips are in red.

Activity Description & Estimated Class Time

There are two activities in this supplement. The first is a brief wrap-up for Part 1 of the STC *Ecosystems* kit, after students observe ecocolumns and read about organisms' roles.

The second of these two activities, "When Plants Become Problems," is useful after students complete part 2 of the STC *Ecosystems* kit. At that point, they will have investigated effects of agricultural runoff on ecosystems, and are ready to look at effects of invasive plant species.

Objectives

Students will demonstrate knowledge and understanding of the following ideas and content:

- an ecosystem is a community of living organisms that interact with each other and their physical environment,
- the interactions among organisms in an ecosystem can be disrupted by natural and man-made events.

Students demonstrate this knowledge and understanding by:

- creating graphic webs depicting the relationships between organisms and their environment for two different types of ecosystems,
- describing the effects agricultural runoff and invasive species can have on ecosystems.

Correlations to NC Science Standards

5.L.2.3 Infer the effects that may result from the interconnected relationship of plants and animals to their ecosystem.

Brief Science Background

Ecosystems are communities of organisms interacting as a system with the air, water soil, and other nonliving components in an environment. An ecosystem's environment is usually a specific place (unless you count the whole earth as an ecosystem) defined by the network of interactions among and between organisms and the abiotic environment in that place. The components of ecosystems are linked through nutrient cycles and the flow through the system of energy, water, nitrogen, minerals, and other abiotic components. Except in rare cases such as thermal vents on the sea floor, the energy flowing through most ecosystems comes originally from the sun, usually through the process of photosynthesis capturing carbon from the atmosphere. The major system components are producers, consumers, and decomposers. Producers, such as plants, convert energy from the sun into forms usable by other organisms. Consumers play an important role in moving matter and energy through the system, and they influence the quantity of producers. As organisms die, decomposers help convert the nutrients in them back into forms that plants and microbes can use.

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Part 1 Mini-Ecosystems In the classroom – 20 minutes

Materials

Materials for the whole class

- BLM 1 Concept Cartoon

Preparation

Be prepared to project BLM 1 (next page).

Wrap Up

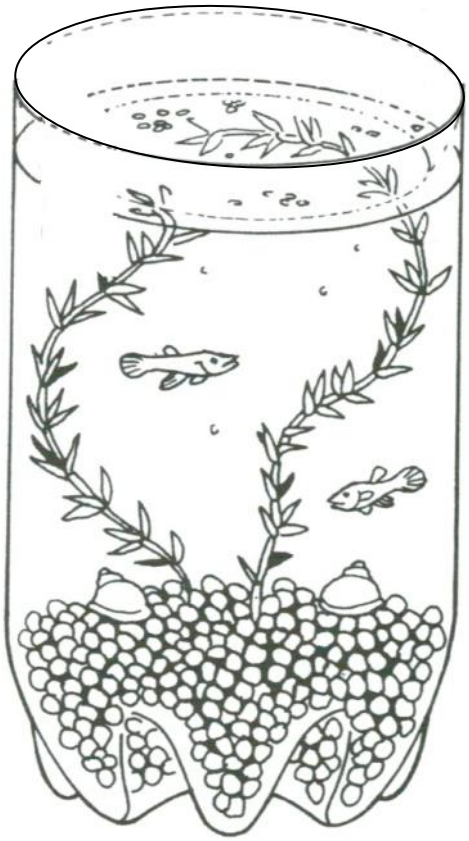
1. Project the concept cartoon shown in BLM 1. Ask students to think about the ideas expressed in the cartoon and decide which of these they agree with and which they do not. Have them write down what they think.

2. Set up a situation in which students must debate their ideas. For example, group the class into pairs and ask them to come up with one idea that both members of the pair agree upon. Then, regroup into pairs of teams and ask each team to defend its idea to the other. If you ask for a few groups to report out to the whole class, regardless of whether they agree with the girl at the bottom, question their idea as if you doubt it.

Answer Key

The girl at the bottom has the correct idea. The class has seen that the student at the top is wrong, because the fish live. The boy with no cap is incorrect because fish do not get oxygen from the food they eat. The boy with a cap is not correct because fish do not have lungs with which to breathe oxygen from air. They can only get oxygen from water through their gills.

