Water Resources

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A Sense of Place

Standards-based lessons that promote appreciation and stewardship of the unique natural and cultural resources of the Catskill Mountain region.

Module III: Ecosystems of the Catskills

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A Sense of Place

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State of the Arts
NYSCA

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Ecosystems

The system formed by the interaction of a community of organisms with their environment is called an ecosystem. As we are a part of that system ourselves, knowledge of Catskills ecosystems is fundamental to understanding our place in the region. Organisms and the environment vary over time, so the ecosystems of the Catskills are constantly changing. Ecological communities also vary from place to place across our broad Catskill region.

Our main goal for this module is to help students understand some of the fundamental processes of nature. General concepts are more useful, more applicable to state learning standards, and leave a more lasting impression than specific information about particular organisms. Students will of course become familiar with local plants and animals as they study these general principles.

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LESSON 4: Living in an Ecosystem

USING THIS BOOK

- Vocabulary words that are *italicized* in this module are later defined in the glossary.

- NYS Learning Standards met by each activity are listed following the activity. The activity may meet more standards than those listed. The number of the standard, its title, and the topic heading are written out. NYSED divides some topic headings into key ideas, and key idea numbers are listed where applicable.

ACKNOWLEDGEMENTS

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Biodiversity in the Catskills

Our main goal for this module is to help students understand some of the fundamental processes of nature and how those principles come into play here in the Catskills. The understanding your students gain will make them more able to make decisions that affect the *environment*, and such decisions are a part of everyday life. We do not intend to advocate any particular position on environmental issues, other than encouraging children to appreciate nature, but we would like to make students more able to evaluate various ideas about the environment for themselves.

Because the principles of *ecosystems* are universal, we are able to teach those concepts with our choice of examples. In this case, local examples from the Catskills will fire children's imaginations with tangible connections to their own home. New York State learning standards likewise focus on broad concepts, like scientific process skills and system theory, so that we can meet the standards while giving students an important sense of connection to place. This approach affords more opportunities for students to learn and use concepts pertaining to the environment than would a simple descriptive approach, and therefore helps meet the New York State learning standards.

The system formed by the interaction of *organisms* with their environment and with each other is called an ecosystem. Ecosystem refers to the living things present as well as the nonliving components of the environment. The particular mix of living things in a place is called a *community*. In the Catskills, there are various ecological communities such as hemlock forest, hardwood forest, wetlands, etc., each of which has its own characteristic assemblage of organisms. There are no sharp lines between these different communities, but you will notice the difference as you walk from one community into the next. Environmental factors such as the terrain, availability of water and light, soil conditions, and historical factors all influence which *species* do well, and therefore which community lives in a particular area.

Organisms depend on other species to create the conditions they need to live. For example, trees when they die create a rotting wood micro*habitat* in which many species thrive, from woodpeckers to the insect larvae they eat. There is a whole community of living things right inside a rotting log, because the log provides the food, protection, and other needs for these many organisms. Live trees provide shade, which profoundly affects the types of other plants (and hence, animals, fungi, and microbial life) that can survive in the area. Many plants require insects – even insects of a particular species – for their pollination, and likewise, some insects can only survive on a particular type of plant. Students may be familiar with the association between monarch butterflies and milkweed. Most species tend to be found in a certain habitat along with certain other species that share that habitat. In other words, they belong to a particular community of organisms.

Each living thing has specific environmental needs that vary according to species. Plants require the right amount of temperature, light, and moisture, and animals require particular food sources, nesting locations, or climate. On this basis alone, it should come as no surprise that certain species live in certain places. Swallows tend to live in open fields where they can easily see and catch flying insects. Cattails need a lot of water, so they grow in flooded areas. Fir trees thrive in cold areas so they grow on mountaintops in the Catskills.

Environmental conditions vary across our broad Catskill region. The area encompasses nearly 6,000 square miles of land and water. There are 35 mountains reaching heights over 3,500 feet, and 63 more are over 3,000 feet. The climate is cold and snowy during the winter months, followed by warm and moist summer months. The coldest month averages about 0° C and the warmest about 22° C. On average, we receive 1.3 meters of precipitation annually, about evenly distributed throughout the year. Rainfall tends to be greatest on mountain slopes, and temperatures are substantially cooler at high elevations.

Organisms and the environment vary over time, as well as space, so the ecosystems of the Catskills are constantly changing. Change often occurs on a human time scale anywhere from minutes to decades. Forest fires, whether started by a match or by lightning, can quickly transform an area, destroying much of the original vegetation and giving new plants and animals a chance to move in. The regrowth process is more gradual.

The first colonizing plants that grow on bare ground are likely to be ones that have a method of dispersing their seeds over great distances, like the tiny, winged seeds of the white birch, or raspberries, which are eaten by birds as a means of seed transport. (Black bears love raspberries.) These species also tend to do well in sunny conditions and grow quickly. They will be replaced, eventually, by more shade-tolerant species that can grow up in the shadow of their forerunners, and in the Catskills, undisturbed old fields tend to give way to forest. This process by which one ecological community is replaced by a series of others is called *succession*. The end result, a particular community that will not automatically give way to another one, is often called a *climax community*. The hemlock forests of the Catskills are one example. The dark shade and acidic soil of a hemlock stand prevent other trees from becoming established. Beech-maple hardwood forests are also very stable in this region. However, even the mature climax forest can be replaced by other communities. Windstorms, fire (which may be caused by humans or by lightning), the introduction of new species, or other causes, can remove the *dominant* species from a forest and allow other species to move in.

Ecosystems also change with the slow movement of the Earth’s plates, on a geologic time scale. We know that about 350 million years ago, Catskills ecosystems were nothing like they are now. A forest of tree ferns and other plants now extinct grew in a swampy river delta environment with few land animals. (See Module 2 for more info.) Much more recently, over just the last few million years, the region and the entire state have been covered by glaciers so that nothing lived here, except for some microorganisms. The last glaciation ended only about 15,000 years ago.

The first people in the area arrived soon thereafter. The forest that grew in the wake of the glaciers was different than what we see today; species like balsam fir and red spruce that now live only on the higher mountains could be found at lower elevations then. Humans have been a part of Catskills ecosystems almost since the end of the last ice age, but in the last few hundred years, new elements of industry have added to the changes taking place here. One of the most important reasons to study ecosystems of the Catskills is to gain some insight into future ecological changes. Change is inevitable; how things will change is difficult to predict but partly under your influence. Especially as a teacher.

Lesson 1 deals with diversity of life in the Catskills. We will look at some of the communities that appear in our region, and students will learn to identify and learn other things about some of the plants and animals that live here. This experiential learning will give students an interest in nature that will help serve as a foundation for the next three lessons.

There are many kinds of ecological community, but for simplicity we will group these into four categories: forests, fields, developed areas, and bodies of water. Students will find a whole different set of living things in each of the habitat types that they explore.

Forest

If you ask students to list things that live in the Catskill forests, they will probably think of deer and bears. White-tailed deer are common in the Catskills, so much so that their excessive browsing in some places is harmful to other living things. Bears can be a problem too, because they get into garbage and even sometimes homes in search for food. Luckily, the bears usually avoid people unless they have been fed. Some other animals that students will find interesting are the fisher, a catlike animal that has been re-introduced to the Catskills, red and gray foxes, and the bobcat. Department of Environmental Conservation lists the cougar (also called mountain lion, puma, catamount, etc.) as extirpated from New York, but some residents report seeing them, possibly released by people who thought they would make good pets. The gray wolf also once roamed the Catskills, but because of hunting (people deliberately wiped them out) they are now found only in Canada, Alaska, and parts of the Midwest.

These large mammals attract the attention of students, but they are just a small part of the ecological community. Most of the things in the forest, by weight, are plants. There are trees, of course, shrubs, and herbaceous (non-woody) plants that grow on the forest floor. Underground fungi and bacteria also make up a huge part of the forest biomass, even though they are unseen. Fungi comprise a diverse group of organisms that is actually more closely related to animals than to plants (and like animals, they don't have *chlorophyll*).

Next are the insects, whose variety and importance are often underestimated. Most of the *vertebrates* in the forest depend on them for food. Students and adults alike usually fail to appreciate the variety of insects. There are thousands of kinds in our region alone, compared to about 150 bird species or about 45 mammal species! Some insect species new to science have been discovered right here in the Catskills.

There are also many kinds of bird species in the forest. Unless they make a special effort to look for them, students do not realize the great variety of bird life that exists. The familiar backyard species are the tip of an iceberg, and students aren't aware of the variety unless they seek out the less familiar species, often hard to see in the tops of trees or the shadows of a thicket.

Scientists recognize several different kinds of forest in the Catskills, defined not just by the trees they contain, but also other species, and by environmental factors like slope and elevation. Hardwood trees dominate most of the forest on the Catskills. Maple, oak, beech, yellow birch, and black birch are common species. Hemlock (an evergreen conifer) is also common, and it tends to form dense, nearly pure stands because it shades out other trees. The highest mountain peaks in the Catskills are home to an unusual fir-spruce forest community. Balsam fir and red spruce are the common trees there. This forest is also home to the rare Bicknell's thrush, a bird with a haunting, flutelike song.

Field

Fields in the Catskills result from human activities, but they contain many species of plants, animals, and other organisms. Some fields are used as food for farm animals, whether the hay is cut and used later, or the animals graze directly in the field. Other fields have been abandoned. These fields will give way to forest before long, but in the meantime, they support a variety a shade-intolerant plants and the many insects, birds, and mammals that use those plants for food. These fields are usually found at low elevations, where humans have cleared land for farming, and the flat bottomlands along streams are the most likely to be used to grow crops.

Water bodies

Streams of the Catskills are perhaps our most important aquatic habitat. Sullivan County, in the southern part of the Catskills, is the only area with abundant natural lakes. Elsewhere, streams are the most frequently encountered body of water. The six large New York City reservoirs in the region are also an important aquatic habitat, and there are many small, manmade ponds in the western part of our region, constructed as farm water supplies.

Aside from offering beautiful waterfalls and the main water supply for New York City, Catskill streams are home to a rich variety and abundance of wildlife. Much of that wildlife is invisible from land, yet it can form the basis for exciting learning activities for your students.

The most obvious stream inhabitants are the fish. The brook trout is native to the Catskills. The brown and rainbow trouts were introduced, somewhat at the expense of their more sensitive relative. The Catskills are known as a major center for fly-fishing, a sport in which fishing lures that resemble insects are used to attract fish. Mayflies, stoneflies, caddis flies, and other insects that spend their youth in streams are the usual subject for the art of fly-tying. These beautiful creatures, as larvae, live camouflaged on the bottom of rocks, where they are somewhat protected from fish as well as from curious students. The winged adults emerge from the water, often in droves, to mate and lay eggs.

Developed areas

Developed areas such as villages can contain a surprising amount of biodiversity, even if one does not consider the amazing range of human-related artifacts present. A full cover of buildings and pavement like you would find in parts of New York City can only support a limited number of species, but less intense development tends to produce a varied patchwork of trees, grassy areas, gardens, and shrubs, each supporting a variety of organisms. Developed areas contain some native plant and animal species, as well as introduced ones such as pets and garden plants. Many of these introduced species take up residence in surrounding areas, sometimes at the expense of native species, but the mostly sun-loving plants we have introduced do not easily invade the forest. Because many of the species living in villages were brought here from other parts of the world, you won’t learn much about native Catskills communities there. However, the more general concepts of ecosystems still apply, and can even be more obvious because of the rapid changes under way in altered habitats.

Maple Leaf I.D.

Grades:

3rd - 6th

Objective:

Students learn how to identify different *species* of maple trees, and they use research and reporting skills.

