



Ecosystems: Can I Help?

Curriculum Unit 92.05.03
by Raymond W. Brooks

Ecology is a subject that students and adults are beginning to become more concerned about and they want to make a difference. This unit gives students an opportunity to learn first hand about the effects that some activities have on the environment.

Groups will be set up to study different environments in the New Haven area such as Long Island Sound, the Water Treatment Center, and the City Parks to provide an opportunity to “stretch out” and investigate areas of interest to them.

Upon completion of this unit, the student will compare his initial views on “ecology” with those after completing the unit.

The effectiveness of the unit can be evaluated by observing how the students follow their own suggestions for improving the local environment and how their behavior impacts other students to follow their lead.

The type of questions and discussions in and out of class can also be used as an indicator for the effectiveness of the unit.

Hopefully the student will realize that all he or she reads or hears on environmental topics may not always be true and they will learn to evaluate this information more objectively and become more environmentally conscious.

Background

Begin the unit by having the students write a paragraph on what the term “ecosystem” means to them. Save these papers for comparison of ideas at the end of the unit. You might also want to have a list of terms that will be used in the unit and ask the student to write a short definition of each to see if they are: familiar—somewhat familiar—no idea—about the meanings of the terms. A walk around the school might be of interest at this time. Have the students take notes on what they like, do not like or are afraid of and keep them for comparison on follow up walks. Also have them write a short paragraph from their notes about the reasons for these conditions.

We will now begin our study of ecology by defining an ecosystem.

An ecosystem is defined as a system consisting of all the living (biotic) and nonliving (abiotic) factors that interact with one another in a given area. The size of the ecosystem depends on the person who is doing the investigating. After discussing these terms, show pictures to the class and have them group the biotic factors in one column and the abiotic factors in another column. By doing this exercise the student will better understand the term ecosystem.

Communities are the living parts of the ecosystem that interact with one another. This topic provides an opportunity to introduce Field Ecology. An exercise in field mapping can be introduced at this time. Break the class into groups and have each group set up a group study area outside 10 meters by ten meters. Have them draw a map of the area designating where trees, grass, paths, etc. are located. Have them look for animals or evidence of animal life in each study area and make a list of what they find. Make a list of things in the physical environment such as sun, shade, soil type, etc. and do not forget to include any human factors that affect the group study area. This will also set the stage for each group to set up a "Bottle Biology" experiment from materials in their group study area. On return trips to the group study area changes over time can be observed by recording new observations such as plant growth, insects, soil surface and any other observable change. Have the student compare them to their earlier findings.

Populations are groups of organisms of the same type, living in the same area. Activities with population density can be performed by using the number of students in the classroom and changing the dimensions of the room and having them stay within the new boundaries. Another activity would be to plant from one to seven seeds in seven different cups of the same size and observe the growth of the seeds in each container. Population densities generally vary among species living in the same area and are classified as clumped, (most common), random or uniform.

Some of the variables that affect population size are births, deaths, immigration and emigration.

Habitats are the places in which organism lives. Because different organisms have different needs there are different kinds of habitats but each must furnish food, shelter and other needs for survival.

Organisms can be producers, consumers or decomposers. The classification of the organism indicates how it will obtain its energy and interact with the other parts of the environment.

The producers are the source of the food in the ecosystem, consumers use the food directly or indirectly, and finally decomposers break down the dead organisms into simple substances.

The most important types of interactions in a community are energy flow, biogeochemical cycles and trophic levels.

Energy Flow ENTERS — THROUGH — LEAVES SUNLIGHT — FOOD WEB — HEAT

In most ecosystems, photosynthesis is the beginning of the energy flow.

$6\text{CO}_2 + 6\text{H}_2\text{O} + \text{sunlight} \longrightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ This equation shows that water and carbon dioxide are used to produce sugar, where the energy is locked in to be used by the plant for its own life processes and oxygen which most organisms need to live. Oxygen gets into the atmosphere by photosynthesis of land and sea plants.

The process of photosynthesis is important as an ecosystem is not a closed system and needs this new energy to replace the energy that is lost by respiration.

Respiration is the process that takes the products of photosynthesis and uses them to produce energy.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{ENERGY}$ Biogeochemical Cycles Movement of water, carbon, + other nutrients such as nitrogen and phosphorus within the ecosystem. Elements essential for life tend to move in cycles that move them from the environment, to organism, then back to the environment.

