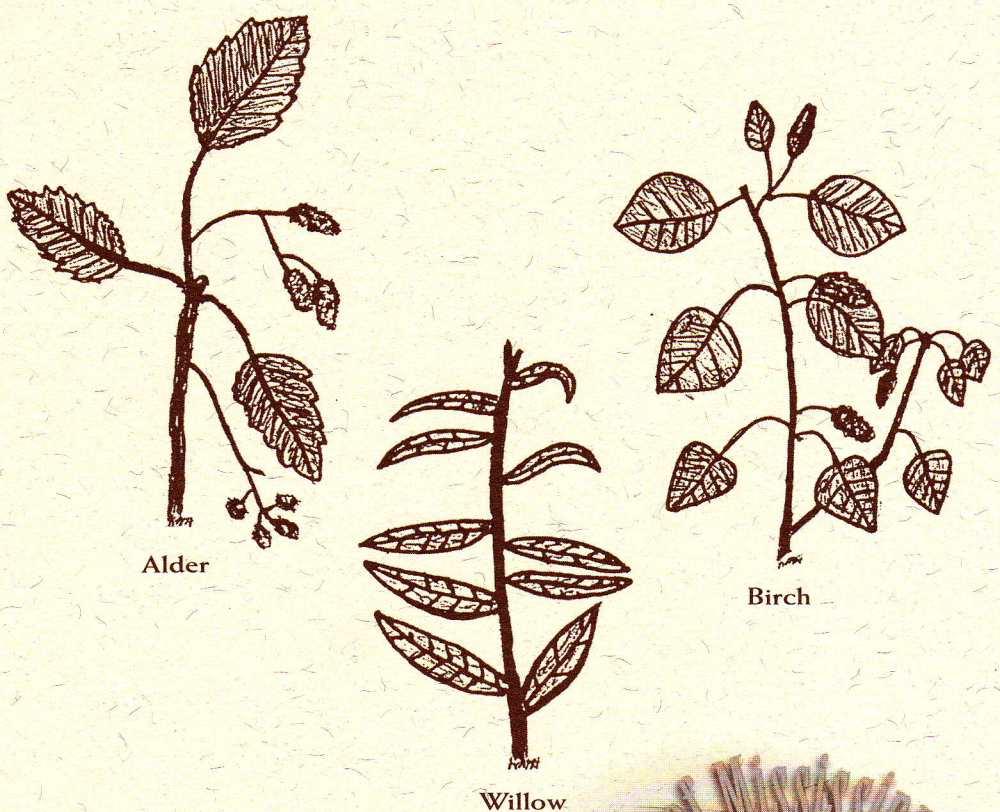
Guide to the Young Scholars

Nature Trail



Written by Phyllis S. Jenkins
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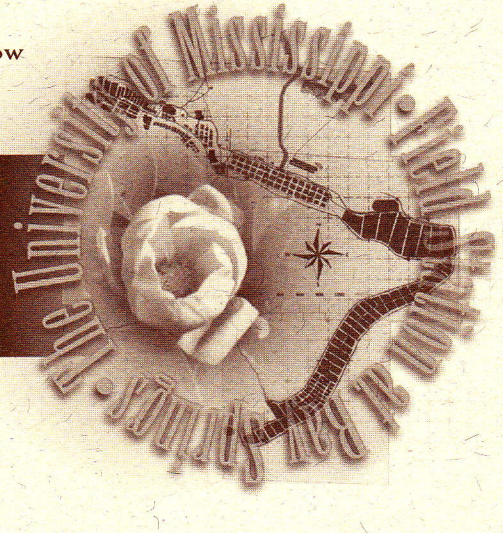
and Jennifer Murchison



The development of the Young Scholars Nature Trail has actually occurred over the last decade through the commitment and vision of numerous people. The name "Young Scholars" comes from a program funded by the National Science Foundation. It was first directed at the UM Field Station by Dr. Gary Gaston in the summers of 1992 and 1993, and later by Dr. Lucile McCook in the summers of 1994 and 1995. The trail itself was created while Dr. Luther Knight was director of the UM Field Station, and it was maintained in various ways by the Young Scholars themselves during the summers of 1992-1995. The vision, support, and diligence of each of these individuals is greatly appreciated.

The recent upgrades to the nature trail were accomplished through the hard work and dedication of Dr. James Gilbert and his Outdoor Recreation class during spring 2000. The following students participated in Dr. Gilbert's class: Rod Banahan, Collietta Bassett, Felisa Bonner, John Bowdoin, Ben Bratton, Allyson Brooks, Jason Church, Ronald Coleman, Kris Cox, Sarah Dausmann, Rachael Davenport, Tim Davis, Marisa Ellender, Jason Ezell, Trellas Forest, Todd Hendrix, Johnny Jones, Jr., Lance Jones, Glenda Landrum, William Lassiter, Michael Maholm, Chris Malloy, Craig Nugen, Rachael O'Dwyer, David Rakestraw, Arthur Sigmund, Shea Stewart, Stephen Vaught, Vince Vavrunek, Amy Warriner, Adam Wilson, and Kenny Woods.

The United States Environmental Protection Agency (EPA) Region 4 Atlanta office awarded funds to the UM Field Station through grant number NE984662-99-0 to assist with development of this forested nature trail. These funds have assured the effective translation of complex technical information into a very attractive booklet. The support of the United States Department of Agriculture Forest Service in preparation of the map of mussel sampling area is gratefully acknowledged.

The numerous Day Campers and teachers who walked the Young Scholars Trail during summer 2000 helped to focus on areas of special interest. Julie Chambers' notes as to what seemed most interesting to Day Campers helped Phyllis Jenkins to focus on particular features of the trail. Appreciation is also extended to Ms. Sabrina Brown, Ms. Amy Howell, and the other staff of University Publications for their involvement in the myriad details necessary to bring this booklet to press. Last, but certainly not least, we acknowledge with gratitude the countless hours invested in this booklet by the author while she was enrolled as a student at The University of Mississippi, as well as those hours invested by the two student artists from Lafayette High School.

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Director, The University of Mississippi Field Station
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UMFS Publication No. 12

Introduction

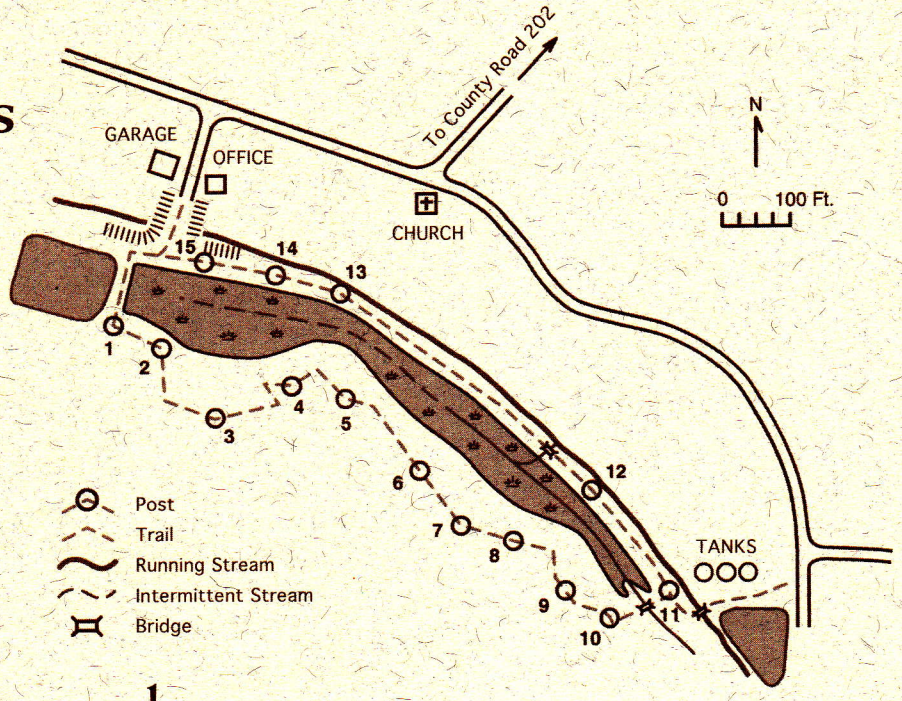
Nature trails provide opportunities to study living organisms in their natural habitats. Let's begin our tour of the Young Scholars Trail by emphasizing scientific inquiry. Scientific inquiry includes the exploration of nature through observation and research. As you observe the forest today, focus on the needs of all living organisms. How does the forest supply these needs? What happens to the dead trees in the forest? Is this forest different from other forests? What trees are located in this forest? And why? What animals live in this forest? And why? Are there hidden communities of organisms? Have humans created any changes in the forest? Can you compare this forest with the forests around your home? Maybe you can compare this forest with your own backyard.

Before you begin your trek through nature, stop and take time to look around. Find a clear spot to sit, and ask a friend to help answer the above questions. Write down your ideas, and compare them with others in your group. Do you think your ideas will change after you have completed the trail? Be sure to look at indications of life such as energy use, reproduction, response to the environment, and growth. Take note of any specific adaptations of the organisms you may see along the trail. Through observation and the process of science, many of your questions can be answered along the trail. Bring along a note pad and pencil, and accept the challenge of asking "Why?"

As you observe living organisms along the trail, remember the basic steps scientists use to solve problems. Stop and compare your ideas with the observations made by each of your friends. Organize your group's ideas, and use these ideas to make predictions or hypotheses based on the observations. As you satisfy your curiosity about living organisms, brainstorm ideas for testing your hypotheses in the classroom. Testing and experimentation provide results and data used to support conclusions. Scientific inquiry involves forming a hypothesis, testing the hypothesis, collecting results, and using the results to form a conclusion. If your hypothesis is incorrect, redesign your experiment, and try again. We learn through experimentation, whether the hypothesis proves to be correct or not.

Young Scholars Nature Trail

Map plotted by Bob and Joe Woolsey



Observe and record the biotic components of the pond in your journal. Can you classify each organism in your journal as a producer, consumer, or decomposer?

