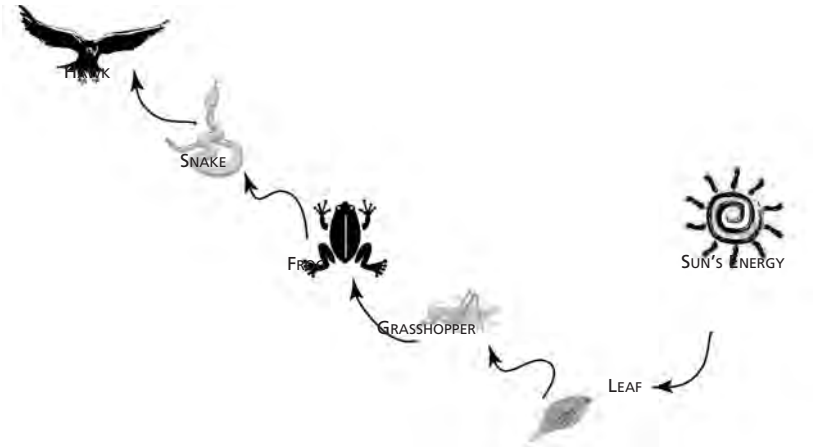
Circle of Life: Ecology

Activities for the Classroom

Introduction

The Circle of Life: Ecology activities included here introduce students to the various issues that impact the health and life of an ecosystem. Students examine various components of an ecosystem and discover how interdependence is the key to the health and survival of an ecosystem. Through water quality sampling, modeling of food chains and creating model ecosystems, students investigate the natural and human actions that impact and upset the balance of our plant and animal life.

This activity kit contains step-by-step instructions on how you can enrich your student's knowledge of ecology. This activity kit includes an overview of the course, activities and investigations you can do with your students together, and a resource list of web sites and books.



Overview

Throughout The Circle of Life: Ecology activities students examine the unique roles that are present in our environment and the types of organisms that carry out these responsibilities. Utilizing personal observations, recorded data and the skills of scientific investigation, students draw and present their own conclusions as to the health of their ecosystems.

Taking these first hand experiences, students focus their attention on answering and discussing the following questions:

- How does asking scientific questions and conducting investigations help us make connections to our present day natural world?
- How can research and inquiry lead to new understandings?

Students focus on two enduring understandings:

- Organisms within the ecosystem are linked to one another
- Organisms perform life processes that are essential for survival and perpetuation of the species

During the course, students conduct the following scientific explorations:

- Identify the survival needs and interactions between organisms and the environment
- Research the biomes of the world and characteristics associated with each major region
- Cite evidence of plant and animal adaptations based upon geographical location and climate
- Identify and give examples of food chains and food webs in a variety of habitats
- Cite evidence that individuals and groups of organisms interact with each other and their environment
- Classify organisms in a habitat based on the function they serve
- Experiment with variables in aquatic and terrestrial environments
- Describe the potential effects of human decisions on ecosystems
- Identify contributors of local pollution sources
- Use pH information about an aquatic ecosystem to determine the health of the ecosystem
- Design experiments to test scholar-derived hypotheses

Students learn to be scientists by collecting, organizing and analyzing data, and compare different elements in order to confirm their findings. In addition, they develop their communication skills in presenting the results of their findings.

The following activities, books and web sites will allow your students to extend these connections within their communities. Ecology is all around us. Students can dive into exploration right where they are, right now!

Suggested Projects For The Classroom

Extending Biomes

There are six main biomes that exist throughout the world: tundra, temperate forest, marine, desert, grassland and tropical rainforest. Biomes are larger communities that have the same kind of plants and animals; within one biome, many ecosystems exist. Each of these geographic regions has unique traits and climates that mandate the species that live there to adapt.

In this activity, your students can construct a diorama illustrating a biome or a 3-D biome (using plaster of paris).