BLM 1



That bottle is so small that the fish will use up all the oxygen and die.

They can probably get enough oxygen from the food they eat.

They can always go up to the surface and breathe the air.

I think the plants in the water make enough oxygen for the fish to use.

Part 2 — When Plants Become Problems – 50 minutes

In the following activity, students learn about two human-made events that stress aquatic and terrestrial ecosystems in North Carolina: agricultural runoff of fertilizer and manure, and the introduction of non-native, invasive plant species. Students then conduct experiments to test effects of these events in the class set of ecocolumns that do not contain animals. They use a concentrated solution of fertilizer to simulate agricultural runoff in three of the ecocolumns, and black construction paper to simulate the way kudzu and water hyacinths shade out native plants in another three ecocolumns. The last of the seven class ecocolumns serves as a control.

These activities are similar to Lessons 8, 10, 11, 12, and 13 of the *Ecosystems* kit, but these have half of the class investigating effects of agricultural runoff (a pollutant) and the other half investigating effects of an invasive plant.

Materials

Materials for the whole class

- the seven class ecocolumns made in Part 1 (these do not contain animals)
- 3 clean plastic bottles with caps, 1- or 2-L size (provided by teacher or students)
- 6 plastic cups
- 6 droppers
- container of plant fertilizer
- black construction paper
- tape
- scissors
- 15 copies of BLM 2 – "Pigs, Potatoes, and Problems"
- 15 copies of BLM 3 - "When Plants Become Problems"

Materials for groups of 4-5 students

- one class ecocolumn that does not contain animals
- food chain wheels students made in Lesson 7 of the Ecosystems kit

Preparation

Divide the class into six teams and give each team one of the ecocolumns. Teams do not need to be the same as in Part 1. There are seven ecolumns, and the seventh one serves as a control.

Procedure

1. Ask students for examples of natural events that could disrupt an ecosystem. **Hurricanes, tsunamis, earthquakes, landslides, tornadoes, and volcanic eruptions are all good examples.** Ask students what effects these events might have on an ecosystem, and have them refer to their food chain wheels if necessary. **In a hurricane, for example, high winds can topple trees and strip leaves from plants, and flooding can destroy animal homes and drown animals that are not able to escape the water.**

Part 2 (cont.)

2. Point out that human activities can also disturb ecosystems. Ask students to think of examples. **Oil spills and forest fires caused by careless campers are familiar examples.** Tell the students that there are two examples that are having an impact on both terrestrial and aquatic ecosystems in North Carolina, and they will now read about them.

3. Group the class into six teams. For three of the teams, provide each student with BLM 2 "Poultry, Pigs, Potatoes, and Problems." For the other three teams, provide each student with a copy of BLM 3 "When Plants Become Problems." Give everyone about 5 minutes to read. When they finish reading, ask teams to discuss how they might simulate these events in an ecocolumn within the following limits. Experiments must:

    - not be done on ecolumns with animals in them,
    - use only materials that are not harmful to humans,
    - use only materials that are inexpensive and easy to obtain, and
    - be observed over 2-3 weeks.

4. Ask teams to share ideas with the other two teams working on the same problem (with the other two "Poultry, Pigs, Potatoes, and Problems" teams or the other two "When Plants Become Problems" teams).

5. Use the background information found in Lesson 10 of the *Ecosystems Teacher's Guide* to help students plan their experiments. Refer teams testing agricultural run-off to the appropriate "Fact Sheet" in the *Ecosystems Student Activity Book*. For students testing shading by invasive plants, point out that when invasive species grow over native plants, they create partial but not total darkness. Let them know that black paper is available for shade. As further resources, use suggestions for implementing experiments, gathering data, and making observations found in Lessons 11-13 of the STC *Ecosystems* kit.

6. Have teams present brief outlines of their test methods and results. Discuss as appropriate.

7. Ask teams to discuss what they think would happen with experiments using ecocolums that contain animals. Ask students to be specific about animals and the effects on them. Ask teams to present and discuss ideas after all presentations are complete.