Post 2

Two different ecosystems meet at Post 2. The aquatic ecosystem blends into the terrestrial ecosystem. Notice the marshlike quality of the area around this post. Please do not leave the trail, but try to classify the plants and animals you observe as terrestrial or aquatic. Take time to look for salamanders, but remember to treat all living organisms with respect. Please do not touch any organisms you find along the trail. During winter, the mole salamanders move from their terrestrial environment into aquatic areas to reproduce. Salamanders reproduce in moist, wet environments because their eggs do not have shells. Their eggs are usually attached in small, jellylike masses to underwater objects (Keiser, 1999). Do you see any salamander eggs? Record your observations in your journal.

This post is representative of an ecotone. An ecotone is the transitional zone between a terrestrial and an aquatic environment (Miller, 1990). Did you observe both aquatic and terrestrial organisms? Usually, these transitional zones represent a larger diversity of life when compared with the organisms found in terrestrial environments or aquatic environments. Record the biotic and abiotic components in your journal for Post 2. The water level at this site varies or changes due to temperature and rainfall. Can you make a hypothesis that predicts the effect of the abiotic factors on the biotic factors for Post 2?

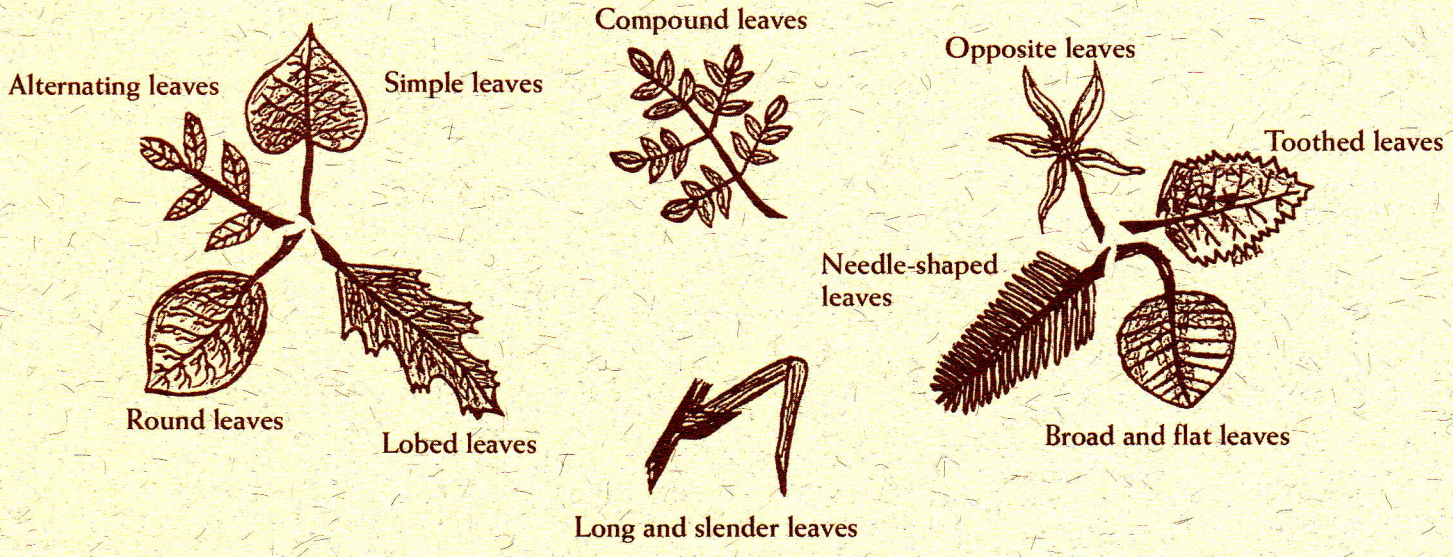
Post 3

As you move into the terrestrial, or forest, environment, stop and record the common names of the trees you expect to see in this temperate, deciduous forest. What abiotic components are important in this forest? Ask your friends for their ideas.

Temperate, deciduous forests exist in regions where the temperature is moderate and fluctuates with the seasons. The majority of the trees lose their leaves in the winter. In some temperate forests, rainfall is consistent throughout the year; however, this is generally not true for the forests of North Mississippi. When does North Mississippi experience the greatest amount of rainfall? Did you include temperature and rainfall as important abiotic factors in this forest? What is the average rainfall in North Mississippi? Can you design an experiment to test your hypothesis?

The common names of the trees include oak, hickory, maple, poplar, dogwood, and beech. The scientific names include the genera *Quercus*, *Carya*, *Acer*, *Liriodendron*, *Cornus*, and *Fagus*, respectively (Logan, 1999). Did you guess any of the common names correctly?

As you move through the forest, observe the different shapes of the leaves. Leaves can be used to identify different species of plants (Fuller, 1997). Collect samples of the leaves, and use the figure below to group the leaves:



Did you collect a leaf from each of the above categories? Why are there so many different leaf shapes? Guess which leaf shape would lose more water. In temperate forests, a big broad leaf is an adaptation that lowers the temperature of the plant through transpiration, or the loss of water through the stomata in the leaf (Balbach & Bliss, 1991). Did you select the biggest leaf or the smallest leaf with needles as the leaf that would lose the most water? What about the leaves that are lobed? Do you think they lose more or less water? Stomata allow plants to take in carbon dioxide needed for photosynthesis. Water is lost through these openings. Some plants can close their stomata when it is very hot to minimize water loss. Remember all plants have adaptations to the abiotic factors in the environment in which they are found (Mauseth, 1991).

Look around. Do you see any honeysuckle? Are the blooms white or red? You will probably notice more white honeysuckle along the trail. The Japanese honeysuckle, *Lonicera japonica,* or the honeysuckle that blooms white, is not native to our southern forests. This plant is native to Asia (Kuhajek, 1999). As you move along the trail, look for the honeysuckle that blooms red. This plant is native to our forests. Sometimes foreign species of plants or animals are introduced to a new ecosystem. These foreign species then become part of a new food chain. What happens to the ecosystem if there are no predators or competitors for the new, introduced species? What happens to the ecosystem if the new species competes for the food source of other consumers?

Kudzu is a foreign species from Asia that was introduced to our forests (Miller, 1990). This plant outcompetes and outproduces many of our native plant species. Did the introduction of kudzu affect our forests? How? Compare your ideas with those of your friends. How fast does kudzu grow? Can you compare the growth of kudzu with the growth of honeysuckle? How would you design your experiment to test your hypothesis?

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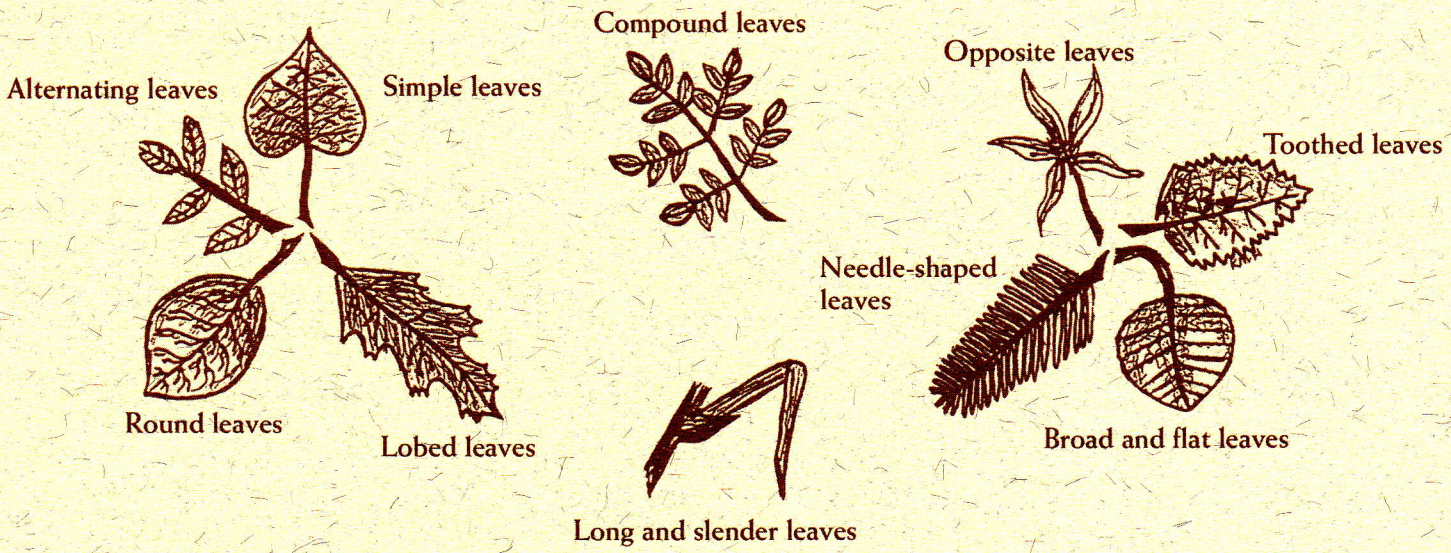