Materials needed for a diorama, depending upon type of activities and animals and plants displayed:

- Cardboard box or plaster of Paris strips (Both can be found in local craft stores)
- Paints or crayons
- Tape
- Pictures from magazines

Sequence of events:

- Students should begin by thoroughly researching the characteristics of biomes.
- Select one biome to explore in depth, including the activities that exist in the climate, the types of animals and types of plants typically found in the biome.
- Using the cardboard box as the backdrop, portray the biome in paint or crayon. Pictures can be created or cut out of magazines to portray various activities and trees, etc.
- An alternative activity is to create a 3-D model of the world and its major biomes. Use the plaster of Paris strips to cover a balloon and let it dry. Create a base for your model by layering multiple strips on top of each other. You should also leave a small section of the balloon uncovered to allow you to deflate and remove the balloon. It is recommended to allow the balloon to dry for a full 24 hours. Once dry, prick the balloon and deflate it. Make sure to remove the balloon from the mold. Draw/cut out pictures of each biome and glue to the model. Your students may also want to draw an outline of the continents first to serve as a reference.

An alternative activity on biomes is creating environmental pictures of the biomes using sand art.

Materials needed for this project are the following:

- Assorted colors of construction paper
- Several pieces of standard tracing paper
- 1 bottle of glue
- Colored Sand (you can also buy regular sand and dye it using food coloring.)
- Pictures of six major biomes (These can be found in books from the library and/or websites. Some suggestions are:
  - *http://mbgnet.mobot.org/sets/*
    This website provides detailed information of the major biomes including unique traits, locations in the world, and animals native to this area.

- *http://www.cotf.edu/ete/modules/msese/earthsysflr/biomes.html*
  Another good reference source with facts and descriptions of major environmental systems. Also contains additional activities to complete with your child.
- *http://earthobservatory.nasa.gov/Laboratory/Biome/*
  Hosted by NASA, the main features of this site include a glossary on biomes, maps/locations of the world and interactive activities.

Sequence of events:

- Spend some time with your students recalling some of the characteristics/traits of the major biomes.
- Have your students find pictures in magazines or websites that are characteristic of these places.
- Place the tracing paper on top of the biome picture and carefully make an outline of the scene.
- Apply the glue to the outline. Shake sand onto the picture and remove any excess. Let the sand dry.
- Make sure to fill in trees, plants, mountains with the appropriate colored sand to create an authentic representation of the scene.

Have your students research the process of photosynthesis, the food-making process that occurs in green plants. It is the most important process that takes places in plants. This reaction occurs in the green chloroplasts within the cells of plant leaves and stems. These chloroplasts contain chlorophyll, which absorbs sunlight. Photosynthesis means "putting together with light."

Procedures for Observing Photosynthesis

1. Get a variety of small plants.
2. Coat the underside of a leaf with a heavy coat of clear fingernail polish (probably five or six layers). When the polish is dry, carefully peel it off the leaf. Place it on a slide and look at it through a microscope. Draw what you see. [You are seeing guard cells surrounding the stomata and epidermal cells.]
3. To observe transpiration of water vapor from a plant's leaves, place a plastic bag over the green leaves of a plant and close with a twist tie or rubber band to seal the bag. Put the plant and plastic bag in bright sun or under a lamp for 24-48 hours.
4. Observe the bag every couple of hours. What begins to collect inside?
5. Remove the bag from the plant.
6. The water in the bag has been produced by respiration and photosynthesis, but its release into the bag from the leaf is due to transpiration.

Extend your student's understanding of this activity with the following questions…

1. What is the function of plant leaves?
2. What is transpiration?
3. Explain the differences between respiration, photosynthesis and transpiration. Create Venn diagrams to illustrate those similarities and differences.
4. Explain why transpiration and respiration are important to other living things on earth.

Additional Extension Activity

Try the same activity with several variables such as a plant that is very dry, one that is kept in the dark, or another kept at a lower temperature than that of the other plants. Do they all release moisture into the bag?

Home Away From Home

Understanding Life in a Terrarium

Organisms have basic needs, which for animals are air, water and food. Plants require air, water and light. Organisms can only survive in environments in which they can meet their needs. The world has many different environments, and distinct environments support the life of different types of organisms.

Discuss with your students the importance of a terrarium including all of the essential elements of a habitat: food, water, air, shelter, space and light. If living things are put together randomly without care for providing for their needs on a long term basis, the result is simply "bugs in a jar," not a terrarium habitat. All organisms will need food and water in order to become established in their new home. Animals will need a place to hide similar to what they have been used to. A successful terrarium habitat will support the life cycles of the organisms living there, enabling at least some of the plants and animals to reproduce during the time it is set up. Some organisms will become part of the food chain for other inhabitants.