Wrap-Up

Pose the following questions to students, and ask them to write their responses in their notebooks.

1. How do you think the plants and animals living in a North Carolina forest would be affected if kudzu began growing in it? Give some examples of the plants and animals living in a typical forest and describe what you think might happen to them.

2. How do you think a North Carolina pond would be affected by farm run-off? Give some examples of the plants and animals living in a typical pond and describe what you think might happen to them.

BLM 2

Poultry, Pigs, Potatoes, and Problems

Did you know that in the U.S., the average adult eats 90 pounds of chicken, 17 pounds of turkey, and 240 eggs each year? These foods are known as poultry products, and poultry is the largest agricultural industry in North Carolina. North Carolina is the fourth largest producer of chicken in the U.S. Only Minnesota produces more turkeys than North Carolina.

North Carolina also produces about 10 million hogs each year. Their meat is known as pork. Ham, bacon, and barbecue are pork products. Behind Iowa, North Carolina is the second largest U.S. pork producer.

Do you like sweet potatoes? Just as the cardinal is North Carolina's state bird, and the dogwood is its flower, the sweet potato is the state vegetable. North Carolina grows more sweet potatoes than any other state in the country.

You wouldn't think that chickens, turkeys, hogs, or sweet potatoes could cause problems, but they can. All those animals, especially the hogs, produce a lot of manure. Also, sweet potatoes and other crops need a lot of fertilizer. Both manure and fertilizer can pollute ponds, lakes, streams, rivers, estuaries and oceans. How does this happen? It happens when there is a lot of rain, and these rich sources of plant nutrients get washed into aquatic ecosystems. This is what happened in the eastern part of North Carolina when Hurricane Floyd caused large amounts of hog waste to enter our waters in 1999.

With more plant nutrients in the water than usual, the aquatic plants grow very rapidly. The microscopic algae reproduce so quickly that they turn the water bright green. However, with so much fast growth both the plants and the algae soon use up all the extra nutrients. When that happens, many die and begin to rot. With so much dead material to feed on, the decomposer bacteria also reproduce quickly and use up oxygen in the water. Bacteria can sometimes use up so much oxygen that fish and other animals suffocate. When that happens they float to the surface and wash up along the shores of lakes, estuaries, or ocean beaches.

What do you think would happen in your ecocolumns if too many plant nutrients got into them? Can you think of a way to test your ideas?

Public Domain Image

Public Domain Image

BLM 3

When Plants Become Problems

You probably read about the water hyacinth when you were learning about different types of ecosystems in previous lessons. It was brought to the U.S. from South America, and it has become a problem in some of North Carolina's lakes, ponds, and streams. Its large leaves float on the water's surface and prevent light from reaching algae and other plants below. All plants need light to survive, so the algae and plants such as elodea can die off when the surface is covered with water hyacinths. When the native plants die and decompose, their nutrients return to the water, where they provide water hyacinths with even more nutrients. It's no wonder they spread so fast.

Like the water hyacinth, kudzu is a fast-growing plant that is a problem in many parts of North Carolina. Kudzu, however, grows on land. It is from southern Japan and southeast Asia, where it is warm and humid. In 1876, someone brought it to a garden in Philadelphia, and it was grown on steep hillsides to help prevent erosion.

Kudzu grows well throughout the south, where the warm and humid summers are similar to its native Asian climate. Unfortunately, kudzu grows *too* well here. It is a vine, and vines can climb up and over trees. Kudzu leaves can be six inches wide or more, so like the water hyacinths, kudzu shades the trees, shrubs, and ground plants that it grows over. When the plants beneath it die, the kudzu uses their recycled nutrients to continue spreading over the landscape. You've probably seen kudzu growing along roadsides and covering trees, fences, and even abandoned buildings and cars!

What do you think would happen in your ecocolumns if plants such as water hyacinths and kudzu invaded them? Water hyacinths and kudzu are too large to fit in the ecocolumns, so try to think of a way to test your ideas without actually adding these plants.

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Appendix

Common Student Preconceptions About This Topic

See the preconceptions described in 5.L.2.1, “What’s in an Ecosystem?” and 5.L.2.2., “Who Does What?”