Method:

Students identify sugar, red, silver, and striped maple leaves using a field guide. They determine identifying characteristics, family, genus, and species names for each tree.

Materials:

Worksheet (enclosed) or Catskill journal (see Appendix), tree field guide(s), pencils, crayons, tape, tree specimens.

Time:

Preparation Time: 40 minutes
Class Time: 40 minutes

Procedure:

Preparation: Photocopy the worksheet (two double-sided copies per student). Identify and collect branches from the four species of maple trees. Gently break or prune a small branch from a large tree near the base of another protruding branch.

1. Maple trees are among many tree species that grow in the Catskills. A distinguishing characteristic of maple trees is their unique winged seeds that are dispersed through the air like mini helicopters. This activity will focus on four species in the Catskills: sugar maple, red maple, silver maple, and striped maple. The sugar maple, our state tree, gets its name from its sweet sap. The sugar maple provides sap for maple syrup production, valuable lumber, and an aesthetic beauty with its red and orange fall foliage. The red maple gets its name from its vibrant red leaves during the fall. The silver maple gets its name from the silvery color of the undersides of its leaves. The striped maple gets its name from the vertical stripes on the bark. Its leaves are goose-foot shaped.

2. Show students a branch (and seeds if possible) from a sugar maple tree. Pass it around. Students should look at the arrangement of buds, leaves, and twigs. What do they notice about them? Point out how all of the buds, leaves, and twigs are opposite from each other, or grow directly across from each other. Ask them to point out other characteristics. They may notice that the leaves have 3 to 5 lobes, gaps between lobes are U-shaped, buds and twigs are brown, buds are sharp-pointed, the edges of the leaves are smooth or without teeth. What type of tree did the leaves come from? Show them the field guide and explain how to use it. They should begin looking in the section that contains simple leaves with *opposite branching*. Then look for the correct leaf shape and the seed. Once the leaf is correctly identified, tell students to fill in the missing information in their worksheets journals. Students should use the field guide to find the family (Maple Family - Aceraceae), genus (Acer), and species (saccharum) for this tree.

3. Each student should draw, trace, or make a leaf rubbing of the leaf in the space on the worksheet or in their journals. They should write down identifying characteristics of the sugar maple. They may also make note of other interesting facts about the tree such as wildlife use, lumber, type of *habitat*, etc.

4. Repeat above with red maple, silver maple, and striped maple. Red maple (*Acer rubrum*) leaves are usually 3 lobed with “V-shape” gaps between them. Their buds and twigs are red. The buds are dull-pointed. The leaf margins have teeth. Silver Maple (*Acer saccharinum*) leaves usually have five coarse-toothed lobes. The leaves are green on top with a silvery white underside. The twig has a bad odor when crushed. Striped maple (*Acer pensylvanicum*) leaves are large and goose-foot. The leaves have many veins. The bark and twigs have white vertical stripes, and the young bark is green.

Extension:

1. Bring in various oak tree branches and acorns and follow the above format.

2. Take students to a nearby forest to identify trees. School grounds usually have planted trees that are introduced. You may not find them in the field guide. Divide the class into groups. Each group should find a tree and identify it. They could collect the leaves, seeds, twigs, buds, etc. A classroom bulletin board could be used to display each tree’s parts, identifying characteristics, family, genus, and species name.

Assessment:

1. Give students a quiz. Put all four branches out on a table. Students should identify all four species of maple trees. They should know maple trees have opposite branching. Older students should be able to tell the family, genus, and species names.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Math, Science, and Technology
Standard 4 – Science: The Living Environment 1,3

Source: Activity developed by Marie Ellenbogen.

Name: **Date:**

Common Name:

Family:

Genus: *species:*

Identifying Characteristics:

Other Facts:

Adopt a Tree

Grades:

4th - 7th

Objective:

Students learn basic concepts of tree identification and gain appreciation of trees.

Method:

Students follow a list of questions to help them identify a tree. They record information about their tree.

Materials:

"Answer a Tree" worksheet (enclosed), "Adopt a Tree" certificate (enclosed), journals, pencils, crayons, drawing paper, measuring tape, meter stick, small containers (film containers can be used), masking tape, and blindfolds (optional).

Time:

Preparation Time: 10 minutes, photocopying
Class time: Three class periods

Procedure:

1. The leaves, bark, twigs, buds, seeds, fruit, and *habitat* are all helpful when identifying a tree. The first thing one should do when trying to identify a tree is to determine if the tree has broad leaves or needles. Ask the class: What are some ways one could identify trees? (Leaves, bark, twigs, buds, seeds, fruit, habitat) What does evergreen mean? Can you give some examples of evergreen trees? What is deciduous? What are some examples of deciduous trees? What is *opposite branching*? *Alternate branching*? Draw examples on the board and have the students decide which is which. What do you think a simple leaf is? A compound leaf? Show them a picture of a simple leaf and a compound leaf. Explain that trees without needles have either alternate or opposite branching and simple or compound leaves. Tell them those are the first two things they should look for when trying to identify a tree with leaves (not needles).

2. Bring students to a nearby forest. Students should bring their journals with them. Hand out copies of "Answer a Tree" and "Adopt a Tree". Hand out drawing paper and drawing utensils. Explain how students should fill out the adoption certificate. They may work alone or in pairs. You can assign them trees, let them pick one, or use the following activity to choose one:

Meet a Tree: Pair off the students and give the following directions. One student is blindfolded. The other student leads them to a tree. The blindfolded student feels the tree. Tell them to feel the bark and try to put their arms around it. The other student brings the blindfolded student back to the central location. The student takes off the blindfold and tries to find the tree. Once the tree is found, the other student is then blindfolded and everything is repeated. Students will adopt the tree they meet.

4. Students should answer the questions on the "Answer a Tree" worksheet in their journals. Supply students with field guides to help with identification of trees. They can make their drawings in their journals or on separate drawing paper. When they have correctly identified their tree they should fill out their "Adopt a Tree" certificates.

5. Students should research their trees and write short presentations about them. The presentation should include: common name, family, genus, *species*, identifying characteristics, habitat, what type of animals eat its seeds, leaves, or fruit, is it native to the Catskills, is its lumber used for anything, are there any diseases or insects that invade it, etc. Students should make up a fact sheet including all of this information. This can be posted in the classroom for others to see. If more than one student has the same type of tree they could work together as a group.

6. Return to the area where students adopted their trees. Each student or group should stand in front of the tree and give the presentation. When the students have completed their presentation, the other students should make tree drawings or leaf rubbings in their journals.

Extension:

1. Students can sit under their tree and write a poem about it.

2. Students can observe and research all the living things that interact with their tree. They draw their tree and a food web of all living things that are linked to their tree (animals, fungi, other plants, or even bacteria).

3. Visit the trees in the fall, winter, and spring, and have students draw their tree and describe differences from their past visits.

4. Give each student a container and a piece of masking tape. Students should collect seeds from their tree and put them in the container. They should label the container with their name, date, class, and type of tree and place in a box to be brought back to the classroom. Some seeds need to go through a freezing stage in order to germinate. Put seeds in the freezer for a while before

trying to plant them. Students should plant their seeds and make observations throughout the year. They should find out what conditions the seedling survives best under (sunlight, shade, soil type, watering specifications, etc.) and may design experiments to find out.

Assessment:

1. Put out branches from various trees. Next to each branch, place a field guide for tree identification. Each student should use the field guide to identify the branch. Grade them with the following point system. One point for a correct response for the following: branching, leaf type, common name, family, genus, and species.

2. Bring the students to the area where they adopted trees. Quiz them on the trees that were presented to them. You can have them study the common name or both the common and scientific name for each tree.

NYS Learning Standards:

Math, Science and Technology
Standard 4 – Science: The Living Environment 1
Standard 7 – Interdisciplinary Problem Solving

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

Source: Activity adapted from PLT; " Meet a Tree" adapted from Project Wild.

Answer A Tree In The Catskills

1. Where am I? Draw a map so you can find me again.
2. Draw a picture of me.
3. How do my leaves look, feel, and smell? Make a leaf rubbing.
4. How does my bark look, feel, and smell? Make a bark rubbing.
5. Do my twigs have a smell when broken? Describe it.
6. Do I have seeds? Draw a picture of one.
7. Are there insects or animals on or around me? What types?
8. Are insects or animals eating parts of me? What parts?
9. Are there signs of insects or animals that lived in or on me? What signs?

CAN YOU IDENTIFY ME?

1. Do I have needles or leaves? (If I have leaves go to 4)
2. Are my needles in groups or alone? (If in groups go to 3, if alone go to 6)
3. How many needles are in each group?
4. If I have leaves are my branches alternate or opposite?
5. Are my leaves simple or compound?
6. Using a tree guide, tell me what type of tree I am.
7. Are there other trees like me around? How many?

Adopt A Tree In The Catskills

Where I Found My Tree:

Type of Leaf:______________________Type of Branching:

Leaf Characteristics:

Seed Characteristics:

Bark/Twig/Bud Characteristics:

Common Name:

Order:____________________________ Family:

Genus:____________________________ species:

Habitat:

Animals that live around or eat parts of the tree:

My Favorite Thing About My Tree:

_____________________________________ was Adopted by:
(Print Tree's Name)

___________________________________on____/____/____.
(Print Your Name)

Signature:____

Forest, Field, and Town Trip

Grades:

5th - 9th

Objective:

Students learn to recognize differences among ecological *communities*. Students learn how to observe and record animals and plants.

Method:

Students observe, describe, and draw the different animals and plants they find in ecological communities near the school.

Materials:

Catskill journals, field guides (wildflowers, trees, shrubs, mammals, birds, insects, reptiles and amphibians), pencils, and colored pencils.

Time:

Preparation Time: 40 minutes
Class Time: 2 to 3 class periods

Procedure:

Preparation: Copy and distribute permission slips in advance. Scout out the field trip locations, which should include a field, forest, and developed area near the school. If possible, use a field guide to identify common species in each community.

1. The Catskills environment supports many varieties of animals and plants, both native and non-native. Ask the class to define the word “community”. Write their definitions on the board. What are some ways in which people depend on their community? Explain that places such as forest and field are called ecological communities. These are only some of the communities in the Catskill Mountain region.

2. Prepare the students before they visit any of the ecosystems by providing them with the following guidelines for observing animals and plants:

Observing and identifying animals: Animals may be easily identified but are hard to observe for an extended period of time. Most students will be able to recognize chipmunks, squirrels, and birds. Specific kinds of bird may be hard to identify. It may be helpful to bring a bird field guide and some binoculars. Each animal observed should be described and drawn to the extent of the student's ability. The students should try to draw the animals in a quick sketch. When they return to the classroom they can make a more detailed drawing from their sketch and description. They should describe each animal they see, where it was, and what it was doing. If they cannot identify the animal they can make educated guesses of what it could be and why they think that. If they have no idea what it is, their description should be detailed enough to allow someone else to figure out what it is. Students should write down any sounds they hear too. They should describe all animals in the town including cats, dogs, livestock, and humans. Students do no have to describe and draw every human, just like they didn't draw every squirrel they saw but just recorded how many. And don't count the teacher or classmates.

Observing and identifying plants: Plants are much easier to observe than animals but may be difficult to identify. They need to be observed with great detail. All parts of a plant should be looked at when trying to identify it. If a plant has flowers, their color and the number of petals can be used for identification. The size, shape, and texture of the leaves are all important clues. The branching is another important factor (opposite, alternate, whorled). Fruit, seeds, and bark can be helpful also. Some plants can be collected and pressed in a notebook. Students should ask your permission before collecting any plants. Do not take plants from private property. The notebook should be placed under a heavy book until the specimen is completely dried out. Identification may take place back in the classroom.