Setting Up Your Very Own Terrarium!

Before you get started, please see the General Guidelines for Setting up a Terrarium on the following pages.

1. Cover the bottom of the terrarium with 3 to 4 cm of gravel for drainage.
2. Dig a section of soil 6 to 10 cm deep and transfer to terrarium, disturbing as little as possible. If the ground is hard, water it lightly the day before digging.

3. Dampen the soil if it is dry and provide for a water source.
4. Dig up small plants, being careful not to disturb their roots. Repair the area from which the soil and plants were collected.
5. Scoop out a small hole in the terrarium's soil, add plants, cover the roots and press down gently but firmly.
6. Add rocks, sticks, a layer of leaves, or whatever shelter will make it look as much like "home" as possible.
7. Keep the soil damp but not soggy. If needed, spray occasionally to dampen the surface.
8. Add various animals a few at a time. Keep in mind their need for space and don't overpopulate. Don't forget earthworms and other underground dwellers if they are part of the natural habitat.
9. Check every day, adding food and water and making adjustments as needed.
10. Wrap a clear terrarium with black paper as high as the soil line. Burrowing creatures will be more likely to work near the sides where they can be checked on occasionally.

General Guidelines for Setting up a Terrarium

Containers

- All sorts of containers will work: glass or plastic aquariums, plastic boxes, large jars, kitchen storage containers, tubs or anything that can hold a reasonable amount of water or moist soil and be enclosed securely enough to prevent escapes.
- Used containers are fine. Check for leaks if an aquatic or particularly soggy terrarium is planned. Repair with aquarium sealant from a pet store.
- If the container is glass, heavy or flexible, put it on a board or piece of plywood so that it can be moved easily and safely if necessary.
- Everything used should be biologically clean. This means that all tools and containers used for both setup and maintenance should be washed well first (scrub, but don't use soap), then rinsed very thoroughly. Don't use chemicals.
- Keep a secure lid on the terrarium.
- If the container has clear sides, wrap a strip of black paper around the outside as high as the surface of the soil. Dirt-dwelling critters will then be more likely to burrow close to the sides where the students can observe them.

Adding Plants and Animals

- Balancing a terrarium involves making mistakes and learning from them. Not everything put in a terrarium is necessarily going to thrive or even survive. When something dies, analyze whether this was in the natural course of things or whether the balance in this small ecosystem is not where it should be, and make adjustments accordingly.
- A true habitat involves predator-prey relationships. If some of the animals require live food, or if the food supply in the terrarium becomes exhausted, additional food will need to be provided.
- Start small, get it balanced, and add cautiously.
- When digging up small plants, include as much of the root system as possible and keep them damp while transporting them. Put them in a terrarium and give them a chance to get established. Give them room to grow and spread. Determine how much water they will need and how often they will need it.
- Add a few creatures and see how they do. Then add more creatures as seems appropriate, keeping in mind that this is a very small habitat. Overcrowding inevitably leads to disaster.

Dismantling

When it is time to dismantle a terrarium, return all animals to the area where they were collected under conditions in which they can survive. If this is not possible, release them in a similar area where other animals of the same type are observed.

Easy-to-Make Equipment

Housing – Terrariums

Plastic or Glass

Many plastic or glass containers can quickly and easily be turned into suitable terrariums as long as they can be completely enclosed so as not to allow inhabitants to escape. Often all that is needed is a secure vented lid.

Clear-sided containers make the best terrariums for classroom viewing. Basic five, ten, and fifteen-gallon aquariums can be purchased at pet stores or through catalogs. Other possibilities include gallon jars, plastic storage containers, plastic shoeboxes, dishpans, and so forth.

Screen Cages

A terrarium housing larger flying insects, such as butterflies or ladybird beetles, can be made from a piece of aluminum screen and two round containers at least 3-4 cm. deep, such as cake pans or potted plant saucers. Form a cylinder with

the screen, measuring so that it will just fit inside the round containers. Fasten the seam with hot glue or sew it with wire, taking care that no gaps occur.