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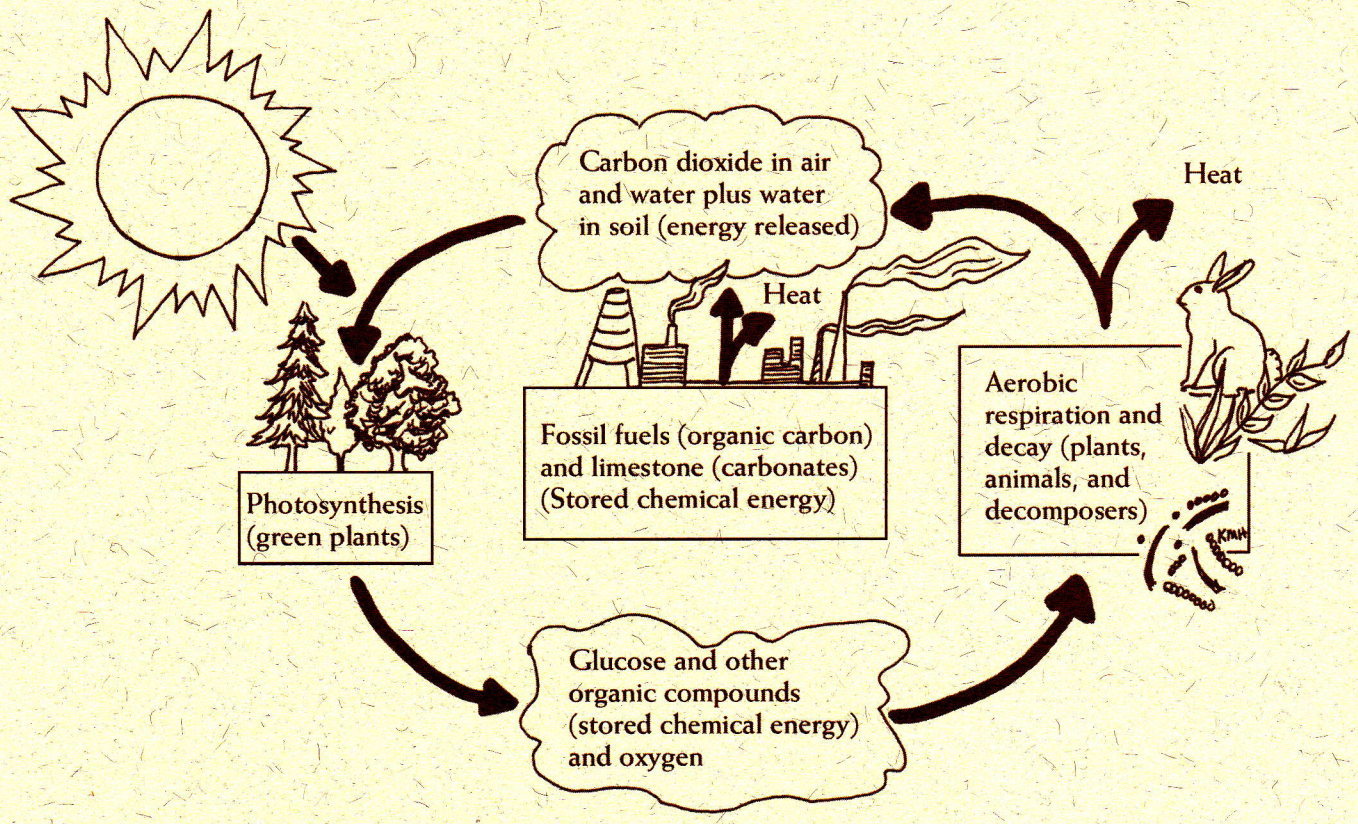
Post 4

As you move upland into the forest, stop at Post 4 and record the natural resources you see surrounding you. Does the forest renew these resources? How? Take time to share ideas with your classmates and record these ideas in your journal.

Many of the molecules used by living organisms are renewed through chemical reactions such as photosynthesis and cellular respiration. Photosynthesis is the chemical process used by autotrophs, such as plants, to capture the energy of the sun. Autotrophs convert this energy into stored energy such as starch (Atkin et al., 1993). Both autotrophs and heterotrophs convert stored energy sources into usable energy through the chemical process of cellular respiration. These chemical reactions occur repeatedly. Chemical reactions that repeat over and over are called cycles (Handwerker, 1999). The forest renews nutrients required for life through chemical cycles such as the carbon cycle, the nitrogen cycle, and the water cycle. Look at your journals. Did you include the availability of nutrients and the rate of recycling of nutrients as resources?

Autotrophs play an important role in the recycling of carbon. Carbon dioxide and water are used along with the energy of the sun to produce the energy source, or food, for the plant (Miller, 1990). Use the diagram below to describe the role of plants in the carbon cycle.

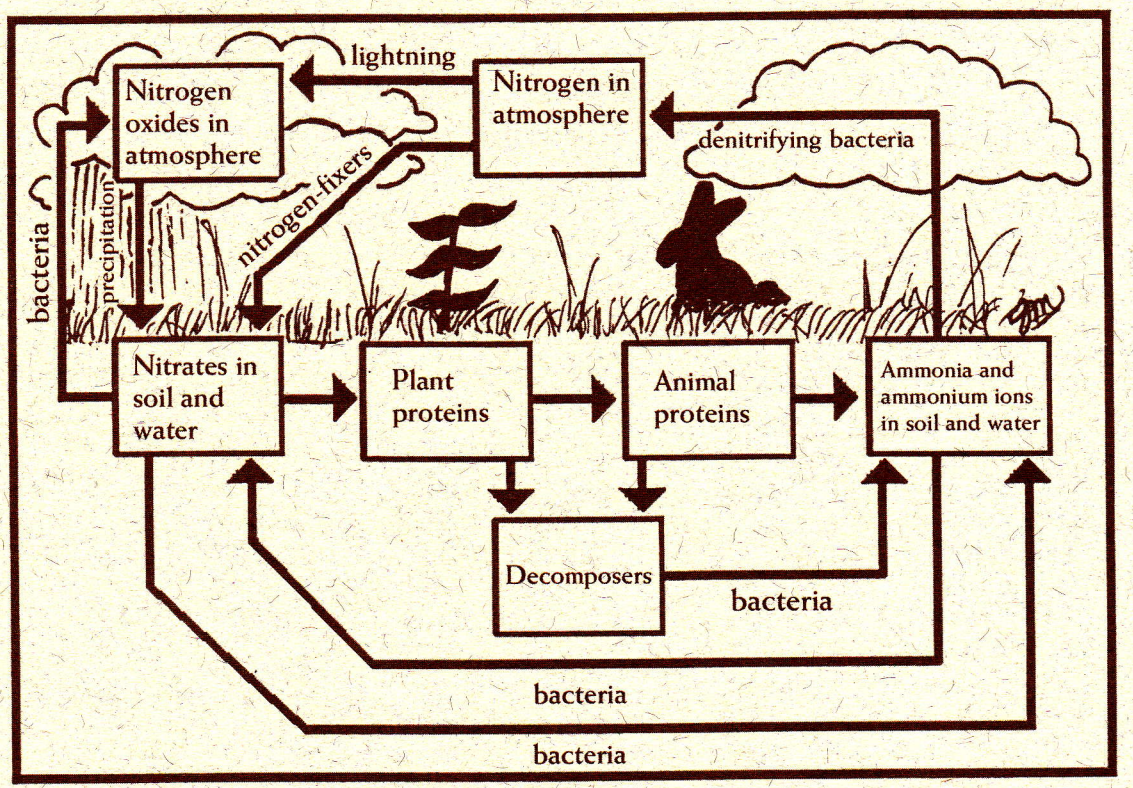


Carbon dioxide is naturally produced during cellular respiration when living organisms make usable energy. Carbon dioxide is then recycled during photosynthesis. What happens to the carbon cycle when humans cut down too many trees? What happens to the carbon cycle when fossil fuels such as gasoline are burned in our cars? Share your ideas with your friends. Record your ideas in your journal. Is the carbon cycle balanced? Can you design a closed environment such as a terrarium to test your hypothesis?

Post 5

At Post 5 notice the amount of dead leaves, branches, or trees on the ground. Is this leaf litter important to the forest? Gently push some of the leaves back from the soil and sketch any organisms you discover. What is the job of these organisms in the environment? Are there organisms that you cannot see on or beneath the dead leaves? Make a hypothesis concerning the role of these organisms in the environment and record it along with your sketches of the organisms you located beneath the leaf litter. After you finish your sketches, please return the leaf litter to its original position in the forest.

All living organisms use the element nitrogen to make proteins and nucleic acids (Miller, 1990). The air we breathe contains nitrogen, but most living organisms cannot use atmospheric nitrogen. Talk to your friends, and brainstorm several ways nitrogen can be obtained by living organisms. Compare your ideas with the diagram of the nitrogen cycle presented below.



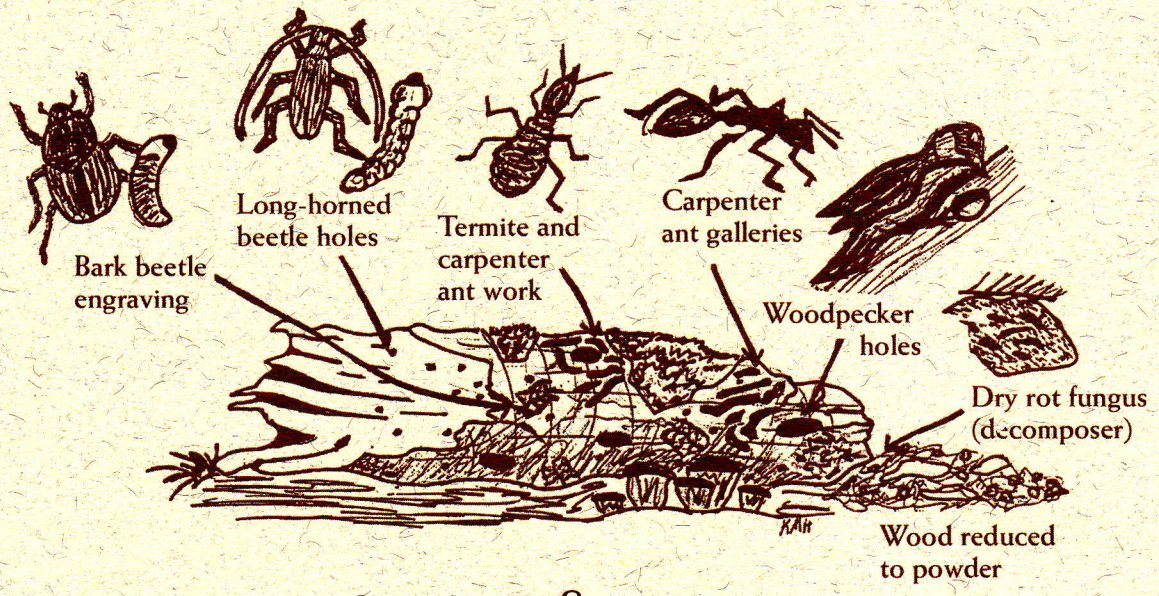
The decomposers you found beneath the leaf litter break down dead organisms and animal wastes as a source of renewable nitrogen. These decomposers include bacteria, fungi such as mushrooms, and lichen. Maybe you saw some thin, white, fibrous veins running through the soil beneath the dead leaves. These veins may be hyphae of various species of fungi. Observe the branches of the fallen trees. Are there lichen attached to these branches? Lichen is a symbiotic relationship between a fungus and an autotrophic organism such as cyanobacteria or a green alga. This relationship is mutualistic, and thus is beneficial to both the fungus and the autotrophic organism (Ricklefs, 1990). Both organisms that make up the lichen depend on each other for specific needs necessary for life. Locate the decomposers on the chart on Page 7. Notice the important role they play in recycling nitrogen for living organisms.