3. Bring students to a forest, field, or town. Remind students to be very quiet so they don't disturb the wildlife. Give the students about five minutes to write down general data about the ecosystem in their Catskill journals. They record such things as the date, time, location, weather, etc. They may also draw a quick sketch of the ecosystem. As a class, spend about ten to fifteen minutes looking for animals or signs of animals.

4. After observing animals give the students about fifteen to twenty minutes to look at plants. Give them boundaries of how far they can look. Tell the class that each student should find three to five different plants. For each plant they should write a detailed description about it first, then draw it in detail using the written description as a guide. They can choose any types of plants such as a trees, shrubs, wildflowers, etc. If they have time students may look for other plants like the ones they have chosen and count how many others there are around it. At the other ecosystem location(s) repeat the same procedure.

5. Assign each student to give a report on one animal and one plant he or she found in each ecosystem. Students should include drawings and descriptions of the animals and plants. They should research what the animals eat and where that food source is found. Students should find out what conditions each plant needs to survive such as amount of sunlight, water, etc. They should come to conclusions as to why certain animals can only live in the forest while others only live in the field or town. They should be able to discuss why plants that grow in fields cannot grow in forests.

Extensions:

1. Students can do research to find out whether the animals and plants they found are native to the northeast or introduced. If the species are introduced, your students can try to find out how they were introduced and list any problems they cause.

Assessment:

1. Grade students on their descriptions, drawings, and research papers.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

Mathematics, Science, and Technology
Standard 2 – Information Systems 2
Standard 4 – Science: The Living Environment 1,7

Source: Activity developed by Nathan Chronister and Marie Ellenbogen.

Collect and Identify Local Plants

Grades:

4th - 12th

Objective:

Students will learn to recognize differences among ecological communities based on the different species found in each, and they will learn that organisms live in particular places where the habitat is suitable.

Method:

Students will collect and identify plants from different ecological communities. They will describe the plants and where they occur in a field notebook. They will draw pictures of local ecological communities showing the appropriate plant species.

Materials:

Plant identification guides, transparent tape, spiral notebook for each student with two sections for pressing plants.

Time:

Preparation time:	10 minutes to collect demonstration materials.
Class time:	85 minutes total. 15 minutes to explain instructions and demonstrate plant pressing. 30 minutes to help with identification after collections are made. 40 minutes for follow-up activity, 20 minutes per drawing.
Homework:	A few hours. Students must obtain spiral notebooks, collect plants, describe plants, and attempt to identify plants.

Procedure:

The Catskills environment supports many varieties of wild flowers and other plants, both native and non-native. In this project, students will collect wild flowers, focusing on two distinct locations. One collection might come from the forest, the other from an open field. Students will compare the species they find in the two locations to illustrate that nature varies from place to place. A field is more than just a woodlot that has not yet grown up; it contains many species not found in the woods, adapted to that particular environment.

1. Before sending students out to collect plants, explain how it works. When you do this, bring a

few plants, tape, and a spiral notebook to class to demonstrate the procedure. Each student will have a spiral notebook with two sections, which will serve as a plant press. The first section is for the first habitat they visit, and the second section is for the other habitat.

2. Collecting could be done as a field trip with the whole class, but intensive harvesting of wild flowers in one location can be destructive. If the collecting is done as a homework assignment, there should be parental supervision.

Students will tape individual plants into their spiral notebooks. No more than one of each species is allowed per notebook section, though a plant may appear in both sections if it grows in both habitats. Leave some blank pages between plants for support. Emphasize that students must not put any plants in the "forest" section of the notebook that weren't found in the woods, and must not put any plants in the "field" section that weren't found in an open area. They will be graded on the accuracy of their collections, not on the number of plants they have!

3. It is best to identify plants in the field before they are picked, but it may be necessary for the teacher to help with plant identification later on. This could be done with the entire class: Have a student show one of his or her plants to the class and then ask if anyone else has one like it.

4. Students should describe each plant in words or pictures. Tell the name of the plant, where it was found, the date, and the size of the plant. Describe the habitat. Was the plant near water? Was it in a shady place? Make other observations. Write this information in the spiral notebook along with each plant.

5. The notebook should be pressed under a stack of books whenever it is not in use, for a period of two weeks or until the plants have completely dried.

6. Lead a class discussion in which students are asked to describe how forest plants differ from plants that live in a field where there is a lot of sunlight. Which plants have larger leaves? Which plants are tougher? Which plants have more colorful flowers? Are there any other differences between forest and field plants? Students are learning about plants here but they should also learn the statistical notion of comparing two broad groups that have variation within as well as between groups. (The Lesson 3 activity, Virtual Ecosystem, relates to this topic.)

7. As a follow-up activity, have students draw pictures of the habitats they have visited. They should draw one picture of a field and one of a forest. They should write the name of each plant they draw. Students should represent real plant species they or their classmates have collected. These plants should be appropriate to the habitat type shown in the drawing.

Extensions:

1. Collect plants from other habitat types: for example, from a wetland, from a pond, or along main street. Areas with a large human population tend to have many introduced species. How

does the total number of species compare to that of the forest or field?

2. Have students collect tree leaves instead of wild flowers. Are the sapling trees in a field the same kinds that grow in the deep woods? Also compare two different-looking woods. How might the history or elevation of the two sites explain the difference in tree species?

In these comparisons, it is helpful to know not only which species are present, but which ones are the most abundant. In the fall, assign students to four teams: maple, oak, birch, and beech, and see which team can collect the most fallen leaves in two minutes. The outcome should give a rough indication of which kinds of tree are more abundant in one place compared to another.

3. Students can also collect insects, carefully noting where each one was caught. Traditionally, insects are killed using a kill jar, which contains a cotton ball soaked in alcohol, and then the ones with hard exoskeletons can be mounted on pins. The Golden Guide to Insects describes how to do this. An alternative is to have students examine and draw the insects they find but release them alive. As in the plant activity, it is interesting to compare insects found in the different habitats. Ask the students to make hypotheses, or think of questions, about how the two habitats might differ, that they can address through on-site study. Are there more crane flies in the woods or in a field? Are the same kinds of butterfly found in the woods as in a field? What kinds of insects are found in or near water?

4. Collect insects along with the plants they are found on. As above, the insects and plants can be drawn rather than killed, if desired. Animals use plants for food, shelter, or simply a place to rest. Some animals are very closely associated with particular plants. Monarch butterflies feed exclusively on milkweed, which makes them toxic and protects them from birds. Some wasps lay their eggs in particular plant species. Other animals use a wider variety of plant species. A dragonfly, being carnivorous, might land on any kind of plant, and many insects can use a variety of different plants for food.

Assessment:

The student plant collections should contain a variety of plants, and students should place field or forest plants in the correct notebook section. Journal entries for each plant should be genuinely descriptive and plant names should be accurate. The follow-up activity is intended as an assessment tool. After reviewing the plant collections, you will be able to judge the extent to which students draw appropriate plants in each habitat area.

NYS Learning Standards:

Mathematics, Science, and Technology
Standard 3 – Mathematics: Uncertainty
Standard 4 – Science: The Living Environment 1, 6, 7

Sock of Seeds

Grades:

2nd - 7th

Objective:

Students use scientific inquiry skills to learn what resources a seed needs to germinate. Students learn what types of plants are growing in a local field or meadow.

Method:

Students walk through a meadow with socks on their shoes to collect seeds. Students record and describe the different types of seeds they collected. Students plant seeds, make observations, and try to identify the plants that grow.

Materials:

Containers (bottom halves of milk cartons or soda bottles, small plastic containers, etc.), soil, fertilizer, mustard or bean seeds, old socks (each student should bring in one or two), film canisters, magnifying lenses, tweezers (optional).

Time:

Preparation time: 10 minutes, gathering materials
Class time: Two 45-minute class periods and ongoing observations

Procedure:

1. Ask the class what they think a seed needs to wake up or grow? Do they need moist or dry conditions, cold or warm, dark or light, etc? Make a discovery-based planting using mustard or bean seeds. Plant seeds under varying conditions such as: moist vs. dry, dark vs. light, cold vs. warm, etc. Only one variable should change during each experiment. Students should make predictions and record observations in their journals. After seeds have sprouted try varying conditions such as: light vs. dark, fertilizer vs. no fertilizer, different amounts of water, etc. Students should label plants according to the treatment they receive and keep accurate records of the outcome. Students should make predictions and record observations.

2. Bring students to a meadow. This can be done before the seed experiments described above are finished. September or June will work best. Students should describe the area and weather conditions in their journals. Tell students to place the old socks over their shoes and pants (socks

should be inside out). Tell students to walk through the meadow. As they walk through the meadow they should describe and draw the various plants they see. If there is time students can use field guides to identify some of the plants. Before leaving the field, tell students to carefully remove the socks making sure they turn them right side out so the seeds are captured in the sock. Bring socks back to the classroom.

3. In the classroom students should turn the socks inside out again and collect any seeds they find. Give them magnifying glasses and tweezers (optional) to remove small seeds. (If there are any insects on the socks they should be placed in a jar with a lid. The insects can be studied and then released.) Place seeds into film canisters. All seeds that are the same should be put together. Assign each canister with a label such as "unknown 1", "unknown 2", etc. In their journals students should record how many of each seed they collected. They should describe each unknown seed. All seed canisters should be placed in a freezer for a week or so. Some seeds need to be exposed to cold temperatures (winter) in order to germinate.

4. Remove seeds from freezer. Plant each seed in a separate container with soil and label with the “unknown” number and date planted. Moisten soil, cover container with plastic wrap or a plastic lid, and place containers in the window. When seed germinates, remove lid and add more water. Students should record how many of their seeds germinate and when. They should describe each plant as it grows. Are the plants from the seeds of the same group similar? If plants begin to flower students should try to identify them using field guides. Are they the same or different than the ones they saw in the meadow?

Extension:

1. Students can collect seeds from their adopted tree and try to grow them inside and then plant them outdoors at the end of the year.

Assessment:

1. Grade students on their observations and journaling.

NYS Learning Standards:

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment: 1

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

Source: Activity developed by Marie Ellenbogen.

See What Pops Up!

Grades:

5th - 12th

Objective:

Students learn about local plant species that colonize cleared land.

Method:

Students clear a piece of land and record what plant species grow.

Materials:

Grid (enclosed), shovels, hoes, rakes, work gloves, meter sticks, meter tape, and colored pencils.

Time:

Preparation Time: 10 minutes, photocopies of grid worksheet (two per student)
Class Time: Two 40-minute class periods

Procedure:

1. Get permission from the school to clear a plot of land on school grounds. The plot should be square, one meter on each side. School maintenance should be advised not to disturb the plot. The plot should be cleared in the fall or early spring.

2. Bring the students outside to the area of study. Assign a group of students to mark off the area to be cleared. They should use wooden stakes and string to mark off the corner boundaries as well as divide the plot into four quarters.

3. Give each student a copy of the grid. The grid represents one square meter. The dotted lines represent a distance of 10 cm. There are two solid lines representing the 50 cm mark. Divide the class into four groups. Each group will be assigned a quarter. One person in each group will make sketches of all the plant species in the quarter. Another person should write descriptions of all the plant species. Other students can count how many different types of plant species are in the quarter and map their locations. The students should shade in squares on the grid where different plant species occur. Use a different color or pattern for each species. Each species should be labeled in a legend as follows: "unknown 1", "unknown 2", etc. Students can also try to identify the different plants or take a sample of each plant back to the classroom to be identified and pressed (they should be labeled with the same unknown numbers as on the grid).