Stand the cylinder on end in one of the round containers and secure it with plaster of Paris or hot glue. When it has hardened, add soil or sod. Use the other round container for a lid. Potted plants or cuttings with aphids or other food supplies can be added as needed. If the cuttings are in water, seal the openings of their containers so that terrarium inhabitants don't fall in and drown. As in other terrariums, a dampened piece of sponge or cotton ball is a good source of moisture.

Note: Insects tend to be less active when the surrounding temperature is cool. Keep this in mind when opening the container.

Terrarium Covers

Choose gray or silver plastic fiberglass screening to allow more light into the terrarium.

1. Measure a piece of lightweight flexible screening
   - 5-cm wider than the width of the terrarium
   - 5-cm longer than the length of the terrarium
2. Cut 5-centimeter wide strips of heavy cardboard (corrugated is fine)
3. Spread the screen out on a work surface. Place the cardboard strips on the screen to form a rectangle with the inside corners not quite touching. The cardboard should cover about 5-cm of screen on each side. Use the grid on the screen to guide you as you line up the strips.
4. Staple the strips of cardboard to the screen at roughly 5-cm intervals. When all strips are in place, check the fit on the terrarium. You should be able to put on and take off the cover easily, but there should not be much space between the cardboard and the rim of the terrarium.
5. Use a hot glue gun to secure the screen to the inside of the cardboard. Be careful-hot glue runs easily through the spaces in the screen. If needed, apply pressure with a piece of scrap cardboard.
6. Line up the 5-cm width of each cardboard strip and tape securely together to form the corners of the lid. A triangular pouch of screen will form on the inside of each corner.
7. Again, check the fit of the lid on the terrarium. Adjust if necessary by re-taping the corners.
8. Flatten the pouch in each corner against one of the adjacent sides and tape it along the edge so it lies flat.

For Gallon Jars

1. Measure a square of lightweight flexible screening about 5-cm wider than the diameter of the mouth of the jar. (Measurements can be approximate.)

2. Cut 2.5 cm wide strips of manila folder or tagboard 3-cm longer than the circumference of the mouth of the jar.
3. Wrap one of the tagboard strips around the mouth of the jar and secure it with a glue gun. Check the fit on the jar. You should be able to put on a take off the cover easily, but there should not be much space between the cardboard and the glass. Trim it to be flush with the top of the glass rim.
4. Work with the tagboard ring on the jar to give it stability. Center the square of the screen across the top of the ring. Put a dot of hot glue on the outside of the ring and tack down the screen. Repeat directly across the ring. Tack twice again halfway between the first two spots, each time gently pulling the screen tight.
5. Run a line of hot glue out from each tack spot to secure the screen. As the excess screen begins to protrude, make a flat "hospital corner" and glue it down. Trim excess screen from the bottom of the ring.
6. Tack the middle of the second tagboard strip to the screen, placing it so that the bottom edge barely rests on the shoulder of the jar. Continue gluing all the way around until the second strip covers the first strip and the screen.
7. Trim any excess tagboard from the top of the ring.

For Gallon Jars
If you are using a plastic shoe box or similar container with a lid and want it to be a permanent terrarium, cut out most of the plastic in the center of the lid and use a glue gun or model cement to secure a piece of screen to cover the hold. Be sure that the glue line is uninterrupted all the way around the screen so that nothing will be able to escape. Do not use white glue. An option is to poke vent holes in the lid with a heated nail or ice pick, or use a drill.

Quest for Your At-Home Terrarium

1. What food chains are already present in the terrarium?
2. Which of the organisms in the terrarium are consumers? Which are producers? Which are decomposers? How do you know?
3. Which plants or animals might be safer in the terrarium because they are away from their natural predator (s)? Explain.
4. Have any of the plants or animals been eaten so far? What has been done to replace what has been eaten?
5. What substitute foods could you try to use instead of what might be found naturally in the playground habitat?
6. How do you think you might be able to tell if all of the critters are getting the food they need?

Extending the Concept of Decomposers
Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some micro-organisms are producers – they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem.

Soil consists of weathered rocks, decomposed organic material from dead plants, animals and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.