Nitrogen, being the most abundant gas in the atmosphere might be a good example to use for discussing cyclic behavior.

The nitrogen cycle is important to living things to make protein which is used for growth and repair/replacement of body cells.

Although 78% of our atmosphere consists of nitrogen, it cannot be used by most organisms in the free state. A process called nitrogen fixation must take place.

The nitrogen cycle allows this process to take place. If you look in most any science textbook you will find a diagram of this cycle. I suggest that you find a diagram in a text for your grade level as the diagrams can become confusing to the student because of the terminology.

The student should notice that there are many paths that can be taken during a cycle but they eventually end up back at their starting point.

Trophic Levels Number of transfer steps away from the energy input into an ecosystem. (position in food web)

LEVEL ENERGY SOURCE

Primary Producers Sunlight
(Plants)

Primary Consumers Primary Producers
(Herbivores)

Secondary Consumer Herbivores
(Primary Carnivore)

Tertiary Consumer Carnivore

(Secondary Carnivore) We can now talk about some important types of biotic interactions that take place in a community: Mutualism—Competition—Predation—Parasitism

Mutualism

- a. Facultative—Both species benefit but each can live without the other.
- b. Obligate—Cannot survive long without the other.

Competition

- a. Exploitation—Equal access by all individuals to resources but differ in speed and efficiency of using the resource.
- b. Interference—Limit or prevent others from using the resource.

Predation

- a. Stable Coexistence—Predation keeps the prey population in check.
- b. Oscillations—Predators reproduce more slowly than their prey regardless of amount of prey available.

Parasitism

- a. Parasitoids—Kills host by consuming its soft tissues. Natural control over other insect populations.
- b. Social Parasitism—One species depends on the social behavior of another to complete its life cycle.

After discussing the background material for this unit, we will break up into smaller groups for investigations. Each group will make a report and give recommendations on their area of study.

Water Biomes “Water, water everywhere,/Nor a drop to drink.” After completing this section, we will be more aware of preventive measures that we can use to conserve water and reduce pollution in our everyday life.

We know water is a substance that can exist in all three phases at the same time and in the same place. We also know that water covers about 75% of the earth’s surface with about 4% being fresh water that we as humans and many other organisms need to survive. Because we live in a closed system we must learn to use this resource wisely to protect our environment and way of life.

To start this topic the group (if possible) should be allowed to do the hydrolysis of water activity to reinforce the formula H_2O .

This exercise is being done so that the student can visually see and test these two gases that make up water.

After completing this activity, we will begin talking about the water cycle. To start this area of investigation, have the student do a distillation activity. Have them set up the apparatus and use a salt water solution for distillation. After completing this activity have them relate the activity to what is happening in nature. (Bottle Biology?)

We must realize that there is no “typical” aquatic ecosystem as environmental influences vary from area to area.

Before going into the field, we should locate the three major oceans and differentiate a sea from an ocean and define a sound and estuary.

It might be fun to take a water sample from the reservoir and an equal volume from Long Island Sound and let them evaporate naturally and compare the evaporite. You can also have your class make a hydrometer from a test tube and glass rod. Have Schooner Inc., bring water samples from various parts of the Sound and from different depths and have the students measure their specific gravity and try to explain why they differ. You can also add tap water to the list for testing.

Have the student realize the zones of ocean water are separated mainly by temperature. They should be able to place these zones in order starting at the surface zone, to the thermocline and finally the deep zone. They should give an example of a life form that lives in each zone and tell how it survives in that zone.

It might be of interest to them that oceanfloor topography is different than continental topography by most features being higher, deeper, and larger than features found on earth.

Ocean life can be classified into three major groups by their habits and the depth of ocean water they reside. The plankton float at or near the surface of the ocean where sunlight can penetrate. The nekton are the swimmers and finally we have the benthos that live on the ocean floor.

After we have become familiar with certain basic information about water, we should begin to look at the water biomes in our area. Because the group will be small you might want to ask another teacher or parent to help you transport your students to the various available sites.

Lentic ecosystems would probably be the best to do our fresh water ecosystem investigation. Arrangements can be made to visit the water treatment plant and sewage treatment plant for on site investigations and information. The information we should try to convey to our students is that many human activities such as the dumping of raw sewage into lakes and streams disrupt the balance but with education and commitment, harmful practices can be stopped and the balance restored.