Some of the bacteria in the soil, such as *Rhizobium japonicum,* convert the nitrogen found in the air into ammonium compounds. This process is referred to as nitrogen fixation. Nitrification occurs when decomposers in the environment convert ammonia compounds into forms such as nitrates that can be used by plants (Ricklefs, 1990). Animal wastes and dead organisms also provide sources of nitrogen for the forest in the form of amino acids. Specific bacteria break down these amino acids into usable ammonia compounds through a process called ammonification. The cycle is continued as anaerobic bacteria release nitrogen into the air through a process called denitrification. Bacteria are involved in each of the four processes. List three renewable sources of nitrogen in your journals.

Post 6

Once you reach Post 6, take another look around at the leaf litter and the dead organic matter. At Post 4 and Post 5, you discovered the importance of carbon and nitrogen to a forest. Are there nutrients necessary for the community in these dead leaves or rotting trees? Use the knowledge you gained at Posts 4 and 5 to form a hypothesis. Predict ways the nutrients in the detritus, or the dead organic matter, is released for use in this community. Share your ideas with your friends, and record these ideas in your journals.

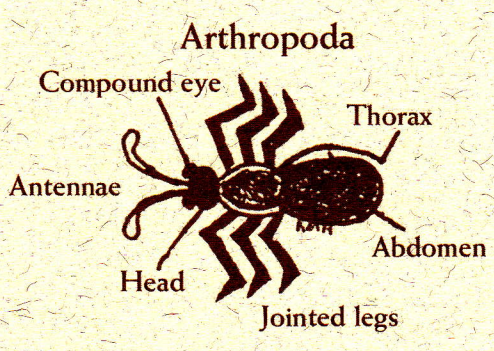
Look at the diagram below.

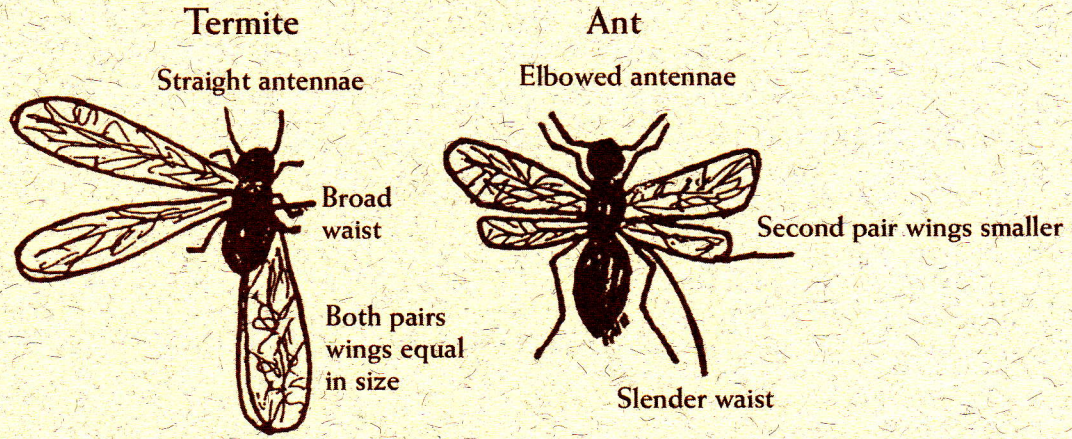


Were you right? Did your predictions include bacteria and fungi as we discussed at Post 5? Did you notice any lichen on the rotting wood? Remember bacteria and fungi break down the large organic molecules into nutrients for the community. However, these decomposers also provide a food source for the consumers found in the leaf litter or the fallen trees (Miller, 1990). Look at the diagram on Page 8. What organisms will you find in a fallen tree? Gently push back the leaf litter, or look around a fallen tree. Look for some of the organisms in the diagram. Do you see any termites, ants, or beetle larvae? Can you group these organisms as consumers or decomposers? Draw and describe the different organisms you find in the fallen logs or the leaf litter.

Termites, ants, and beetles are all insects. How are these organisms alike? How are they different? Insects all have similar characteristics. These similarities consist of a body that has three parts: head, thorax, and abdomen (Atkin et al., 1993). Other similarities include one pair of antennae on the head, a thorax with three pairs of jointed legs, and an abdomen with 11 segments, or parts, and no attached legs or wings. Some species of insects also have wings attached to the thorax (Handwerker, 1999). The diagram below, right illustrates the anatomy of the ant.

Insects are also very different. Each insect has evolved or adapted to fill a niche in its local community. A niche includes habitat, food supply, and reproductive behavior (Atkin et al., 1993). Can you describe the differences between termites, ants, and beetles in your journal? At times during their life cycles, both the ant and the termite have wings. Using the diagram below, describe the different characteristics of the termite and the ant: Look at the wings. Where are they attached? Would the abiotic components of an ecosystem affect the adaptations of these insects? Record your ideas in your journal.





As you continue to observe any decaying wood in the forest, look for small, white creatures. Look for evidence of trails inside the decaying wood. Please remember to stay on the trail, and do not disturb the forest community. Can you identify the consumers found inside rotting logs? Write down your ideas in your journal. Compare them with your classmates' ideas. Did anyone include termites as inhabitants of decaying wood? You are probably right!

Termites occupy a very important niche, or place, in the forest ecosystem. They contribute to the forest's supply of nitrogen by feeding on the cellulose found in the cell walls of plants (Kamble, 1999). These small organisms do not feed on living trees. They eat the cellulose contained in dead wood. A termite is another example of a symbiotic relationship. They need help to digest the cellulose in the wood. A microscopic protozoan lives in the digestive tract of the termite (Kamble, 1999). These protozoans produce enzymes that help the termite digest the wood.

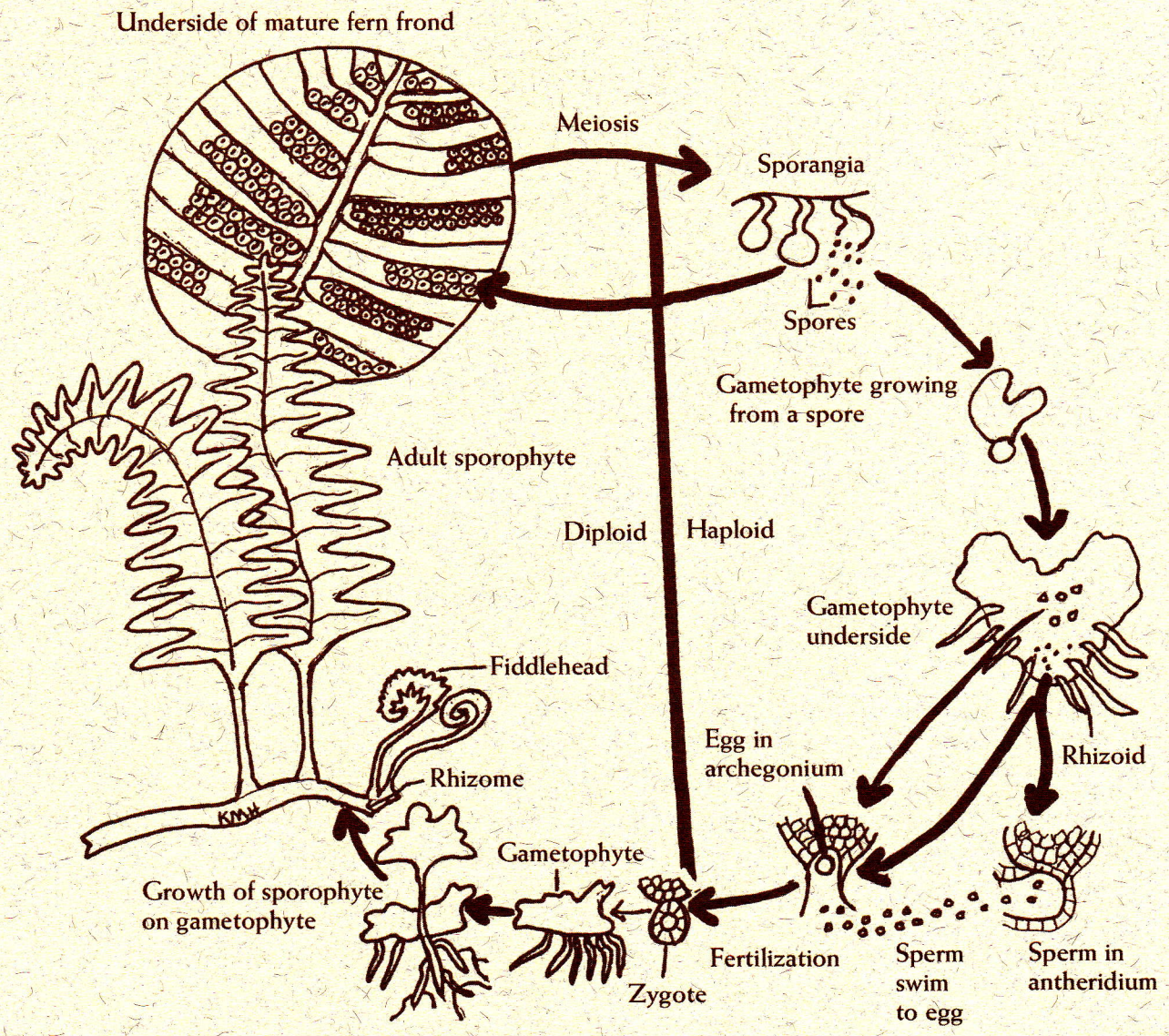
Compare this relationship between the termite and the protozoa with the relationship discussed at Post 5 between the fungus and the cyanobacteria. Is the relationship the same? Record these relationships in your journal, and list the benefits provided for the protozoan and the termite. Do you think termites are pests? Be sure to explain your answer.