Decomposers have the important job of eating and changing dead plant and animal material into very small pieces. As they do so, they leave droppings which are food for other animals or which become an enriching part of the soil. Thus nutrients return to the soil so that it can continue to support plant life.

Leaf litter is an organic mixture consisting mostly of dead leaves. It may also include other plant material and the droppings and remains of animals. When leaf litter piles up, such as, under a tree or against a wall, it becomes a habitat in itself, providing for the needs of many different animals.

The organisms that visit or dwell in this special habitat typically are most active among the bottom layers, working on the rich material around them. Earthworms, certain types of insect larvae and other tiny critters in the dirt pull down the bottom layers of decomposing material and continue the process underground.

Not all decomposers are animals. Bacteria and a few kinds of plants that have no chlorophyll and thus can't make their own food (fungi, saprophytes) are also found in leaf litter, especially when it is in a damp, shady area.

Procedures

1. Set up the Berlese funnel early in the day (please see assembly instructions under the section titled "Building Your Berlese Funnel" on page 13. It is most effective when the light is on for several hours. Use a screen or net with small enough spaces to keep the soil itself from falling through the funnel, but large enough to let the tiny animals get through. Standard window screen (1-2 mm spaces) or hardware cloth with 1/8" spaces will work well for most types of soil.
    a. If possible, have your students collect the leaf litter so that they will be able to observe the layers of decomposition in progress. Try to collect from an area under a tree or bush that has not been

disturbed recently. You should be able to see organic material (leaves, twigs) mixed in with sand or clay as well as some visual evidence of critter life – worms, ants, sowbugs, etc. Do NOT use potting mix because it has been sterilized.

2. Your students will need a holding container (plastic cup, margarine dish, jar lid, etc.). If you are using a microscope, use clear plastic holding containers that will fit the stage of the microscope. Flexible plastic cups can easily be cut down to size.
3. Review the distinguishing characteristics of insects (three body parts, six legs) and spiders (two body parts, eight legs) when your students attempts to classify animals in their sample.
4. A slightly dampened cotton swab is useful for transferring tiny creatures to the holding container. The edge of an index card may also be used.
5. If you have access to "bug boxes" (plastic containers with a built-in magnifier) or Discovery Scopes, these will enhance what your students are able to see.
6. Give your students a large spoonful of the soil/leaf litter, toothpicks for probes, a damp cotton swab, a holding container, and a hand lens. Encourage them to investigate their sample carefully. Demonstrate the use of a damp cotton swab to pick up the smaller critters and put them in a "holding" container lined with a damp paper towel. Point out that these creatures live in a damp habitat and need the moisture in the holding container so they won't dry out and die.
7. Ask your students why they think these dirt dwellers exist. Have them project what would happen in the area where the leaf litter was collected if all these critters disappeared. Guide them to understand that many different tiny animals live in the soil and dead leaves, and that their job is to eat the dead plant and animal material that falls on the ground. Talk about decomposers and the importance of their particular role in the food chain and in the habitat.
8. Ask your students what they might expect to find in the container under the Berlese funnel. Encourage them to offer ideas of reasons for each part: Why heat and light? Why moisture in the container? Why black paper? What do they think may have happened to the soil sample and whatever was living in it? Guide them to understand that a dirt dweller's natural environment is dark and damp, which means that they can be expected to move away from the heat and light of the lamp.
9. Encourage your students to design a graph or Venn diagram and use their drawings to show the variety of creatures and how many of each species were found.
10. At the end of the activity, have your students return their sample to the container. If possible, take the animals and soil back to the original site. As you release them to continue their work of decomposition, you will have a good opportunity to stress the importance of the job these creatures do.

Follow-Up Questions to Extend Higher Level Thinking Skills

1. What kinds of animals did you find? How are they alike or different? Describe what you found in such a way that if other groups found similar organisms, they could identify them by your description.
2. In what ways do these creatures seem well-suited to live in the soil? What do you think they eat? Where do you think they get the water they need?
3. What other kinds of things did you find in the sample? What parts of the soil were non-living (never living)? What parts were once living and now are dead and decomposing?
4. What would happen to a habitat if there weren't decomposers? What is important about their particular role?
5. Do you think this sample is a good representation of life found in the soil in the habitat from which it came? Explain. If you took other samples from this habitat, would you expect similar results?