The marine environment can be studied with the aid of Schooner Inc. They offer educational programs for studying life along the shore and in Long Island Sound. A three hour educational experience on the schooner "Quinnipiack" is very worthwhile. The students get to participate in gathering life forms and learning about their habitats and life cycles. If you are unable to get funding for some of these activities through the school or with the school partnership try having the Sound School give a lesson or two to your students.

When doing this group activity, have the students:

1. Research the average rainfall for this area.
2. Find out who are the large consumers of water.
3. Trace local sources of water pollution.
4. Suggest ways to conserve water.
5. Suggest ways to lower water pollution.
6. Make oral or written class report.

EVALUATION

Enthusiasm and attendance during project. Questions and answers after report. Request for information. Ideas for solving problems.

Water Biomes

Schooner Shore Walk Water Treatment Plant Sewer Treatment Plant Sound School Visitations Whitney Water Center

Land Biomes "Oh give me land lots of land"

With the population increasing and the attempts to save some of the earth's natural habitats, the dream of each person having his own plot of land is becoming more difficult to accomplish.

More food is needed to feed the population, more houses are being built using up and destroying natural resources and landfills are overflowing.

In this section we want to concentrate on the recycling process, how to increase plant life and find more

effective ways to get rid of solid waste.

Although we are going to concentrate on investigations in our school yard and local parks, before we begin these investigation we should make the student aware of the six major land biomes and their characteristics.

1. Tundras—very cold and dry—the poles
2. Coniferous Forests—evergreens—humid cold climates
3. Deciduous Forest—leaves—humid, mild climate
4. Tropical Rain Forest—humid, tropical climate
5. Grasslands—semiarid climate
6. Desert—hot, dry climate

At this time we might revisit our group study area and do a change over time follow-up investigation. We then can do some classroom activities using corn and vermiculate. Check the package for the % of germination. Have each student plant one or two seeds in a cup of vermiculate and make sure it stays moist. Compare your results with germination to the predicted results. Explain why the results might not be exactly as stated on the package.

Discuss the needs for germination and the role of each need.

Experiment with different growing conditions, observe and record your results. You might also want to set up various types of “Bottle Biology” experiments using pollutants, animals, and various other organic + inorganic matter to see their effects on this closed system.

A nature walk with a Park Ranger can be a rewarding and educational experience. Students can get information on local areas and also do follow up visits on their own or take younger brothers or sisters.

When doing this group activity, have the students:

1. Find the location of the city parks.
2. Determine the major uses of these parks.
3. Find out what the city is doing to keep the parks in good condition.
4. Find out what future plans they might have for the city parks.
5. Determine what individuals and communities can do to improve the parks.
6. Find out what citizen groups are active in park improvement.
7. Investigate the responsibilities of the Park Ranger.

EVALUATION

1. Enthusiasm and attendance during the project.
2. Questions and answer after oral report.
3. Request for information.
4. Ideas for solving problems.

Land Biomes

Conservation

Conservation is the wise use of natural resources. However, there are times when economics wins out over conservation. People need jobs to feed their families, but are these needs more important than saving the environment?

Can alternatives be found to lessen the impact on our environment? The answer is probably yes. But are people willing to sacrifice some of their conveniences?

Pollution

Briefly let's discuss some of the major pollutants to our environment and the steps that are now being taken to bring them under control.

Air Pollution

Industrialized countries are serious offenders with air pollution as their burning of fossil fuels provides an opportunity for a variety of pollutants and other unwanted substances to be released into the atmosphere. Another major source of air pollution, especially in the United States, is caused by automobile exhaust.

These pollutants can cause SMOG, which damages people's health and acid rain which damages buildings, and both plant and animal life.

The Environmental Protection Agency is trying to help control this problem by placing into law a number of regulations that restrict the amount of pollutants that can be released into the atmosphere by industry and automobile emissions.

Are commuters willing to use mass transit instead of driving to work everyday?

Are we willing to pay a higher price for goods so that factories can use cleaner fuels?

Water Pollution

Because our water supply is limited, it is necessary that we use good water conservation practices and prevent the pollution of our water. Water can be polluted in many ways such as placing untreated sewage into rivers and streams, dumping chemicals from industry into the waters, fertilizers from lawns being brought into bodies of water from rain, and the release of warm water into lakes and streams from power plants.