Termites live in social colonies. A social colony consists of the king and queen, workers, and soldiers. You may have observed the workers or the soldiers of the colony. Both are white, blind, and wingless. However, the soldier has a large brown head with large jaws. Which did you see? Draw and record the differences in your journal. Can you predict the role of the worker and the soldier? Why would the soldier have such large jaws? Share your ideas with your friends.

Post 7

This site contains many different species of ferns. Look around and observe the different types of ferns located in this area. Observe the size of the ferns and their location. Make sure you draw and record the different types of ferns in your journal. Why are ferns so abundant at this site? Make a hypothesis and compare your ideas with your classmates'.

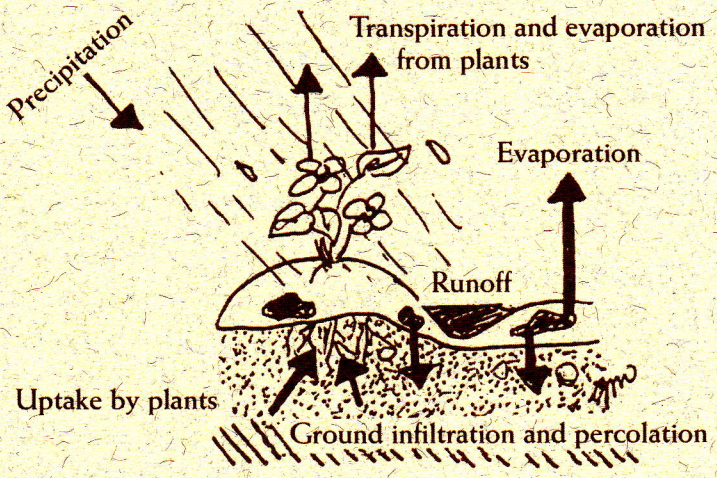
Ferns were among the earliest plants to use a vascular system to transport water and nutrients from their roots to their leaves. A vascular system is an adaptation for a terrestrial life (Handwerker, 1999). Ferns do not produce flowers because they are seedless plants. They reproduce by releasing spores. These spores allow the ferns to reproduce sexually by producing archegonium (female) and antheridium (male) structures on gametophytes. The egg and the sperm cells combine in the form of a fertilized egg or zygote (Balbach & Bliss, 1991). This zygote will develop into a new fern. The life cycle of the fern is diagramed on Page 11.



Carefully examine ferns located along the trail for spores. Look underneath the leaves and record your observations. Please do not destroy any plants or leave the trail. These spores require a very wet environment to ensure their development into new plants. Now, why do you think there are so many ferns at Post 7? Compare your new hypothesis with your original hypothesis.

Post 7 is located within an area of the forest that contains a constant source of groundwater commonly referred to as seeps. Groundwater accounts for approximately 97 percent of our world's fresh water and is renewed through the water cycle illustrated below.

The Water Cycle



The water cycle starts with precipitation, or rain, falling on the surface of the earth (Miller, 1990). Runoff water, or surface water, renews the water found in lakes and streams. This runoff carries sediment, or soil particles, and nutrients from the drainage area, or watershed, into the lakes and streams. Some of the precipitation seeps into the ground and becomes soil water. This water fills the pores in the soil and rocks. Soil particles determine the amount of water evaporated from the soil surface (Ricklefs, 1990).

Examine the soil at Post 7. Again, remember not to disturb the environment. Write down a hypothesis concerning the type of soil, particle size of the soil, and the ability of the soil to hold water. Compare your ideas with your those of your classmates. Compare the soil at Post 7 with the soil at other sites. Is there a difference?

Plants use soil water during transpiration. Transpiration is the evaporation of water through the small openings in plant leaves called stomata. Can you name any plant adaptations used by plants to conserve water in dry environments? What about leaf shape? Why do plants in this forest have leaves? Does the shape of the leaf affect the rate of transpiration? Remember the discussion at Post 3.

Take a break and observe your surroundings. Do you see any lizards or salamanders at Post 7? Salamanders are amphibians, and lizards are reptiles. Salamanders prefer a moist, damp environment. Which would you expect to find at Post 7, salamanders or lizards? Be quiet! Look carefully around the ferns, leaf litter, and fallen logs, but don't leave the trail. Respect the living things in the forest and do not touch any salamanders or lizards. You might see a two-lined salamander. These salamanders are common inhabitants of the UM Field Station (Keiser, 1999). These salamanders are slender and dull yellow with dark stripes on their sides.

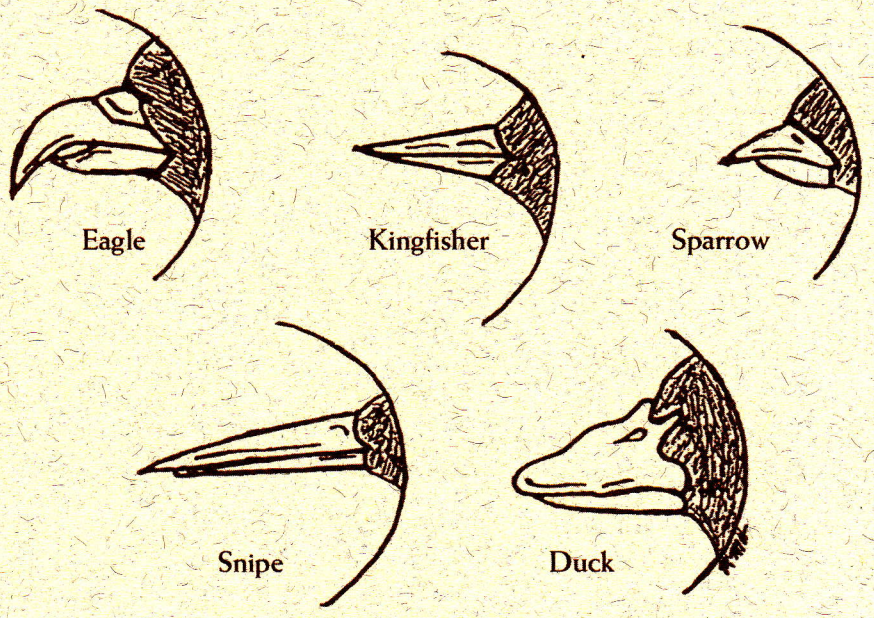
Post 8

Observe the size of the trees at Post 8. How often do you see trees this large? Do you have trees this size in your backyard? How old are these trees? Take a guess, and share your ideas with your friends. Did anyone suggest counting annual growth rings to determine the age of a tree? That's a good idea! Can you count growth rings without cutting the tree down? Have you heard of the science of dendrochronology? Tree growth rings can be counted and analyzed without damaging the tree or cutting it down (www.plantbio.ohiou.edu/epb/instruct/ecology/dendro.htm). Scientists use an increment borer that is hollow. The borer is inserted into the tree, and a small sample or core is removed from inside the tree. This core contains the pattern and number of annual growth rings. Bores allow scientists to collect environmental data concerning rainfall along with dating the tree.

Old growth forests contain large trees that have never been cut. Forests that have never been disturbed by humans contain a larger diversity of plant and animal life than younger forests (Miller, 1990). Forests also function in the regulation of water from higher elevations to lower elevations. What happens to the soil when a forest is clear-cut? Record your hypothesis in your journal.

The trees in the forest soak up the water and hold it. The roots of the trees slow the progression of the water through the soil as springs and groundwater supplies are replenished. This slow release of water prevents erosion. Do you think that clear cutting of trees is a good idea? Can you think of a more environmentally sensitive way to manage our forests? Record your ideas. Can you predict effects of clear cutting on the carbon cycle we discussed at Post 4?

Find a comfortable place to sit along the trail. Be quiet, and give the forest time to accept your presence. If you wait long enough, the forest inhabitants will begin to emerge. What types of birds do you think live in this forest? What do they eat? Are there any birds here that are nocturnal, or forage for food at night? Look at the diagram below.



Will you find all these birds in this forest? Does the shape of the beak give you any clues as to the kind of food the birds eat? Are the beak shapes adaptations due to available food sources? Some birds eat seeds, some eat insects, and some are carnivorous (White, 1993). Which of the birds on Page 13 eat meat? Which birds eat seeds? Record your ideas in your journal. What do the birds in your backyard eat? Write a hypothesis, and design an experiment to test this hypothesis. Use the birds in your backyard.

Post 9

Stop at Post 9, and divide up into groups. Look for ants. Have a partner look along the ground. Have another partner look at tree trunks. Look at the leaves and branches of the plants growing along the trail. Please do not leave the trail or disturb the ants, but remember to record and draw your observations. Share and discuss your observations with your partners. Did you see different types of ants? Were they all the same size or the same color? What do they eat? What niches do they fill in our forest community? Are they consumers or decomposers?

Ants fill many different niches in a community. Some ants are predators, some eat plants, some eat dead wood, and many ants aid in the pollination of different plants (Atkin et al., 1993). Ants live in social colonies that include a queen, males, and workers. Compare and contrast the role of ants in a community to the termites discussed at Post 6. How are they alike? How are they different?

At Post 3 we discussed the changes in our local forests due to the introduction of foreign species such as white honeysuckle and kudzu. Are you aware of any other introduced species to North Mississippi? What about ants? Brainstorm ideas with your friends and discuss the impact of ants on our forest. Share your previous observations about the types of ants found on the trail. Did you see red ants, black ants, large ants, or small ants? Are these ants indigenous or native to our forest?