Activity Extension

1. Compare the diversity and density of life found in different types of soils and soils from different locations.
2. Use the Berlese funnel to compare population densities of different types of animals from several different locations. Look for variations in such things as type of leaf litter, type of soil, comparative dampness of soil, exposure to direct sunlight, etc.

Building Your Berlese Funnel

1. Use a utility knife to cut the neck from a two-liter bottle.
2. Invert the neck portion to make a funnel. Roll a cone of black construction paper to fit inside the funnel.
3. Cut a small piece of screen or netting and tape it so that it covers the small opening of the paper cone. Put the paper cone with screen attached inside the plastic funnel.
4. On a paper towel, trace around the bottom of the holding container; cut out the circle and put it on the inside bottom of the container. Dampen it.
5. Put the holding container inside the bottom portion of the two-liter bottle. Rest the funnel half above it with the spout directed into the holding container. Wrap the entire apparatus with black construction paper and secure.
6. Put about a cup of soil/natural litter combination inside the funnel. Arrange the light source so that it shines directly on the top of the funnel at close range. Wait several hours or until the soil/litter has become brittle and dry.

Understanding Your Habitat Creatures

Beetles

Background Information
There are more varieties of insects than any other animal, and there are more kinds of beetles than any other insect! So far, scientists have identified about 500,000 different species of beetles. All beetles have four life cycle stages: egg, larva (worm-like grub), pupa and adult. In a balanced terrarium situation, the beetles may reproduce so that each stage of the life cycle can be observed (the eggs may be microscopic).

Beetles found on school playgrounds are likely to be good beetles or scarab beetles, but there are many possibilities. A good field guide or help from a local entomologist or wildlife center may help identify the beetles and determine what they eat. Mealworms, the larvae of darkling beetles, are available in pet stores. Easy to raise in the classroom, they thrive in 4-5 cm of oats, cornmeal, or brain, plus potato, zucchini, apple or other firm fruit or vegetable as a source of moisture.

Setup
Use 2-3 cm of small gravel, covered with 3-5 cm clean sand or dirt. Make it deeper at one corner for burrowing. Add a flat rock, chunk of bark or small piece of wood for beetles to hide under. Keep another corner constantly damp as a source of water. Growing plants aren't necessary; they will be uprooted and possibly eaten.

Maintenance
Add water to the damp corner every day.

Centipedes

Background Information
The name centipede means "100 feet," but they actually have anywhere from 15 to 175 pairs of legs. Their long body has many segments, but unlike millipedes, each body segment has its own pair of legs. Centipedes eat earthworms and insects, using the hooked fangs on their first segment to inject venom into their prey. They are nocturnal and prefer staying out of sight in underground burrows or beneath dead leaves, rocks, and logs.

Setup
Use 2-3 cm rich forest soil, potting soil, or peat moss; add decaying wood and leaf litter. Keep moist, not soggy, at all times. Provide a chunk of bark large enough for them to hide under.

Maintenance
Keep a piece of potato in the terrarium for the sowbugs; keep soil damp all the time; take out rotting food; mist with water daily.

Crickets

Background Information
Crickets have three life stages: eggs, wingless nymphs which look much like small adults, and adults. They have long hind legs for jumping, wings which are too short to enable them to fly, antennae which are often longer than their body and two tail-like structures called cerci at the end of their abdomen. The familiar cricket song is produced by the male rubbing his wings together. Each wing has a file, a thick vein with cross ridges, and a scraper with a sharp edge. A cricket chirps by rubbing the scraper of one wing across the file of the other.

Setup
Put clean sand (no salt) 2-5 cm deep in bottom container. Put large, clean gravel in a dish and cover with water so the crickets can drink without falling in and drowning. Provide dry grass, dead leaves, toilet paper tubes or egg carton pieces piled up for crickets to hid in. (Very important to prevent territorial battles.)

Maintenance
Remove molding food and droppings; keep habitat dry and warm (27-32^{o}C or 80-85^{o}F). Crickets will survive at lower temperatures but will not do as well or grow as fast.