We are now trying to prevent some of this pollution by having sewage treatment plants in many cities and towns to remove the pollutants from sewage before the water is released into the larger body of water.

Many industries are having their own water treatment centers installed in their factories to make sure the waste water is clean enough to be released into the environment without any harmful effects.

Land Pollution

Land pollution, which is caused by wastes that are disposed on land, has two major sources. One source is municipal garbage from our homes. Our landfills are now overflowing and if steps are not taken soon it will be

a disaster. Hopefully the recycling program will gain even more momentum and help alleviate much of the problem.

The other source of land pollution is the disposal of hazardous waste by industry. Many of these waste are buried improperly and leak out of their containers into the environment causing much harm.

Although there are regulations on the books for the disposal of hazardous waste, more supervision and enforcement of waste disposal regulations are needed to bring this problem under control. But, probably more important than regulations is the desire of the individual to want to save the environment.

Summary

Ecology is a topic each person should be made aware of as each person can make a difference. The activities and investigations in this unit will make the student more environmentally conscious and hopefully this information will be passed on to others. Ecology: Can I help? I'd better.

Vocabulary *This list can be used as a pre-test for students to determine if they are familiar—somewhat familiar—no idea about these terms.*

1. Abiotic—The nonliving things in the environment.
2. Biome—A large geographic area that has similar climates and climax communities.
3. Biosphere—All areas of Earth where life exists.
4. Biotic—The living things in the environment.
5. Community—All the populations of different species that live in the same place at the same time.
6. Competition—The struggle with one another for the available survival needs.
7. Conservation—The wise use of natural resources.
8. Cycle—A repeating pattern.
9. Decomposers—Organisms that break down the wastes or remains of other organisms.
10. Ecology—The study of relationships between organisms and their environment.
11. Ecosystem—The living and nonliving things in an environment together with their interactions.
12. Environment—Everything that surrounds an organism.
13. Estuary—An ecosystem where freshwater and seawater mix.
14. Food Web—Many overlapping food chains.
15. Greenhouse Effect—When greenhouse gases build up in the atmosphere trapping the heat resulting in increasing temperatures on earth.
16. Habitat—The place an organism lives.
17. Mutualism—Each organism needs the other for survival.
18. Natural Resource—Materials found in nature.
19. Niche—The role an organism has in its community.
20. Organism—Any living thing.
21. Pollution—The release of harmful materials into the environment.
22. Population—A group of the same kind of organisms living in a certain place.
23. Predator—An organism that eats other organisms.

24. Prey—An organism that is eaten by the predator.
25. Water Cycle—The continuous movement of water in the biosphere.

Problem *How much paper do we use in class each week of school?*

Goal *Upon completion of this lesson, the student will be more conscious of paper conservation.*

Procedure

1. Place a large container in the classroom and have the students place all used paper for the week in it.

Application

1. Mass the paper at the end of the week.
2. Remove and evaluate the major use of the paper.
3. Determine the % of paper not written on.
4. Determine ways to reduce the wasting of paper.

Evaluation

1. Keep weekly records on the mass of paper used.
2. Keep a graph of the results in a visible area.

Problem *Do you waste water?*

Goal *Upon completion of this exercise, the student will be conscious of water conservation.*

Procedure

1. Discuss sources of water—Water Cycle
2. Discuss uses of water.
3. Visit the Water Treatment Center.

Application

1. Keep track of the water used in the home (all family members) over a week-end.
2. Use this table as a guide for water usage.

shower 5 gallons/minute

brushing teeth 5 gallons per brushing

bath 40 gallons

cooking 3 gallons/meal

washing clothes 30 gallons/load

hand dishwashing 30 gallons/load

dishwasher 20 gallons/load

flushing toilet 5 gallons/flush

3. How much water did the student use?

4. How much water did the family use?
5. Which activity accounted for the most use of water?
6. What are some ways the household can conserve water?

Evaluation

1. Observations of family members following suggestions.
2. Checking the water bill.

<https://teachersinstitute.yale.edu>

©2019 by the Yale-New Haven Teachers Institute, Yale University

For terms of use visit <https://teachersinstitute.yale.edu/terms>