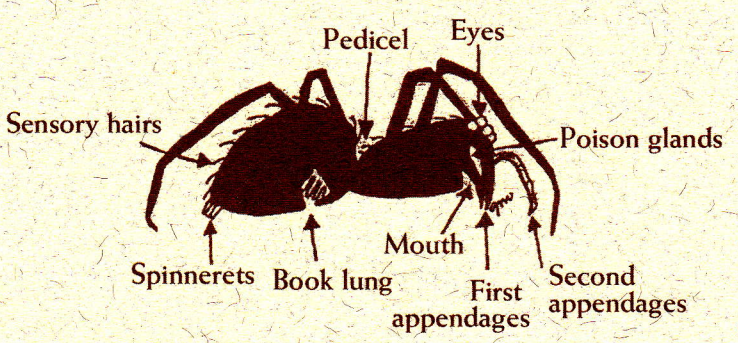
What do you know about fire ants? Some fire ant species are native to Mississippi; however, the red imported fire ant and the black imported fire ant were introduced to Mississippi from South America (www.colostate.edu/Depts/IPM/natparks/ants.html). Because these ants prefer sunny areas that have been cleared of large trees, you probably did not see any fire ants in the forest. What impact did the introduction of these ants have on the food chain? Do they have natural predators? Are they more aggressive in their feeding habits and their reproductive methods than the ants that are indigenous to this area? Take time to discuss effects created by the introduction of fire ants to our forests.

Do ants communicate? Have you ever invited ants to your picnic? What happens when you disturb a long line of ants that leads directly to a cookie you left outside? How do ants find each other? List several ideas in your journal.

Ants communicate through chemicals called pheromones (Atkin et al., 1993). Did anyone write down chemical communication in her or his journal? Each ant in line releases a trail of pheromones for the ants behind them. Different types of pheromones are also released to control reproduction and development. What about termites? Do they use chemicals to communicate? Can insects communicate through sound? Can you design an experiment to test sound communication between insects?

Post 10

During your trek through the trail, did you walk into any spider webs? Divide into teams again. Carefully observe the ground, the leaves, the branches, the detritus, and the tree trunks for spiders. Always remember not to leave the trail or disturb the spiders. Do you think spiders are insects? Remember our discussion at Post 6 concerning the characteristics of insects? If you find a spider, draw and record your observations. If you did not find a spider, look at the diagram below.



Do you still think spiders are insects? Do spiders have three distinct body parts?

What do spiders eat? Spiders have eight legs, and insects have six legs (Beller, 1994). Spiders generally feed on insects and do not have antennae. They use their poison glands to kill their prey. Most spiders cannot bite humans because they cannot penetrate our skin; however, some spiders such as the black widow and the brown recluse are dangerous to humans.

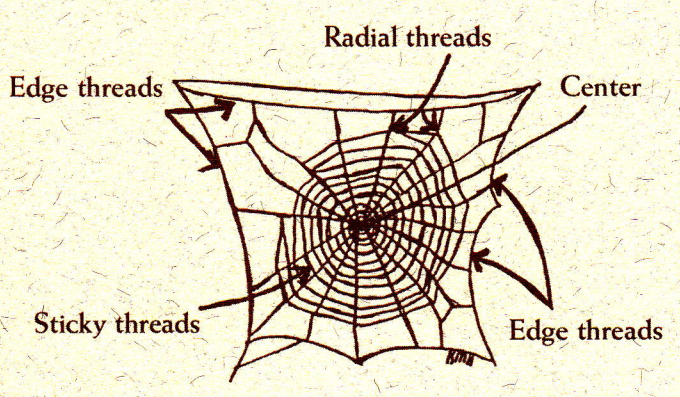
Please remember to treat all living organisms with respect. What do you think would happen to the insect population if we destroyed all the spiders? How do spiders use their webs? Are all spider webs alike? Can you design an experiment to determine different types of spider webs? As you move to Post 11, look for spider webs. Take time to draw the webs you find, but leave them intact and do not disturb the forest.

Post 11

Did you find any spider webs along the trail? Break into teams and look around Post 11 for more spider webs. Carefully look along the tree branches and the ground. Please do not leave the trail or disturb the forest. Draw and record any spider webs you find at this post. Compare your drawings. Do all the webs look alike? Do all spiders spin webs? Are spiders predators? Did you find any webs that resemble the one below?

This type of spider web consists of a series of circles or orbs. It is constructed to hang vertically. Sometimes you might walk into spider webs like this. Other common types of spider webs include sheet webs and dome webs (Beller, 1994). The next time you find a spider web in your house, take time to look at the web. These webs are usually sheet webs. They look flat and hang horizontally. There are many different types of spider webs. Some spider

Orb Web

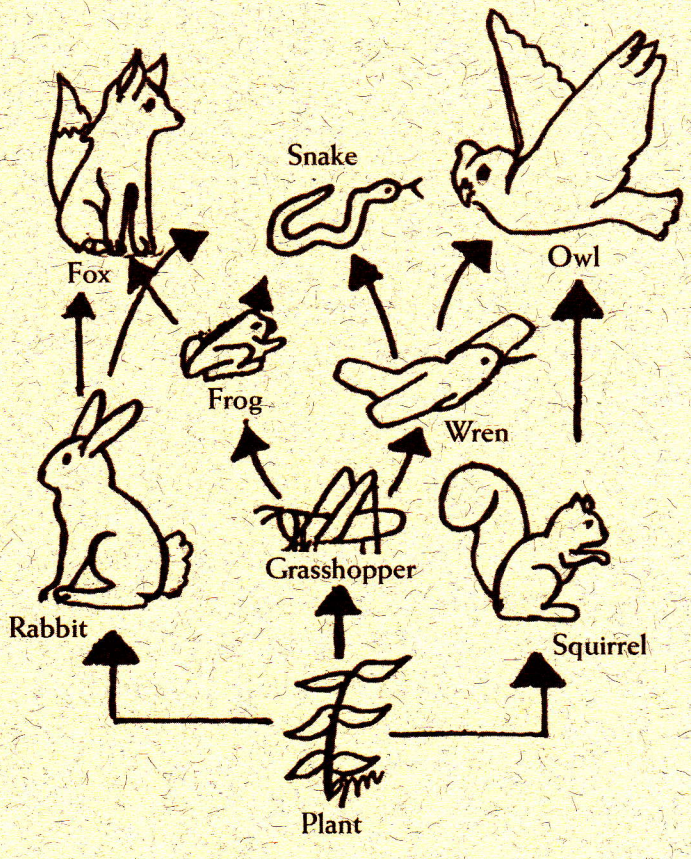


webs are sticky and trap the spider's prey. Some webs simply alert the spider to the presence of insects through a series of vibrations. There are also spiders that do not spin webs. They are predators that hunt their prey.

Were you right? Did your observations help you to predict the existence of many different types of spider webs?

Stop and take time to design a food web for the forest. A food web consists of all the interrelated food chains in an ecosystem (Atkin et al., 1993). Where would spiders fit into the forest food web? First, compare your food web with your friends', then compare your food web with the food web illustrated below.

Forest Food Web

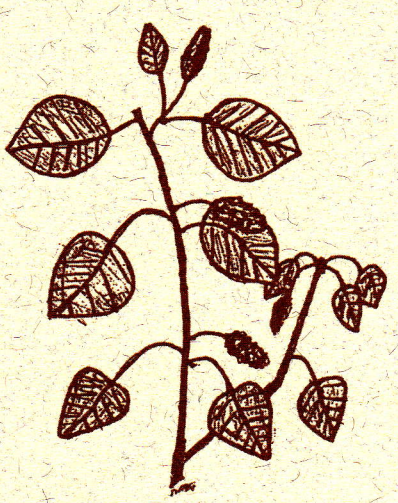


Post 12

Look around Post 12. Has the environment changed? Do you notice different trees at this site? Are the trees larger or smaller? Are you still in an upland forest? Is this area wetter? Can you compare this area with a marsh? Do you see more grasses? Take a few minutes to discuss and record these differences with your friends. Maybe you can even sketch your surroundings.

Look at the trees. Birch (*Betula*), alder (*Alnus*), and willow (*Salix*) are trees common to wetland areas (Mitsch and Gosselink, 2000). Compare your sketches with the illustrations below.

Alder



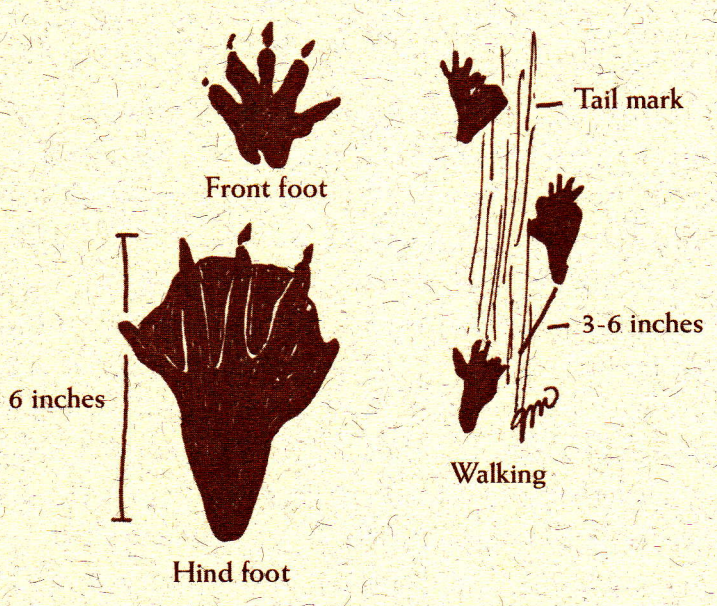
Birch

Willow

Did anyone notice the beaver dam located at this post? What about the man-made levees? There have been several environmental changes at Post 12. Humans have impacted this area by introducing levees to regulate the flow of water. The beaver dam has also altered the flow of water in this area. Beavers change the environment by converting a free-flowing stream into a standing pond that sometimes floods the area. List several environmental changes created by beaver dams. Why do some landowners want to get rid of beaver dams?

Beavers are large rodents that feed on aquatic plants such as water lilies (http://ngp.ngpc.state.ne.us/wildlife/wildlife.html). Beavers also like to eat the green bark or cambium of trees such as poplar, willow, and alder. Did you notice any willows or alders in this area? Use the illustrations above to identify the willows and alders. The beavers use these trees to provide structure and form to their dams. The beaver initially builds the dam with the trees, and then fills in the dam with mud. Examine the stream bank. Look for signs of beavers. Do you see any beaver tracks? Use the diagram (right) to help you identify beaver tracks.