4. When students have recorded all plant data they should clear their quarter of all vegetation. This can be done using garden tools. When pulling up the vegetation they should make sure to get the roots. The plot should be smoothed over with the rake when all of the vegetation is gone. The plants should be put in a designated area away from the field site.

5. Return to the classroom to exchange data between the groups. Each group should extend their grid map to include the other three quarters. Students should make predictions of what will happen to the land and record them in their journals. They should make predictions answering such questions as: Will the same plants come back? Will new plants begin to grow? How will the new plants get there?

6. Return to the site at the end of June, or periodically throughout the year. Give each student another grid. Identify and record all of the plants in the same manner as before. They should look at their predictions and compare them to what actually happened. The students look around and see if they can find out where the seeds may have come from. What will happen if the area remains untouched for anther year? Five years? Twenty years?

7. Students should try and locate any new plants they find in areas outside of the grid. If they find any, they should find out what type of seed that plant disperses and then make a conclusion about how the plant got to the grid. Some plants can propagate by means other than seeds.

Extension:

1. Clear a plot of land in the forest and see what types of plants grow. Are they the same that grew in the field?

2. Try experiments such as comparing a bed of sterile potting soil to soil collected in various habitats. How does the colonization of these plots differ?

Assessment:

1. Grade students on their grids, predictions, conclusions, and journaling.

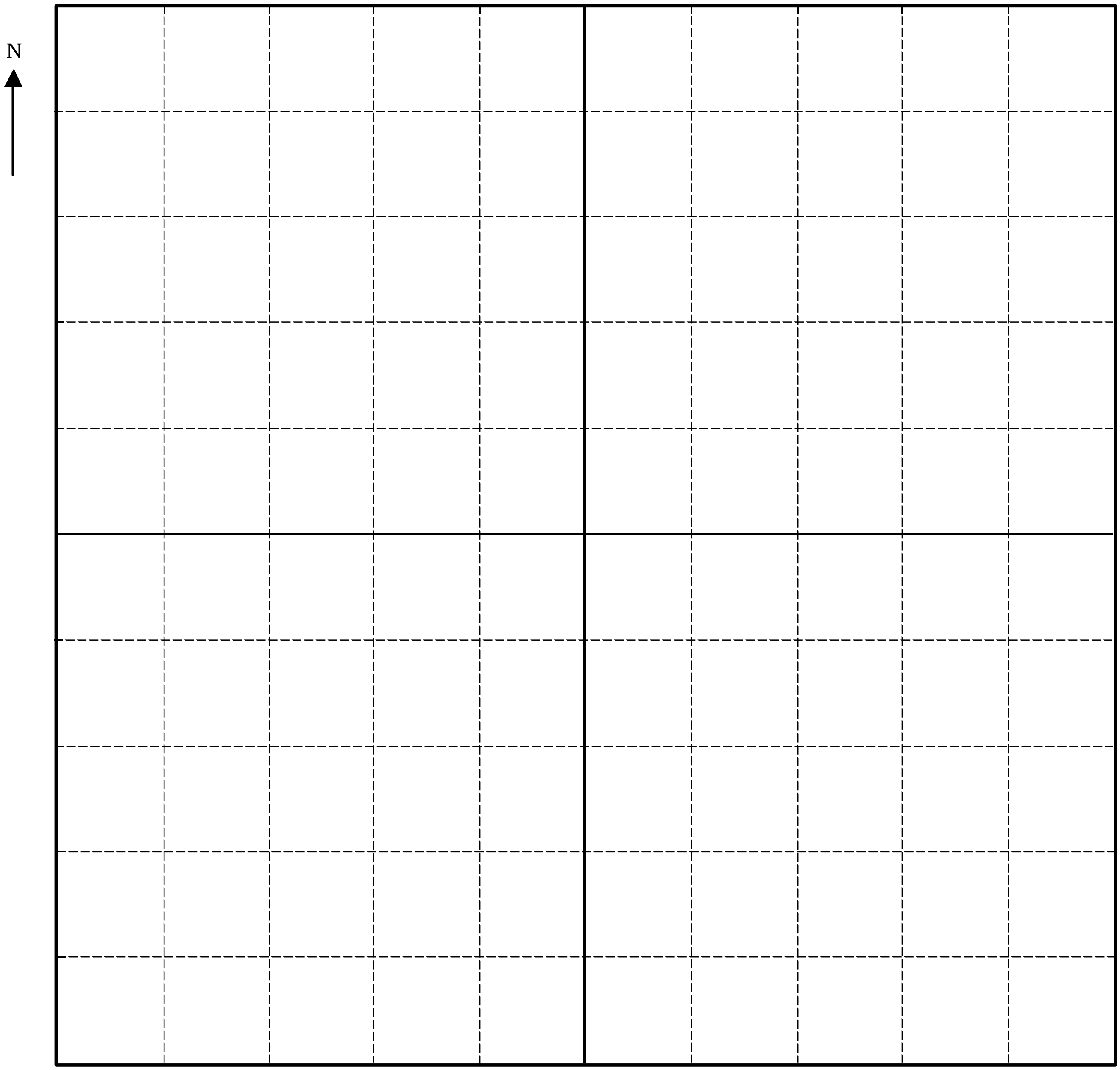
NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading, Speaking and Writing
Standard 4 – Language for Social Interaction: Listening and Speaking

Mathematics, Science, and Technology
Standard 3 – Mathematics: Modeling/Multiple Representation, Measurement
Standard 4 – Science: The Living Environment 1,5,6

Source: Activity developed by Nathan Chronister and Marie Ellenbogen.

Name:__________________ Location:______________________________ Date:__________



Native Garden

Grades:

4th - 12th

Objective:

Students learn the difference between native and introduced plants. They will learn that different plants need different conditions to grow.

Method:

Students will plant native seeds, research native plants, predict which plants will grow best under certain conditions, and make observations to test their predictions.

Materials:

List of native plants (enclosed), topsoil, shovels, rakes, and planting containers such as bottoms of milk or soda containers, old fish tanks, plastic tubs, etc.

Time:

Class time: 40 minutes and ongoing observations

Procedure:

1. Ask the class if they know what native means. Ask the class to describe how a plant might be considered native to the Catskills. A plant that is native to the Catskills is one that was not brought by humans. Describe how a plant is considered introduced if it was brought to the Catskills accidentally or purposely. Ask the class to give examples of native and introduced plants in the Catskills. Some introduced plants, such as purple loosestrife and Japanese knotweed, are considered invasive. These species tend to move into new areas quickly, often at the expense of the plants already living there. Introduced invasives often lack natural enemies here in the Catskills. How might invasive plants affect native animal species?

2. Get permission from the school to designate an outside area for native planting. If possible get two sites, one in the shade and the other in the sun. Notify the school maintenance about the site and ask them not to disturb it. Use the list of native plants as a reference for buying seeds. Obtain native seeds from the local nursery or contact one of the resources provided in the appendix.

3. Locate the planting site. Students should describe the location in their journals. Clear the site of all previous vegetation. Remove large rocks and use them to create a border around the garden.

Add some topsoil and rake over. Plant the seeds at the required depth and distance from other seeds suggested on the seed packet. If there are two sites, plant the same seeds at both places. Water the seeds. Future maintenance is optional. The garden can be left untouched or cared for with watering, weeding, or fertilizer.

4. Divide the class into groups of three. Assign each group to one of the plants. They should find out the plant's family, genus, and species. They should research where the plant is usually found, how much water and sunlight it needs, the soil conditions (pH, composition) it prefers, what organisms use it as food or shelter, and any other information. Students should go to the garden and make observations. They should analyze the soil (pH, composition), the amount of sunlight, and other factors. Based on the plant research and the survey of the garden, the students should predict what would happen to the seed or plant in the area where they planted it. What is the likelihood of the seed germinating? If the seed germinates, will the soil, sun, and water conditions be suitable to maintain a healthy plant? Students should make these predictions and record them in their journals. Their predictions should be based on the scientific facts they have gathered about the plant and where they planted it. They should also draw a picture of what the plant looks like. Students should present their research, picture, and predictions to the class.

5. At the end of the school year students should record which plants germinated and how healthy they are. Where their predictions accurate? What do the plants that require shade conditions look like? What to the plants that require sunny conditions look like? If there were two garden sites, which plants grew the best at each site? What will happen to the plants over time? Will they be healthy enough to reproduce? What would happen to the plants if an invasive species were introduced?

Extensions:

1. Students plant native and invasive species outside and do not care for either of them to see which ones survive.

2. Take a field trip to look for native plants growing in the Catskills. Compare the number of native plants found vs. introduced.

Assessment:

1. Grade students on their presentations.

2. Grade students on the quiz. Answers are as follows:

   1. Any three of the seeds that were planted in the native garden.
   2. Purple loosestrife or Japanese knotweed.
   3. Accept any plausible explanation, whether deliberate or accidental.
   4. A plant that requires full sun will grow best in full sun. A plant that requires little sun will grow best in the shade.

5. Native plants are important for maintaining native organisms that use the plants for food or habitat. Also, native plants are part of the unique character of our region.
6. Amount of water, soil pH, amount of nutrients available in the soil.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading, Speaking and Writing
Standard 4 – Language for Social Interaction: Listening and Speaking; Reading and Writing

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 3, 5-7

Source: Activity developed by Marie Ellenbogen.

Native Garden Quiz

Name:______________________________ Teacher:__________________ Date:______________

1. Give three examples of native plants in the Catskills.

2. Give an example of a non-native plant in the Catskills.

3. Give an example of how a non-native plant can be introduced to another area.

4. How does the amount of sunlight affect the growth rate of a plant?

5. Why is it important to have native species growing in the Catskills?

6. What is another factor besides sunlight that determines if a plant can grow and remain healthy?

Some Native Plants of the Catskills

Common Name	Scientific Name *Genus species*	Common Family Scientific Family	Habitat	Comments
Bloodroot	*Sanguinea canadensis*	Poppy Papaveraceae	rich, moist woodlands stream banks	Native Americans used the red juice from the roots & stems for dyes, war paint, & insect repellent
Blue cohosh	*Caulophyllum thalictroides*	Barberry Berberidacaceae	rich, damp woods	the seeds may be used as a coffee substitute
Bunchberry	*Cornus canadensis*	Dogwood Cornaceae	cool, moist, acidic soil	considered hard to establish unless transplanted with rotten log attached
Cinnamon fern	*Osmunda cinnamomeum*	Osmundaceae	damp woods	unfolding fronds (fiddleheads) can be harvested for food
Closed gentian	*Gentiana andrewsii*	Gentian Gentianaceae	moist meadows and thickets	easy to grow in a moist wildflower garden
Common barberry	*Berberis vulgaris*	Barberry Berberidacaceae	pastures; thickets	susceptible to black stem rust fungus
Common wood sorrel	*Oxalis montana*	Wood Sorrel Oxalidaceae	rich, damp woodlands	inversely heart-shaped; white or pink flowers have dark pink veins
Corn-lily (Clinton's lily)	*Clintonia borealis*	Lily Liliaceae	moist woodlands; acidic soil	deep blue berries are poisonous
Downy yellow violet	*Viola pubescens*	Violet Violaceae	rich woodlands	downy (hairy) stems and leaves
Dutchman's breeches	*Dicentra cucullaria*	Poppy Papaveraceae	rich woodlands	closely resembles squirrel corn and is often found in same habitat
Early saxifrage	*Saxifraga virginiensis*	Saxifrage Saxifragaceae	dry rocky outcrops	can also be found in wet habitats
False hellebore (Indian poke)	*Veratrum viride*	Lily Liliaceae	moist woods; swamps; meadows	leaves & roots are poisonous; Native American chiefs were selected if they ate plant and lived
Goldthread (canker-root)	*Coptis groenlandica*	Buttercup Ranunculaceae	damp woodlands; swamps; bogs	Native Americans and colonists chewed on the underground stem to heal mouth sores
Jewelweed	*Impatiens capensis*	Touch-Me-Not Balsaminaceae	shady wetlands	hummingbirds, bees, and butterflies are important pollinators; stem juice may relieve itching from poison ivy and athlete's foot
N. bush honeysuckle	*Diervilla lonicera*	Honeysuckle Caprifoliaceae	open woods; dry soils	differs from other honeysuckles because of its toothed leaves
N. jack-in-the-pulpit	*Arisaema stewardsonii*	Arum Araceae	swamps; bogs	flower cluster is partly concealed by a bract (modified leaf); produces a red fruit
N. maindenhair fern	*Adiantum pedatum*	Polypodiaceae	Moist woodlands	usually grows near bloodroot and jack-in-the-pulpit
Rose twisted stalk	*Streptopus roseus*	Lily Liliaceae	damp woods and thickets	zig-zag stems; twisted stalks hold bell-shaped pink flowers

Birding

Grades:

2nd - 7th

Objective:

Students learn how to identify different *species* of birds in the Catskills.