Isopods (Sow bugs, Pill bugs, Roly-polies, or Wood Lice)

Background Information
Isopods are related to lobsters and crayfish and are among the few examples of land-dwelling crustaceans. They must live in damp places since they breathe through gill-like structures. Isopods are not insects, but like insects they are members of a larger group called arthropods and they have the characteristic hard outer body covering and jointed legs. They also have two pairs of antennae which may have special humidity receptors. They generally eat decaying vegetation. Female sow bugs protect their eggs by carrying them in a special pouch under the abdomen. Pill bugs, also called “roly-polies,” roll up when disturbed, but sow bugs do not.

Setup
Use 2-3 cm good garden or forest soil or potting soil; add decaying bark and leaf litter; perhaps rest a piece of cardboard on a few pebbles to provide a dark sheltered area.

Maintenance
Remove rotting food and replace with fresh as needed; sprinkle or spray soil to keep it constantly damp but not soggy. In a balanced situation they will reproduce fairly quickly.

Ladybugs

Background Information
There are about 5000 different kinds of ladybugs. They come in a variety of colors including red, orange, yellow and black. Their spots come in different patterns too, or they may have no spots at all. Although most kinds are helpful, there are a couple of types that damage plants. Ladybugs have continued to be one of our most helpful insect predators. Other animals don't like to eat ladybugs because they have a very bitter taste.

Setup
Include an aphid-covered plant or branch. If a branch is used, put it in a container of water and cover the opening of the container with foil so the ladybugs don't fall in and drown. Add a wet cotton ball for water. Mist with water to provide droplets for drinking.

Maintenance
Replace aphid-covered plant whenever needed and be sure to change the water in its container.

Snails and Slugs

Background Information
Snails and slugs are part of a group of animals called mollusks, many of whom live in the ocean. Their relatives include clams, oysters, squids, and octopuses. Snails have a thin, one piece spiral shell, but slugs have only a small internal shell or none at all. They produce and travel on a "slime trail" which protects them from sharp or rough areas in their path. Their eyes are on stalks and can distinguish light from dark. Most use a radula, a sandpaper-like tongue with hundreds of tiny teeth, to scrap algae or green plants, but a few types are predatory.

Setup
Use 2-4 cm moist soil for burrowing, branches to climb on, damp sponge for constant moisture.

Maintenance
Replace food if it begins to mold. Keep terrarium cool and damp at all times, away from direct sunlight or source of heat.

Macroinvertebrates

Macroinvertebrates are invertebrates which can be seen without the aid of a hand lens or microscope such as mayflies, dragonflies, shrimp, sow bugs, snails, clams and leeches. These organisms may spend all or part of their lives in water and they are often used as one of the indicators of water quality. If your student wishes, he or she may choose to examine several water samples from different streams or observe one stream over time. The following are directions for these types of projects.

Materials needed:

- A stream or pond
- Bucket or ice cube tray
- Scoop or ladle
- Magnifying glass
- Collecting net (can also use a nylon stocking)
- Strainer (helpful to sift through bottom debris)
- Turkey baster
- Thermometer (non-mercury)

Collect samples from:

- The shallow water, where plants grow near the edge
- The surface of the pond, where the air and water meet
- The bottom of the pond

Procedures:

- Wade into the stream and place your net so the mouth of the stream is facing the flow of the water
- Carefully pick up and rub stones directly in front of the net to remove attached organisms
- Place the organisms into the ice cube tray or bucket with stream water in it
- Record the types of organisms found in the stream
- Record the temperature of the water and air
- Observe the amount of pollution in the stream

Your students can look at two different collection sites with different surrounding land uses. For example, compare an area which is surrounded by farmland to an area which is surrounded by a wooded tract or by homes. Students can then compare the results of their survey and analyze why they might differ. Your students may also be interested in creating an aquatic insect collection or a photo journal on water quality.

An excellent source for macroinvertebrates is Pond Life: Revised and Updated, by George Reid, Sally D. Kaicher and Tom Dolan (A Golden Guide from St. Martin's Press, paperback). This guide describes and illustrates, in full color, the plants and animals that live in or near ponds, streams and wetlands. It also includes suggestions for where and when to look, observing and collecting specimens and making exciting discoveries.