Beaver Tracks



What about the stream inhabitants? Do you think the same kind of aquatic organisms live in a free-flowing stream as a standing pond? Many organisms are specifically adapted to life in free-flowing water. These organisms anchor themselves to prevent being washed away by the stream current. Beaver dams alter the current of the stream. Beaver dams also create new habitats for both aquatic organisms and wildlife. These dams become filters and remove the sediment carried by a stream. As the dam slows the water, stream bank erosion is prevented. Beaver dams store water during periods of drought, and during periods of high water, the dams aid in flood control. These are positive impacts on the environment.

Did you list any negative impacts created by beavers and their dams? Many landowners are concerned because beavers cut down trees. Many of these trees actually benefit due to the pruning provided by the beaver. Landowners are also concerned with the loss of farmland due to flooding caused by the beaver dams. What do you think? Do you think beavers are beneficial? Can landowners learn to live with the beavers? Can you lead a campaign to educate your classmates? Once you return to your classroom, research wetlands, beaver dams, and the environmental impacts of wetlands and beaver dams. Make a campaign poster to promote wetlands and beavers.

Post 13

Before you begin to explore Post 13, reemphasize the importance of the carbon cycle (Post 4) and the nitrogen cycle (Post 5) to the environment. What is the role of decaying plants and animals in the carbon cycle? Does the amount of nitrates in the soil and water affect the productivity of the environment? Can you relate the carbon cycle and the nitrogen cycle to the role of wetlands? Record your ideas, and then share them with your friends.

Terrestrial and aquatic ecosystems are interdependent. As rainwater travels over the soil, it carries nitrates into the streams. Decaying plant and animal matter also moves into the stream through this runoff water. The organic matter contains carbon and provides a food source for the decomposers found in the stream. Aquatic organisms depend on the terrestrial environment to help replenish nutrient supplies such as nitrogen and carbon. Does this information help you link the carbon cycle and the nitrogen cycle to the role of wetlands?

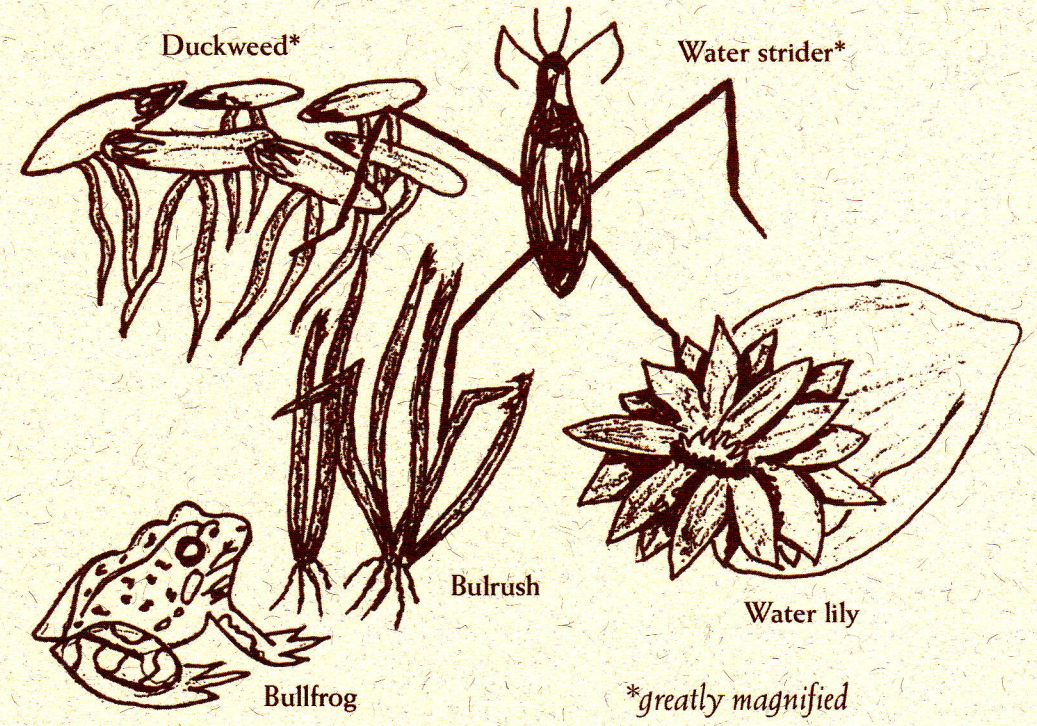
How does soil erosion change the aquatic environment in the stream? Remember the discussion involving the clear cutting of trees during the stop at Post 8? What happens to the soil when the trees are cut? What happens to streams that are located in areas that have been clear cut? Take time to record and share your ideas.

Once the trees are removed, soil, organic matter, and nitrates move into the stream at a faster rate. Does the stream change once the trees are cut? Does the stream become muddy? What happens to the organisms that live in the stream? If the amount of nutrients is increased, the productivity of the autotrophic organisms increases. These organisms release energy through cellular respiration (Post 1). This chemical process uses oxygen. What happens to the supply of dissolved oxygen (Post 1)? Do fish need oxygen? What happens to the fish?

Look over the positive environmental effects of beaver dams from Post 12. Can a wetland mitigate or lessen water problems created due to clear cutting or agricultural runoff? A wetland

is similar to the environment created by the beaver dam. Floodwater is slowed as the wetland regulates the flow of water. The slower flow of water helps to prevent erosion caused by rushing water. Wetlands also trap the soil that is suspended in the water, thus improving the quality of the water. As these sediments are trapped, they settle to the bottom of the wetland.

Over time, new habitats are formed for wildlife and new terrestrial environments emerge from the wetland (Miller, 1990). Look around you. Do you notice any aquatic plants? Are there plants located along the edge of the water? Draw and record these plants in your journal. Did you see any insects, amphibians, reptiles, or fish? Do your sketches look like the illustrations below?



Can wetlands be used to correct some of the environmental impacts created by humans? Take time to list several ways wetlands can be used in your area.

Post 14

During your trek from Post 12 to Post 14, the trail moves along a series of man-made levees. Imagine what this area looked like during the construction of these levees! Take time to draw three pictures. Draw a picture to simulate this area during the time immediately after the levees were constructed, draw a current picture of Post 14, and draw another picture of Post 14 that simulates the appearance of this post in 15 years without the interference of humans. Compare your pictures with your friends'. What do the pictures illustrate? How do environments recover after changes created by clear cutting or levee construction?

In the above activity, you illustrated different stages of ecological succession. Once the vegetation is removed from an area, secondary succession occurs as long as the soil remains fertile (Miller, 1990). Sedimentary deposits or topsoil provides the basis for secondary succession. Annuals (plants that die and reseed each year) appear first. Perennials (plants that live longer than one year) such as grasses are the next to appear. Over a period of time, low-growing shrubs and bushes begin to grow, followed by pines and then hardwoods. The different types of plants create changes in the soil such as pH (Post 1). These changes prepare the soil for new plant types (Tomera, 1989).

From Log to Forest Soil

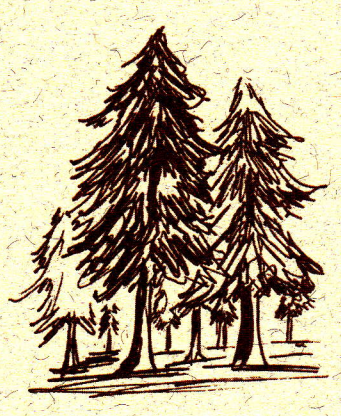
A. Log

B. Lichens colonize the log

C. Lichens replaced by mosses

D. Mosses replaced by grass and flowers

E. Grass and flowers replaced by blackberry and raspberry bushes



F. Forest finally grows where a log once existed

The diagram on Page 20 illustrates secondary succession. What is the importance of the dead log to the environment? What stage of succession does Post 14 currently illustrate? Do you see grasses, small bushes, or large hardwood trees?

Post 15

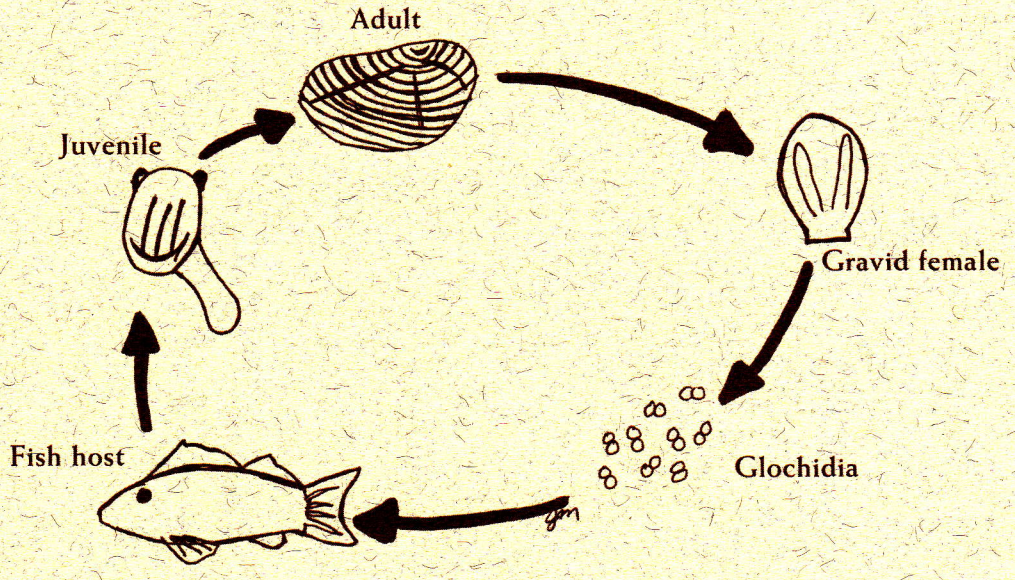
As you complete your trek along the Young Scholars Trail, stop by the freshwater raceways. These tanks are used to simulate freshwater ecosystems under controlled conditions for testing. Many aquatic organisms are studied to determine water quality. Can the health of the organisms, the reproductive ability, or the absence or presence of organisms be used to indicate the quality of the water? What do you know about freshwater mussels?

These mussels are freshwater invertebrates. They are similar to clams. Their shell consists of two halves, and they are often called filter feeders. What do mussels eat? Mussels use their muscular foot to anchor to the bottom of a freshwater stream. They are sessile and do not move around frequently. Mussels are "suspension feeders." They use the water current to bring their food to them. The moving water passes over their gills. The water does not pass through the gills or any other type of sorting structure. Does the term "filter feeder" adequately describe the feeding habits of mussels?