Method:

Students make birdfeeders to attract Catskills birds. Students describe, draw, and identify birds.

Materials:

Instructions for easy to make birdfeeders (enclosed) lists materials for each feeder. Field guides.

Time:

Preparation Time: 20 minutes – students bring in birdfeeder materials
Class Time: 40 minutes and ongoing observations

Procedure:

1. Ask the class to name some birds they know and to describe what they look like. Explain to students that there are many different birds in the Catskills. They occur in *habitats* such as fields, forests, wetlands, streams, lakes, and even backyards. Birds are easy to observe because most of them are active during the daytime. The easiest way to observe birds is to put birdfeeders outside.

2. Divide students into groups of four. Give each group instructions and materials for one type of birdfeeder. Students in the group that are making the pine cone feeders can each make one and string them together. Groups that are making the other types of feeders can make one per group. Hang the feeders near the classroom window. If the school is in an area where bears are prevalent, only put feeders out during the winter, or take them in at night during other months.

3. It may take a week or more for birds to first locate the feeder. Students should describe and draw in their journals the various birds that come to the feeders. They should identify the birds using field guides, record how many of each bird feeds at once, popular feeding times, and any other interesting things. Try varying the type of seed to see what types of birds prefer what types of seeds. Students should compare various bird species and describe the differences of beaks, wings, feet, etc. and how they are adapted for obtaining and eating different types of food.

4. When students are familiar with using the field guides take some field trips to other habitats such as streams, lakes, wetlands, open fields, or forests. Students that have binoculars should bring them. Remind students that to see birds in the wild they must be quiet. Students should describe and draw the birds they see on their field trip. Students should determine what *adaptations* the birds have to help them survive in a particular habitat. They should also record where and when they saw each bird and any other interesting information about the sighting. They should use field guides to help identify the birds they see.

5. Each student should choose one bird he or she saw at the feeders or on the field trip and write a poem about it.

Extension:

1. Take a field trip to Mongaup Falls Reservoir in Sullivan County to observe bald eagles. Contact the Eagle Institute in the resource section of this module for information. In addition to guided field trips , the Eagle Institute may also offer classroom programs about eagles.

2. Participate in Classroom Feeder Watch, a national program that allows your students to submit data from their feeding station to scientists via the internet. Count season begins in November. See the resource section for info.

Assessment:

1. Grades students' journal descriptions, drawings, and poems.

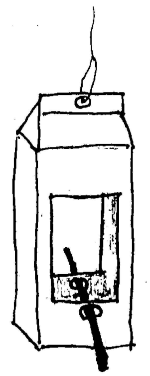
NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading
Standard 2 – Language for Literary Response and Expression: Speaking and Writing

Mathematics, Science, and Technology
Standard 3 – Science: The Living Environment 1,2

Source: Activity developed by Marie Ellenbogen.

Easy to Make Birdfeeders



Carton Feeder

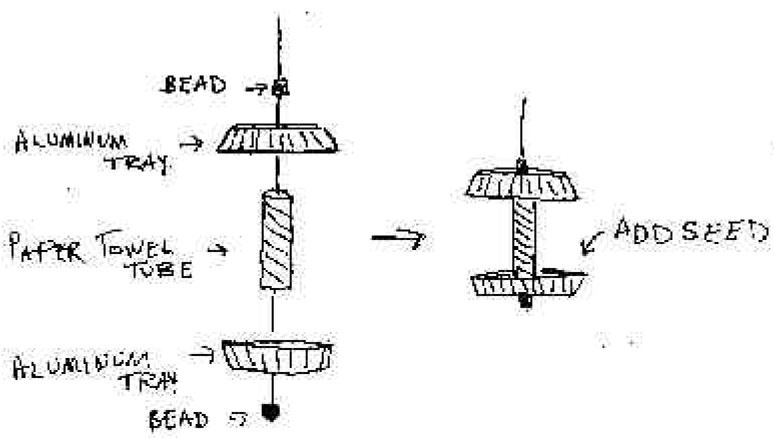
Materials: half-gallon carton, utility knife, hole puncher, stapler, twig, pin.

Cut a large hole on opposite sides of the carton. Under each large hole, punch a hole using a hole puncher. Put a twig through these small holes, making sure it hangs over about two inches on each side. Poke some holes with a pin in the bottom for drainage. Staple the top of the carton shut. Punch a hole in the top and tie a string to hang it. Fill with seed up to the twig.

Bottle Feeder

Materials: two-liter soda bottle, utility knife, hole puncher, twig, pin.

Cut a large hole on opposite sides of the bottle. Punch a hole with a hole puncher under each large hole. Put a twig through the small holes, making sure it hangs over about two inches on each side. Poke some holes with a pin in the bottom for water drainage. Keep the cap on so water doesn't get in through the top.



Aluminum Tray Feeder

Materials: two aluminum trays, paper towel tube, two beads, string, pin.

Feed string through one bead, aluminum tray, paper towel tube, aluminum tray, and through the other bead. Then tie. Poke holes in the bottom with a pin for water drainage.

Pine Cone Feeder

Materials: pinecone, string, peanut butter.

Tie string to the top of a pinecone. Cover it with peanut butter. Roll it in birdseed and hang.

Nature Trading Cards

Grades:

1st - 6th

Objective:

Students learn about Catskills organisms and local biodiversity.

Method:

Students make their own trading cards with information about native organisms. They can then trade these cards with other students.

Materials:

Card stock or plain index cards, markers or crayons, reference books such as field guides.

Time:

Preparation Time: 5 minutes
Class Time: 40 minutes

Procedure:

1. Hand out materials and tell students to make trading cards for Catskills organisms. On the front should be a picture of the organism, and on the back should be at least five facts about it such as size, where it lives, what it eats, or other interesting facts. The student's name should also be on the card. You may allow the students to choose any Catskills organism (plants, animals, fungi, etc.) or limit their choices to a particular group you wish to focus on, such as birds, insects, or wildflowers. Students can only draw organisms they have personally seen in the Catskills. This will make trading the cards more meaningful. (Hoop snakes and side-hill winders are not allowed, even if a student claims to have seen one.)

2. Once the cards are made, and once you have graded them, students can trade them on their own as they would other trading cards.

3. You may wish to coordinate with another teacher to do this project at the same time. The other class may or may not use the same group of organisms for their cards. For example, your class can make animal cards and the other class can make plant cards.

Assessment:

Grade the cards for the following criteria: Cards should contain at least five facts about the organism, which should be well researched and properly explained. The drawing should show key identifying features of the organism. A week or so later, you may ask students to write something in their journals about an organism they learned about from another student's card.

NYS Learning Standards:

Math, Science, and Technology
Standard 4 – Science: The Living Environment 1

English Language Arts
Standard 1 - Language for Information and Understanding: Speaking and Writing

Catskills Animals

Grades:

3rd - 6th

Objective:

Students learn facts about Catskills wildlife.

Method:

Students read facts about animals from cards while their classmates try to figure out which animal is being described.

Materials:

"Who Am I" cards (enclosed)

Time:

Preparation Time: 10-20 minutes
Class Time: 30-45 minutes

Procedure:

Preparation: Photocopy "Who Am I" cards (one copy of each sheet), glue them to poster board, and cut them out.

1. Ask students to name some animals that live in the Catskills (mammals, birds, insects, reptiles, amphibians). Write a list on the chalkboard or overhead.

2. Hand out one "Who Am I" card to each student. Students should not show other students their cards.

3. Divide the class into two teams, Team A and Team B. Have the first student on Team A read the first line of his or her card. The first student from Team B tries to guess the animal. If he or she guesses incorrectly, the Team A student reads the next line and another student from Team B guesses. Continue until a student on Team B answers correctly or all four lines have been read.

4. The first student on Team B reads a line from his or her card, and the first student on Team A tries to guess the animal.

5. Keep score as follows: One line read = 4 points; Two lines read = 3 points; Three lines read = 2 points; Four lines read = 1 point.

6. Play continues until all cards are read. Remind students that the answers only pertain to animals that live in the Catskills. The team with the highest score wins.

Extension:

1. Students write a poem about a Catskill animal that includes factual information about its habitat, behavior, physical features, etc.

Assessment:

1. Write questions about Catskills animals on the board and grade the written responses. Questions can be derived from the animal cards or game questions.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 1

Source: Activity developed by Marie Ellenbogen.

● I am nocturnal (active at night). ● I eat flying insects like mosquitoes. ● I am the only truly flying mammal. ● When I sleep during the day, I hang upside down in hollow trees or caves **Answer:** Little brown bat	● I am a member of the weasel family. ● I den underground or in rock piles. ● I eat insects, rodents, and sometimes garbage. ● I am black and white and let out a stinky odor when in danger. **Answer:** Striped skunk
● I am a type of rodent. ● I eat twigs and bark. ● I would rather be in trees than on the ground. ● I have sharp quills that fall off into a predators skin when it attacks me. **Answer:** Porcupine	● I am an omnivore (eat plants and animals). ● I have an excellent sense of smell. ● I sometimes den in hollow logs, under fallen trees, or in caves. ● I have black fur, a short tail, and can weigh up to 600 pounds. **Answer:** Black bear
● I am a herbivore (eat plants) and like to eat acorns, leaves, twigs, grass, and fruit. ● I make a snorting sound when alarmed. ● My tail is white underneath. ● I will have antlers only if I am a male. **Answer:** White-tailed deer	● I am an aquatic rodent. ● I have thick fur, webbed back feet, and a big tail. ● My home is made of sticks and has an underwater entrance. ● I cut down trees with my teeth and use them to build dams and the lodge that I live in. **Answer:** Beaver
● I den underground, under rocks, or in hollow trees. ● I am an omnivore (eats plants and animals). I like to eat fruit, nuts, insects, frogs, and I also raid garbage cans. ● My tail has rings of yellow, white, and black. ● I look like I have a mask on my face. **Answer:** Raccoon	● I am nocturnal (active at night) and feed on fruit, vegetables, meat, and insects. ● I am the only marsupial in the Catskills. ● My mom carried me in her pouch for 2 months. ● My tail is used for climbing and I faint or "play dead" when in danger. **Answer:** Opossum