A very helpful web site is: http://www.epa.gov (stream monitoring, EPA Student Center) and Biology for Kids (http://www.biology4kids.com/index.html) which includes a section on invertebrates. There are also many other web sites dealing with various aspects of the environment and water pollution, for students interested in pursuing other related topics.

Books to Read

Burnie, David. **How Nature Works/100 Ways Parents and Kids Can Share the Secrets of Nature.** Putnam Publishing Group.

Vancleave, Janice Pratt. **Biology for Every Kid: One Hundred One Easy Experiments That Really Work.** John Wiley & Sons Inc.

Kneidel, Sally Stenhouse. **Creepy Crawlies and the Scientific Method: More Than 100 Hands-On Science Experiments for Children.** Fulcrum Publishing.

Roa, Michael L. **Environmental Science Activities Kit.** Jossey-Bass, 2002
32 detailed experiments designed with Junior High school students as the target audience, covering everything from water issues to energy issues.

Needham, Bobbe. **Ecology Crafts for Kids.**
50 Great ways to make friends with planet earth.

Web Sites

National Institute of Environmental Health Sciences
http://www.niehs.nih.gov/kids/home.htm
This site provides games, stories and jokes having to do with environmental science.

Discovery School
http://school.discovery.com/
Discovery School, a section of the discovery.com site, gives students, teachers and parents' wide access to a variety of articles and stories concerning science and discovery.

Earth and Sky
http://www.earthsky.com/
The web site for this popular radio program allows you to access both the radio program itself, along with links to other science sites and provides discussion forums for students.

Energy Quest
http://www.energyquest.ca.gov/
This web site devotes itself to frequently asked questions about energy and conservation. Also featured is the "Ask Professor Quester" section in which common energy questions are answered.

Kids do Ecology
http://www.nceas.ucsb.edu/nceas-web/kids
This site, hosted by the University of California at Santa Barbara, is devoted entirely to young students and their questions and roles in ecology, from marine mammals to conservation projects.

The National Parks Service: Links to Learning
http://www.nature.nps.gov/studentsteachers/linkstolearning/index.cfm
The National Parks Service web site provides students with locations and information about the parks nearest to them.

Y.E.S. Publications
Minibeast World is an informal magazine filled with fun and facts for children with an interest in minibeasts (insects, spiders and other arthropods). Y.E.S. Publications. *http://members.aol.com/YESbugs/pubmenu.html*
They also publish the *CyberBugs Minibeast e-Magazine,* a monthly e-mail publication that features minibeast information, trivia and activity ideas.

Places To Visit

Liberty Science Center, Jersey City, New Jersey
Liberty Science Center, a short drive from New York City, offers Invention, Health and Environmental-themed floors, along with hands-on experimentation and an in-house IMAX theater.
http://www.lsc.org/

The New York Hall of Science
The New York Hall of Science is one of the largest in the New York Metropolitan Area, boasting a Biochemistry Discovery Lab, an exhibition of Nobel Prize winners and a "science playground", among others.
http://www.nyhallsci.org/

The Science Museum of Virginia
The Science Museum of Virginia, located in Richmond, contains a "Science of Investigation" exhibition, along with an IMAX theater and exhibits focusing of life sciences and physics.

The Smithsonian Institution Museums, Washington, D.C.
The Smithsonian Institution is composed of 15 museums in Washington, D.C., along with research centers and archives in the area. The exhibits change frequently, and it's best to call ahead to a specific museum to inquire about programming.
http://www.si.edu/

United States Botanic Garden, Washington, D.C.
Garden contains revolving exhibits of plants, flowers and vegetation unique to many different parts of the world. Highlights include family classes and a children's garden.
http://www.usbg.gov/

University of Virginia's Historic Blandy Experimental Farm: The State Arboretum of Virginia
Blandy Experimental Farm is a 700-acre University of Virginia research facility, displaying more than 8,000 trees and woody shrubs, more than half the world's pine species, the Virginia Native Plant Trail and much more. Admission is free!
http://www.virginia.edu/blandy

Junior National Young Leaders Conference
1919 Gallows Road
Suite 700
Vienna, VA 22182

Accepting nominations online at:
www.cylc.org/JrNYLCnom