These organisms reproduce sexually. The male releases the sperm in the water and the current carries the sperm toward the female to fertilize the eggs. The life cycle of the mussel includes the fertilized egg, a larvae form (glochidia), the young juvenile, and the adult mussel (www.nature.nps.gov/facts/ftmussel.htm). The glochidia are parasites that depend on a host fish for nutrients. During this stage the glochidia attach to the gills of a fish. Without this host, the glochidia cannot survive. Can you compare this parasitic relationship with the symbiotic relationships discussed at Post 5 and Post 6?

The diagram below illustrates the life cycle of a freshwater mussel.

Life Cycle of a Freshwater Mussel



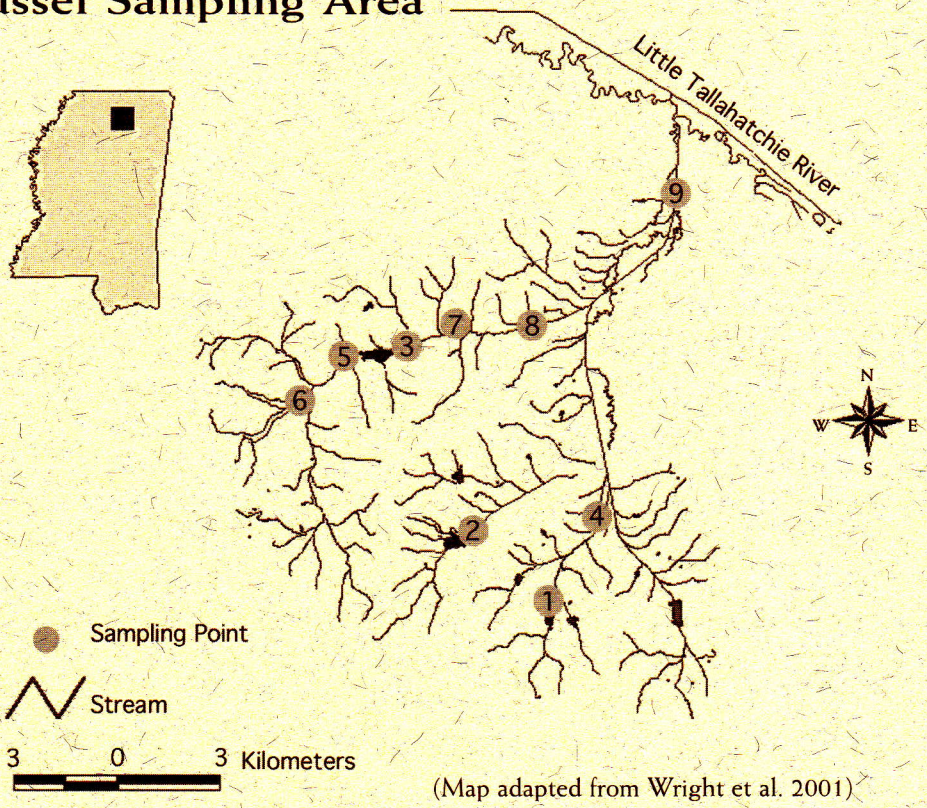
Sketch the life cycle in your journal. Remove the fish from the life cycle. What would happen to the mussel population if the fish disappeared from the stream?

Can mussels be used to determine the quality of water? Use the following data table (Wright, 2000):

Table 1:

Map Location	Location	Common Names	Number of Mussels
1	Cypress Creek, 200m downstream of bridge at CR 252	Little Spectaclecase	1
		Texas Lilliput	1
2	W. Cypress Creek, 60m downstream of Cypress Lake at FS 844-C	Pondmussel	19
3	Puskus Creek at mouth of Tulip Branch, 0.5 miles downstream of Lake Puskus	Pondmussel	5
		Fatmucket	4
		Plain Pocketbook	1
		Bleufer	1
4	E. Cypress Creek, 25m downstream from bridge at CR 251	Texas Lilliput	1
		Fatmucket	1
5	Puskus Creek 1 mile upstream of Puskus Lake	Wabash Pigtoe	1
		Fatmucket	14
		Little Spectaclecase	2
6	Bay Springs Branch of Puskus Creek east of CR 235	Fatmucket	2
		Rayed Creekshell	2
		Giant floater	1
7	Puskus Creek, approximately 1 mile downstream of Puskus Lake at CR 245	none	0
8	Puskus Creek approximately 1 mile from confluence with Cypress Cr. At CR 249	Fatmucket	1
9	Cypress Creek approximately 2 miles from confluence with Little Tallahatchie Canal at CR 244	none	0
	Total		57

Map of Mussel Sampling Area



(Map adapted from Wright et al. 2001)

Looking at the above map of the mussel sampling area, compare and contrast the different sites. Does water quality contribute to the absence of mussels at Post 7 and Post 9? What about Post 5? How does it compare with Post 7 and Post 9? Look at the different species located at Post 3. Does the presence of different species serve as an indicator of stream health? Could the absence of fish in the stream affect the mussel population? Take time to answer the questions and record your ideas. Compare your ideas with those of your friends. Brainstorm ideas for different experimental designs to determine water quality in streams. Can you design an experiment using aquatic plants to test nutrient overloading in streams? As you design your experiment, remember you must have a control to use for comparison.

Conclusion

Take a moment to look through your journal and the ideas, observations, sketches, hypotheses, and experimental designs you recorded as you traveled along the Young Scholars Trail. What did you learn?

One of the main themes of biology is the interdependence of all living organisms. Life is connected at the level of chemical reactions. Carbon dioxide produced during cellular respiration (Post 4) is recycled through the process of photosynthesis. Necessary nutrients such as carbon, nitrogen, and water are continuously recycled and reused.

The abiotic factors influence the adaptations of the biotic factors. The biotic inhabitants adapt to their environment over time to maintain life. All life requires food, shelter, safety, land space, and the ability to reproduce. Each organism fills a necessary role in the cycle of life whether it is a consumer, producer, or decomposer. Organisms are interdependent. They fill a niche in the local environment that meets their needs and contributes to the needs of the local food web. Sometimes humans disrupt the local food web by introducing foreign species to the food chain or through land-management practices such as clear cutting. The environment usually recovers from human interference through succession, but recovery takes time. Remember all life, including humans, is interdependent.

What did you learn about the application of scientific inquiry? Don't forget to take your observations and test them. Make sure your experimental designs include a control. Be sure to test your hypotheses more than once so you can average your data. Use your data to support your conclusions, and always remember to use scientific inquiry to find the answers to your questions.

Thanks for your participation, your observations, and your enthusiasm as you traveled through the Young Scholars Trail. Also, thank you for protecting our trail and the ecology of our local environments.

Learning Objectives

Learning objectives for the nature trail are directly related to the Mississippi Science Framework (1996), specifically to Biology I.

- Identify the characteristics of all living organisms.
- Compare and contrast abiotic factors and biotic factors in an environment.
- Explain the effect of abiotic factors on the biotic factors in an environment.
- Apply scientific inquiry to explain our natural environment.
- Compare and contrast different ecosystems.
- Explain the interdependence of various ecosystems and the interdependence of the organisms in these ecosystems.
- Relate the carbon cycle, the nitrogen cycle, and the water cycle to the needs of living organisms.
- Relate changes in the different ecosystems to natural changes in the environment or to the influence of humans.

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As a teacher, I rely on many different teacher reproducible resources to enhance my teaching methods. I would like to mention several publishers specifically since several of my ideas for this field guide were inspired through their resources. Many thanks to the following publishers: J. Weston Walch, Portland, Maine; Frank Schaffer Publications, Inc., Torrance, California; The Center for Applied Research in Education, West Nyack, New York; and Good Apple, Carthage, Illinois.

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Most of all I would like to thank my family, Gary, Josh, and Haley, for their continued help and support.

Phyllis Jenkins
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Notes

About the Author

Phyllis Jenkins has created an interactive learning program for high school biology students through the text of the *Guide to the Young Scholars Nature Trail*. She designed this trail guide to provide an applicable approach to basic biological objectives that are related to the Mississippi Science Framework. The Young Scholars Trail guide paints a vivid picture of and creates a greater understanding of the often unseen world around us.

Mrs. Jenkins intends to use this trail guide as an interactive supplement in the biology classroom. This trail guide also provided an opportunity for Mrs. Jenkins to integrate biology with art. Through collaboration with Mrs. Joan Vaughn, Mrs. Jenkins provided real-world experience to several Lafayette High School students, including Kelly Houston and Jennifer Murchison. Their illustrations create a "user-friendly" quality throughout the trail guide.

Mrs. Jenkins teaches Biology I and Advanced Placement Biology at Lafayette High School. She also attained National Board Certification for Teachers in October 2000. Currently, Mrs. Jenkins is completing the necessary requirements for a M.Ed. degree in curriculum and instruction at The University of Mississippi. Through the development of the *Guide to the Young Scholars Nature Trail*, Mrs. Jenkins continues to display her commitment to the classroom and the educational experience of her students.

James Keith Davis
Principal
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About the Artists

Kelly Houston is a junior at Lafayette High School. She participates in Future Farmers of America, National Art Honor Society, and Spanish Club. Kelly is also vice president of the Beta Club and a junior class representative for the Lafayette High School Student Council. Kelly received the Outstanding Student Award in Horticulture and Landscaping from the Oxford & Lafayette Business and Industrial Complex. She also received a scholarship from the Oxford Garden Center that allowed her to participate in a horticultural summer seminar offered through Mississippi State University. Kelly plans to attend college and continue her education in the following areas: botany, biology, landscape design, sign language, and art.

Jennifer Murchison is a sophomore at Lafayette High School. She participates in Students Against Drunk Driving and Mu Alpha Theta. Her hobbies include sketching and collecting music. Jennifer has been a member of Gateway Art for the past four years. In 2001, she was honored as "Most Talented Student in Advanced Art for Who's Who Among Lafayette High School Students." Following high school, Jennifer plans to attend college and continue to study art and graphic design.

P.S.J.

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