● I am a solitary animal (live alone). ● I am a carnivore (meat-eater) and I eat small animals such as mice and birds. ● I have retractile claws (can keep my claws in). ● I have a short "bobbed" tail with black at the end. **Answer:** Bobcat	● I am territorial (protect the area where I live) and make noise at intruders. ● I make nests with leaves. ● I have gray fur and a bushy tail ● I store nuts and acorns in tree holes or in holes in the ground. **Answer:** Gray squirrel
● I am nocturnal (active at night). ● I live in the forest and nest in holes in trees. ● I am a type of squirrel. ● I have a flap of skin between my front and back legs that helps me glide from tree to tree. **Answer:** Flying squirrel	● I live in fields and forests. ● I am a great mouser. I also eat other small animals, fruit, and insects. ● My fur is reddish brown and I have a bushy tail. ● I am often mistaken for a small dog. **Answer:** Red fox
● I can be found at some of the reservoirs. ● I eat fish and sometimes ducks or geese. ● I can have a wingspan of seven feet. ● As an adult I will have a white head and tail. **Answer:** Bald eagle	● I use my large eyes and my excellent hearing to find my prey. ● I am a nocturnal (active at night) predator. ● I have large wings that flap silently so my prey cannot hear me. ● I have tufts of feathers above my eyes that look like horns. **Answer:** Great horned owl
● I nest on the ground in the forest. ● I feed on acorns, nuts, insects, and green plants. ● I do not have feathers on my head. ● In the spring, the male tries to attract the females by spreading his tail feathers, strutting around, and "gobbling". **Answer:** Wild turkey	● I am diurnal (active during the day). ● I hunt for small animals like rodents and birds. ● I perch in trees and look for prey with my sharp eyesight. ● I have a whitish chest and reddish brown tail. **Answer:** Red-tailed hawk

● I like to perch on cliffs or dead trees. ● I soar through the sky smelling for dead animals. ● I fly through the air holding my wings in a 'V' shape. ● I have dark feathers and a red head without feathers. **Answer:** Turkey vulture	● I like to eat farm crops such as corn. ● I can live in a wide range of habitats such as farms, orchards, forests, and parks. ● I am all black and often say, "caw cah". ● Farmers often put men made of straw near their crops to scare me away. **Answer:** American crow
● I have a plump body covered with fur to keep me warm. ● I am nocturnal (active at night). ● My light green color helps me hide on leaves. ● I have false eye spots on my wings to scare away predators. **Answer:** Luna moth	● I am an aquatic insect. ● When I become an adult I will swim to the surface and leave the water. ● I can be found under rocks in streams. ● I build a case around my body by attaching small pebbles, twigs, or leaf bits. **Answer:** Caddisfly larva
● I am a decomposer (eat dead plant and animal matter). ● I live in the soil and I don't have eyes. ● I can eat threes times my weight each day. ● I am a favorite food source to Robins. **Answer:** Earthworm	● I have a two-year life cycle. ● I wait on plants for my food source to come near. ● I suck blood from animals' skin, especially mice and deer. ● I often have bacteria that I pass along to the animals I feed on, giving them lyme disease. **Answer:** Deer tick
● I am a herbivore (plant eater). ● I have six legs and four wings. ● I make noise by rubbing my legs together. ● Although I'm often seen hopping, I can also fly. **Answer:** Grasshopper	● I pollinate flowers. ● When I was young I ate milkweed plants. ● I made a cocoon so I could turn into an adult. ● I flutter around with my orange and black wings. **Answer:** Monarch (milkweed) butterfly

● I was born in the water and will return there to lay my eggs. ● I am an amphibian, and I live in damp woodlands. ● I am usually yellowish brown in color and have a large ‘X’ on my back. ● I am usually heard "“peeping" in the springtime. **Answer:** Spring Peeper	● I live in large lakes and ponds. ● I like to burrow in the mud. ● I was born on land and go back there each year to lay eggs. ● I catch fish by extending my head quickly from my shell and “snapping” down on the fish with my powerful mouth. **Answer:** Snapping Turtle
● I eat rodents, frogs, and birds. ● I live near rocky ledges so I can sun myself. ● I have a poisonous bite. ● I have a rattle on my tail that I use to scare off or warn predators. **Answer:** Timber rattlesnake	● I am often seen in the forest after it rains. ● Few predators eat me because of the bad tasting mucous on my skin. ● I have red spots. ● When I become an adult I will lose my orange color and return to the water. **Answer:** Red eft stage of red-spotted newt
● I am native to streams in the Catskills. ● I need a lot of oxygen in the water so I can breathe. ● I like to eat mayflies and other aquatic insects. ● I am a colorful freshwater fish. **Answer:** Brook trout	● I leave tracks in a bounding pattern. ● I kill my prey by piercing their neck or skull. ● My fur is dark brown with white underneath in the summer and all white in the winter. ● I'm in the same family as minks and ferrets. **Answer:** Weasel
● I can fly. ● My long tongue helps me reach insects under the bark of trees. ● I have red feathers on the top of my head. ● I made my nest by pecking a hole in an old tree with my chisel-like bill. **Answer:** Woodpecker	● I am an omnivore (eat plants and animals). ● I often live in groups. ● My body is covered with hair that can be light or dark colored. ● I am the only Catskills mammal that walks on two legs. **Answer:** Human

Organism Functions

In the first lesson, students learned to describe and identify some of the varied living things that inhabit our Catskill region. This second lesson is about how living things continue living. It is about their basic needs for food, water, shelter, and reproduction, and their methods of survival. Once students understand how individual *organisms* function, they will be better-prepared in the next lesson to learn about the complex interactions among organisms that make up an *ecosystem*.

When we talk about functions of an organism we are talking about survival. What does a plant, animal, or other living thing need to survive? How does it get what it needs? What are the threats to its survival, and what assets does it have?

All living things need certain substances from the *environment* we can call *nutrients*. Plants are called *autotrophs* because they can make their own food through the process of *photosynthesis*. However, they must have plenty of air, water, and sunlight just to carry out photosynthesis, and they need a few things like nitrogen and minerals that can't be photosynthesized. Plants absorb minerals from the soil and get their nitrogen in the form of nitrate from bacteria.

Animals need food, air, and water. Since we get our food by eating other organisms, we are called *heterotrophs*. We get our minerals by eating plants or things that ate plants. We get our nitrogen by eating things that contain protein. We also need vitamins, which are organic molecules made by other living things. Animals that get their food directly from plants are called *herbivores*. These that eat mostly other animals are called *carnivores,* and those that eat a variety of plants and animals are called *omnivores*.

In Lesson 3, we will take up the subject of how some of the major chemical elements of living things cycle in the environment. For now, be aware that all living things get their nutrients either from other organisms or from the nonliving environment.

Diet and survival needs change as an animal matures. Newborn mammals feed on milk, and pigeons too produce a milk-like substance to feed their young. Many insects, because they undergo metamorphosis, shift to a new diet when they become adults, and the adults of some insects eat nothing at all! In most animals, there is a transition from immature to adult at which point the animal becomes capable of reproduction. Activities in this lesson will help students learn how organisms invest resources and use particular strategies to take on the difficult task of establishing offspring. The life cycle is an important concept that will help students understand their own existence as well as that of other *species*.

Adaptation is another important ecological principle featured in this module. An adaptation is a characteristic of an organism that helps it survive in its particular environment and *niche*. Some examples include lungs for getting oxygen out of the air, fur for staying warm, big feet for walking on snow, or teeth for grabbing onto food. Adaptation is also the process of a species changing over time to become better suited to the environment or to keep up with a changing environment. *Evolution* occurs through mutation (changes in the *genes*) followed by selection (individuals with the new gene survive or reproduce better than those without). Contrary to popular misconceptions, adaptation is a blind process in that it does not anticipate future needs and in that most mutations are not beneficial. Adaptations do not necessarily benefit the species as a whole. Genes that cause an animal to defend its territory from other members of the same species would help that animal pass on its genes, but would not benefit the species.

Taxonomy, or classification into hierarchical groups, is one of the oldest branches of biology. A descriptive, rather than theoretical, science, it began with the assumption that similar species were derived from the same plan in the mind of the creator, called an archetype. Since that time, classification has moved toward using evolutionary relatedness, rather than overt similarity, as the basis for classification. Yet exact evolutionary relationships are often difficult to determine, so the taxonomy itself may evolve as new evidence is discovered.

Taxonomy is a hierarchical system, with groups of closely related species placed inside of larger groups of less closely related species. All life on Earth falls into five kingdoms: plants, animals, fungi, bacteria, and protists. Within each kingdom are smaller groups: phylum, class, order, family, genus, species. Because the evolutionary tree has branched many times, scientists often create new *taxonomic levels* such as subfamily, superfamily, etc.

A note on evolution and creationism: As a teacher, you may have encountered situations in which students have trouble reconciling what they are taught in school with what they learn at home. Life science poses a greater potential for conflicting ideas than other subjects. The science of biology relies heavily on evolution, and the New York State learning standards call for evolution to be taught. Evolution relates closely to several important ecological concepts such as adaptation and taxonomy; therefore, it is implicit in some of our activities. In cases where students are concerned about the differences between our scientific understanding and their religious teachings, some teachers explain that these are two alternative beliefs, and that the student is free to decide which one he or she wants to believe. In many cases, though, people find that the two ideas can be integrated successfully – that their religious beliefs do not rule out evolution. One of the teachers we work with enthusiastically teaches her students about the ways of biology and evolution, but is an active member of her church. If students can assimilate evolution in this way, they are less likely to be turned off to science than if they feel it is contrary to what they learn at home.

Seed Dispersal

Grades:

5th - 12th

Objective:

Students learn how adaptations work in the context of an organism's physical surroundings. Students develop scientific inquiry skills.

Methods:

Students test various seeds and determine their seed dispersal mechanisms. Students design a seed that will disperse by wind.

Materials:

Small beads or beans, a variety of wind-dispersed seeds, craft materials, large electric fan.

Time:

Preparation Time: 30 minutes, gathering seeds
Class Time: Two 40-minute class periods

Procedure:

1. Ask the class: What would happen if all of the seeds from a plant fell straight to the ground? You may wish to have students write or draw this scenario in their science journal. Then discuss: Seed dispersal prevents overcrowding and helps plants take advantage of unused *habitat*.

2. Ask the class how seeds are transported from one place to another. Seeds are dispersed by wind, water, animals, or thrown by the plant itself. On the board, make a table with one column for each dispersal method. Ask the class to give examples of seeds that are dispersed by wind, and write their examples on the board. They may list maple, cottonwood, dandelion, milkweed, cattail, ash, or others. Do the same for each of the other dispersal methods. There are no native plants in the Catskills that are dispersed by water, but the horse chestnut along the Hudson River is dispersed in this way. The coconut is also dispersed by water. Some seeds that are dispersed by animals are cocklebur, bur marigold, tick trefoil, raspberries, grasses, trillium, beechnuts, walnuts, and acorns from oak trees. Touch-me-not, witch hazel, and wild cucumber are self-dispersed.

3. Divide the class into groups of four. Give each group two or three seeds that are dispersed by wind. Each group should have seeds that are different than the other groups. Each group should describe each seed and how it is dispersed by wind. Each student should write down the description in his or her journal. The description should be accompanied by an enlarged drawing of the seed. The student should label parts of the seed that help it disperse. Each group should present their seeds and drawings to the class. They should describe each seed and explain how it is dispersed.

4. Have students test the performance of the wind-dispersed seeds. Each group will drop their seeds in front of a fan (six feet from the fan should be a good distance) and measure the distance they travel. This can be done in the hallway or in the classroom with the floor cleared. Each group should get two or three launches from a pre-determined height and then record the average times for each species of plant in their journals.

5. Each group will try to make a seed dispersal mechanism that represents their seed that is dispersed by wind. Give each group a small sized bead or bean. Each group must design a dispersal mechanism based on the real seed. The mechanisms should be able to disperse the bead or bean. Give students a week to complete the project. Students should draw blueprints of their mechanism. They should write a report that includes materials they used, how they constructed the mechanism, and any problems they faced during development. (A working replica of the maple seed is the most challenging.)

6. Schedule a day for testing the artificial seeds. Repeat the same procedure used for the real seeds. Which group's seed mechanism dispersed the farthest? Did any seed mechanisms disperse farther than the actual seed? If the artificial seed didn't work as well as the real one, what factors might account for this? Ask students to think of additional tests to see whether a factor, such as size, might affect the dispersal performance of seeds.

Extension:

1. Students can try to identify plant species by looking at the seeds used in this activity.

2. Students can conduct experiments to determine the effect of factors such as size on the performance of various seed dispersal methods. The activity above may give them some ideas for hypotheses they could test, such as: Parachuting works better for small seeds than large ones.

3. For more precise testing, students can measure the time it takes a seed to fall in still air instead of the distance it travels in wind.

Assessment:

1. Grade students on their journal entries. Check for accurate descriptions of seeds, accurate drawings of their artificial seeds, and recording of individual and average dispersal distances.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading, Speaking and Writing
Standard 4 – Language for Social Interaction: Listening and Speaking; Reading and Writing

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment: 1,4
Standard 6 – Interconnectedness: Models

Source: Adapted from “Seeds by Design” by Joyce Valenti in NYSED’s *MST Learning Experiences*.

Plant Game

Grades:

5th - 12th

Objective:

Students learn about decision-making and tradeoffs organisms must make to survive. They also learn scientific process skills.

Method:

Students play a game that simulates the growth of a plant using paper cutouts. They can compare different growth strategies to maximize the plant's reproductive success (flower production). The finished plants can be glued together and saved as a reminder of the activity.

Materials:

For each group:
Student instructions and tracking sheet, one sheet of blank paper, yarn cut into 2" lengths, colored paper cut into squares as described below: green, blue, white, and purple.

For teacher:
Weather chart, die.

Time:

Preparation time: 20 minutes
Class time: 50 minutes

Setup:

1. Set up for this activity by cutting up plenty of colored paper squares. For each color, put a few sheets together and cut them on a paper cutter into strips. Then cut strips into small squares. Each sheet of 8.5 by 11 inch paper will supply about 150, roughly ¾ inch squares. For a class of twenty working in pairs, you will need to cut up two sheets each of green and purple paper. Cut three sheets of white paper. You will need much more blue paper, so cut up four sheets of paper into squares and another sheet into 4-inch strips that will represent 10 units of water each. Also cut yarn into 2-inch pieces to represent roots. You will need about 200 of these.

2. You will also need to run off copies of the student instructions (or write them on the board for reference). You can copy the tracking sheet onto the back of the instructions or dispense with this

altogether for younger students.

3. Normally the teacher will determine the weather conditions for plant growth by rolling a die and reading the weather from a table. Optionally, using a paperclip and heavy paperboard, you can make a spinner, labeled with the appropriate weather outcomes.

Procedure:

1. Explain the activity to students. Explain that they will pretend to be plants and will have to make decisions about how to use their resources – water and sunlight – to help the plant grow.

2. Hand out the instruction sheet (if used), yarn, and colored squares to each group. The honor system is used to make sure students don't cheat, for example by adding parts to their plant when no one is looking. It's easier to give the students a pile of materials at the beginning than it would be to give out squares during the game only when students earn them. Each group of students should have a sheet of paper on which to grow their simulated plant.

3. Identify the various plant components. Students know that plants get their energy from the sun. Ask them to recall the name of this process – *photosynthesis*. In photosynthesis, plants use water, sunlight, and carbon dioxide to make sugar. The sugar is how they grow.

Component	Represents
green squares	leaves
purple squares	flowers
yarn	roots
blue squares	water
blue strips	worth 10 waters
white squares	sugar

4. Students begin by drawing a line across the page to indicate the surface of the ground. Then they take one leaf and one root, and arrange them on the paper. Students may draw a stem connecting the leaf to the root. This tiny plant is what you get when a seed germinates, and it grew to this size using the energy stored in the seed rather than directly from sunlight. Tell students the other leaves, roots, and other items should remain in a pile, unused, until the students are instructed to use those items.

5. Students should also take six waters from their pile to start the game with.

6. Using the rules sheet, explain the rules for each round of play. Explain that in plants, water is gained from the roots and lost through the leaves because of *transpiration*. Tell students that the goal is to have as many flowers as possible at the end of the growing season, when the first frost hits in the fall.

7. Roll the die the first time, and read the weather from the chart. Help students count out the appropriate number of sugars or waters. (Some may have to give water back to the pile.)

8. If you are using the tracking sheet, recommended for older kids, explain how to record each round of play on the sheet.

9. Roll the die again. Help students if needed, and make sure they know that they need water for photosynthesis. If no water is left, they can't get sugar until it rains (though they can still add leaves or roots using sugar they already have).

10. Continue rolling the die. The game can end at a predetermined time announced to the students, or you can introduce uncertainty by not telling students when the game will end. You can even announce at some point that a six on the die will mean frost instead of hot weather.

11. If desired, have students make graphs based on the tracking sheet.

12. Go over discussion questions and administer the quiz.

Weather Chart for the Plant Game

Die	Weather	Photosynthesis	Rainfall or Transpiration
1	stormy	no photosynthesis	gain 6 waters for each root
2	light rain	1 sugar for each leaf	gain 3 waters for each root
3	*cloudy*	1 sugar for each leaf	lose 1 water for each leaf
4	some clouds	2 sugars for each leaf	lose 2 waters for each leaf
5	sunny	3 sugars for each leaf	lose 3 waters for each leaf
6	sunny	3 sugars for each leaf	lose 3 waters for each leaf

Discussion Questions:

1. Was it better to grow a lot of roots, or a lot of leaves? First one and then the other? Have students discuss why some strategies worked better than others.

2. Do the plants in the game respond to their environment, or grow the same way regardless of conditions?

3. Do real plants think about how they should use their resources to grow the best? If plants can't think, how do they do the right thing?

Various mechanisms in plants produce the appropriate growth patterns in response to environmental factors. Biologists often refer to these responses as "decisions" even though no thought is involved, simply because the plant can select among alternative responses.

Extensions:

1. You might assign one group to be an aphid. This small animal is like a mosquito that feeds on plants. It feeds through a thin tube and draws sugar out of the plant's leaves and stems. In the game, once each turn the aphid can choose any plant to take sugar from, and can take up to four sugars each turn. The aphid tries to get as much sugar as possible and can produce one offspring for every six sugars. (The offspring disperse, or leave the area, so they aren't part of the game.) How does the presence of an aphid affect the plant's growth strategy? What if there is more than one aphid?

2. Would plants look different if you changed the weather chart? What would happen if there were more rain, less often? Less rain, more often? How would these contingencies affect the number of roots, leaves, and flowers over time?

3. Ask students to make up their own game that simulates the development or behavior of some other organism. Does their game show a degree of thought about real environmental factors and the costs involved in development?

Assessment:

1. Monitor student decision-making from one season of play to the next. Does the discussion within groups show a more sophisticated understanding of the factors that affect growth? Is there an increase in the number of flowers produced?

2. Use the enclosed quiz as an assessment. Quiz answers:

> 1. Water scarcity encourages roots. If there is plenty of water, it is better to grow leaves to increase sugar production. Therefore, the weather is an important environmental factor.
> 2. It's a good idea to get a lot of leaves first, to increase sugar production, and save making flowers for later.
> 3. Risk of an early frost would cause plants to produce flowers sooner.
> 4. In the mountains there is a shorter growing season so plants should flower sooner.

NYS Learning Standards:

Math, Science, and Technology
Standard 3 – Mathematics: Number and Numeration, Operation, Modeling, Uncertainty
Standard 4 – Science: The Living Environment 1-6
Standard 6 – Interconnectedness: Systems Thinking, Models, Equilibrium and Stability, Patterns of Change, Optimization
Standard 7 – Interdisciplinary Problem Solving: Connections

Source: Adapted from "The Plant Game: Plants' Strategies for Growth" by R. Beloin, M. Cordts, and M. Colvard. © 1996 Division of Biological Sciences, Cornell University, Ithaca NY 14853.

Plant Game Rules

1. The teacher will roll the die and read from the chart what the weather conditions are for each day. For example, on a rainy day, the plant will get 2 waters for each root and will gain one sugar for each leaf. On a sunny day, the plant would gain 3 sugars for each leaf, but it would also lose 3 waters for each leaf. A small amount of photosynthesis goes on even if it's rainy.

2. At the end of each turn, you can use sugars to add new leaves or roots to your plant. Leaves and roots cost 6 sugars each. You can also add new flowers, for 12 sugars each. You can save the sugars if you want and use them later. When you add a leaf or flower to your plant, draw a stem for it. You can arrange the parts any way you like.

3. Plants need water for photosynthesis. If you run out of water, you can't get any more sugar until it rains. If you are supposed to get two sugars and give up two waters, but you only have one water left, then you only get one sugar because you ran out of water.

4. Your goal is to get as many flowers as possible before the fall frost kills all of the plants. Your teacher will announce the frost.

Plant Growth Tracking Sheet

		How many did the plant have?*				
Day	Weather	Sugar	Water	Leaves	Roots	Flowers
start		0	6	1	1	0
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

* Write how many the plant had at the *end* of each day, after you get your leaves, roots, or flowers, if any.

Plant Game Quiz

Name:_______________________ Teacher:______________________ Date:______________

1. How did you decide whether to grow leaves or roots? How did the environment affect your decisions?

2. How did you know when to start making flowers?

3. If you had no idea when the frost was going to happen, would you start making flowers sooner or would you wait longer?

4. How would location (being in the Catskills compared to the Hudson Valley) affect your decisions?

Bear-ly Visible

Grades:

1st - 4th

Objective:

Students become more aware of Catskills wildlife and how animals survive.

Method:

Students read about *nocturnal* animals that live in the Catskill region. Each student then depicts an animal in its habitat with related items such as food, a nest, or offspring. Drawings are made on an overhead transparency using permanent markers. When viewed against black paper, the transparency forms a nighttime scene that can be viewed with a simulated flashlight beam.

Materials:

Field guides or books about Catskills wildlife
Overhead transparencies (one for each student, or cut in half)
Black paper
White cardstock
Cellophane tape
Permanent markers for each student
Optional: Overhead projector

Time:

Preparation Time: 10 minutes to gather materials
Class Time: 40 minutes

Procedure:

1. Tell students they will be giving a presentation to the class about one of the nocturnal (active at night) creatures of the Catskill Mountains. Give the students books and allow them to choose their own nocturnal animals, or assign each student an animal. Here are some examples, some of which are active in the daytime as well as at night.

great horned owl	screech owl	spring peeper (frog)	raccoon
opossum	white-tailed deer	white-footed mouse	northern flying squirrel
black bear	coyote	bobcat	little brown myotis (bat)
porcupine	striped skunk	gray fox	red fox
longtail weasel	mink	bullfrog	green frog
big brown bat	meadow vole	beaver	red bat

2. Students should read about the animal to find out what it eats, what kind of habitat it lives in, or similar information appropriate to grade level.

3. Students use markers to draw their animals on the overhead transparency material. Have them include the animal's surroundings and items such as food, nest, offspring, or predators.

4. Students tape their transparency to black construction paper (with tape only along the top edge) so the animal scene becomes nearly invisible against the dark paper. Talk about how it is difficult to see in the woods at night. How do animals get around this problem? Most nocturnal animals have large eyes that let in a lot of light. Some use echolocation (sonar) instead. They make high-pitched sounds and listen for echoes that bounce off of objects. Many mammals rely heavily on scent to find food at night. Humans use flashlights to make up for poor night vision.

5. Have the students make a "flashlight beam" from cardstock. When a white disk is inserted between the transparency and the black paper, the drawing becomes visible again as if lit.

6. Students speak in front of the class, each telling a few facts about his or her creature while using the nighttime scene as an illustration. Students should talk about what the animal is and how it lives, using their drawing to illustrate some of the animal's food sources, adaptations, or habitat features.

7. Quiz the students on selected information from the presentations. You may wish to write questions on the board and have the students answer them in their notebooks.

Variations: You may wish to have the students work in pairs. Assign one student to research and one to drawing. Then have the two students present to the class. The drawings can be displayed on an overhead projector using a round hole in a sheet of poster board as the flashlight beam.

Assessment:

Quiz the students on selected information from the presentations. You may also grade the transparencies and presentations, giving consideration to the quality of research, understanding of how the animal interacts with its environment, and effectiveness of presentation.

NYS Learning Standards:

Math, Science, and Technology
Standard 2 – Information Systems 1
Standard 4 – Science: The Living Environment 1, 5, 6

English Language Arts
Standard 1 - Language for Information and Understanding: Listening and Reading, Speaking and Writing

Source: Flashlight idea from Scholastic, Inc. *Hidden World* series.

Rival for Survival

Grades:

3rd - 7th

Objective:

Students learn the four basic survival needs of animals: food, water, shelter, and space.

Method:

Students play a physically active game in which they portray black bears and try to obtain enough food, represented by cards scattered on the lawn, to survive.

Materials:

Seeds, berries and fruit, plants, insects, and meat playing cards (all enclosed), blank charts (enclosed), paper lunch bags, and pencils.

Time:

Preparation time: 30 minutes
Class time: 45 minutes

Setup:

Photocopy each food card sheet onto a different colored sheet of paper. You need one copy of each for the entire class. Cut out each card and fold it in half. Make a photocopy of the blank chart for each student.

Note: The playing cards total to 1600 pounds. This is enough for twenty students. To adjust poundage for your class size, make sure there are about 80 pounds of food available for each student. If you change the total pounds, make sure it is 25% seeds, 25% berries and fruit, 25% plants, 15% insects, and 10% meat.

Procedure:

1. Ask the class what all animals need to survive. Animals need food, water, shelter, and space in the right combination. What types of food do black bears eat? Black bears are *omnivores* and get their food in forms of seeds, berries, plants, insects, and meat. They find their food mainly by smell, not sight. Black bears are thought to be able to smell at least 10 times better than humans. Where do black bears get their water? They get it from springs, streams, rivers, lakes, and

marshes. Where do they take shelter? Black bears take cover under evergreen trees, under ledges, in hollow logs, and also in caves. They make their dens in hollow logs and caves. How much space do black bears need? Male black bears usually occupy about 100 square miles of territory while females only occupy about 25 to 50 square miles.

2. Bring the class to a large playing area. Align students in a circle around you. Spread the cards evenly about the playing field. Tell students they are going to be black bears. Pass out paper bags and have the students write their names on them. Tell the students the bags represent their stomachs.

3. Students should mimic the black bears by walking on all fours when gathering food. Tell them the colored squares represent a variety of foods. Remind the students that black bears are omnivores so they should collect an assortment of colors. Remind the students that water, shelter, and space are also essential elements of survival, but the game does not emphasize those factors.

4. Assign one student as an injured bear with a broken leg. That student must keep one hand behind his or her back at all times. Assign another student as a bear who was blinded by a porcupine. Put a blindfold on that student. Assign a third student as a bear that is pregnant. Tell the students to begin foraging. Once all the colored papers are gone, return to the classroom.

5. Students should empty their bags onto their desks and unfold all the slips. Hand out copies of the food chart. Have them fill in the number of pounds for each food item. Then they should combine individual food sources to get a total food weight. A black bear needs 80 pounds of food every ten days. The pregnant bear will need twice that amount or the cub will not be born.

6. Students that got 80 pounds or more should raise their hands and be counted. Write down the total number of students that survived. Did the bear with the broken leg survive? How much food was it able to forage? What about the blind one? Did the pregnant bear get 160 pounds? If a pregnant bear does not double her body weight before winter, she will not give birth to a cub. Her body will not allow her to give birth unless she has enough fat to make it through the winter. She will live and will have another chance to have a cub the following year.

7. Tell the students to look at their food charts. Younger students: Compare the individual food source totals to the individual required food source totals. Older students: Each student should convert the individual food source totals into a percentage of the total poundage collected. They should compare the individual percent to the individual required percent. Ask the class: How many black bears obtained a balanced diet?

8. Why did only ___________ bears survive? How healthy are the black bears? Did they get the required nutrition needed? What percentage of the bears that did survive had a healthy diet?

9. Ask the students to consider a *habitat* with less available food, 800 pounds instead of 1600. They should divide the total by 80. How many bears could be supported in this habitat?

10. What types of natural and cultural factors could affect the availability of food, water, shelter, and space in the Catskill region? Students should write down factors in their Catskill journals. Give them about five minutes to make a list and then make a class list on the board. List what the factor is, what it will affect and how. Here are some examples:

1. A drought will decrease the availability of water and the amount of food.
2. Fire will decrease the amount of available food and it will destroy shelters.
3. Development of new buildings or houses will decrease the amount of space available.
4. A faulty septic system may pollute the water.
5. A disease of plants or trees could decrease the amount of food produced.

Extension:

1. Students can choose another animal that lives in the Catskills. They can research what it eats and how much, where it gets water, where it takes shelter, and how much space it needs. They should compare and contrast the black bear's necessary habitat components to that of another animal such as a mammal, bird, reptile, amphibian, or insect. They can present their findings to the class or write a short essay.

Assessment:

1. Grade students on quiz. Answers to quiz are as follows:

1. Food, water, shelter, space.
2. Seeds, berries and fruit, plants, insects, and meat.
3. Smell.
4. 8 pounds.
5. Any natural factor discussed during class.
6. Any cultural factor discussed during class.

NYS Learning Standards:

English Language Arts
Standard 1- Language for Information and Understanding: Listening and Speaking

Health, Physical Education, and Home Economics
Standard 1 – Personal Health and Fitness: Physical Education

Mathematics, Science, and Technology
Standard 3 – Mathematics: Operations
Standard 4 – Science: The Living Environment 5,6

Source: Adapted from Project Wild activity “How many bears can live in this forest?”.

Name:________________________ Teacher:__________________ Date:_________

	Seeds	Berries and Fruit	Plants	Insects	Meat	
						Total
Total (lbs)						
Needed (lbs)	20	20	20	12	8	80
Percent (%)						
Needed (%)	25	25	25	15	10	100

Name:________________________ Teacher:__________________ Date:_________

	Seeds	Berries and Fruit	Plants	Insects	Meat	
						Total
Total (lbs)						
Needed (lbs)	20	20	20	12	8	80
Percent (%)						
Needed (%)	25	25	25	15	10	100

Seeds 25	Seeds 20	Seeds 15	Seeds 10	Seeds 10	Seeds 5
Seeds 25	Seeds 20	Seeds 15	Seeds 10	Seeds 10	Seeds 5
Seeds 25	Seeds 15	Seeds 15	Seeds 10	Seeds 10	Seeds 5
Seeds 20	Seeds 15	Seeds 15	Seeds 10	Seeds 10	Seeds 5
Seeds 20	Seeds 15	Seeds 15	Seeds 10	Seeds 10	Seeds 5

Berries and Fruit 25	Berries and Fruit 20	Berries and Fruit 15	Berries and Fruit 10	Berries and Fruit 10	Berries and Fruit 5
Berries and Fruit 25	Berries and Fruit 20	Berries and Fruit 15	Berries and Fruit 10	Berries and Fruit 10	Berries and Fruit 5
Berries and Fruit 25	Berries and Fruit 15	Berries and Fruit 15	Berries and Fruit 10	Berries and Fruit 10	Berries and Fruit 5
Berries and Fruit 20	Berries and Fruit 15	Berries and Fruit 15	Berries and Fruit 10	Berries and Fruit 10	Berries and Fruit 5
Berries and Fruit 20	Berries and Fruit 15	Berries and Fruit 15	Berries and Fruit 10	Berries and Fruit 10	Berries and Fruit 5

Plants 25	Plants 20	Plants 15	Plants 10	Plants 10	Plants 5
Plants 25	Plants 20	Plants 15	Plants 10	Plants 10	Plants 5
Plants 25	Plants 15	Plants 15	Plants 10	Plants 10	Plants 5
Plants 20	Plants 15	Plants 15	Plants 10	Plants 10	Plants 5
Plants 20	Plants 15	Plants 15	Plants 10	Plants 10	Plants 5

Insects 16	Insects 12	Insects 8	Insects 6	Insects 6	Insects 4
Insects 16	Insects 12	Insects 8	Insects 6	Insects 6	Insects 4
Insects 16	Insects 8	Insects 8	Insects 6	Insects 6	Insects 4
Insects 12	Insects 8	Insects 8	Insects 6	Insects 6	Insects 4
Insects 12	Insects 8	Insects 8	Insects 6	Insects 6	Insects 4

Meat 10	Meat 8	Meat 6	Meat 4	Meat 4	Meat 2
Meat 10	Meat 8	Meat 6	Meat 4	Meat 4	Meat 2
Meat 10	Meat 6	Meat 6	Meat 4	Meat 4	Meat 2
Meat 8	Meat 6	Meat 6	Meat 4	Meat 4	Meat 2
Meat 8	Meat 6	Meat 6	Meat 4	Meat 4	Meat 2

Rival For Survival Quiz

Name:________________________ Teacher:______________________ Date:___________

1. List the four basic things an animal needs to survive.

2. List the five different types of food a black bear eats.

3. Which one of the five senses do black bears use most to find food?

4. How much food does a black bear need per day? (Hint: It needs 80 pounds every 10 days.)

5. Name something in nature that could affect food, water, shelter, or space.

6. Name something humans do that could affect food, water, shelter, or space.

Animal Tracking

Grades:

3rd - 6th

Objective:

Students learn to identify animal *signs* and learn about animal *adaptations*.

Methods:

Students make a list of signs animals in the Catskills leave behind. Students follow the pattern of four types of animal tracks and read clues of other signs left by the animals to try to determine which animal made the tracks.

Materials:

Animal track templates, stride patterns, clues, and quiz (all enclosed), scissors, glue, pencils, and a large roll of paper.

Time:

Preparation time: 30 minutes
Class time: 45 minutes

Procedure:

Preparation: Make photocopies of the templates. Make sure you have enough animal tracks of each type to make a trail about half of the length of the classroom. Cut out each footprint and use the stride pattern template to correctly place the tracks down. Tape the tracks securely to the classroom floor or glue them to paper from the roll of paper. Place the clues face down next to the tracks for the students to read as they follow them.

1. Ask students to name various animals in the Catskill Mountains that they have seen (mammals, birds, insects, etc.). If they haven't mentioned a certain animal such as the bobcat, ask them how we know there are bobcats living in the Catskills. It is unlikely a person would see a bobcat in the wild. How do we know they are in the Catskills? They leave tracks and other signs behind that we can see, as do most animals.

2. Divide the class into groups of four or five. Each group should have one piece of paper and a pencil. One person in each group should be the recorder. Tell them to make a list of signs that animals leave. After 10 minutes, ask each group to write some items from their list on the board.

3. Tell students to make a list of signs that humans leave. They should not write down every piece of litter or garbage they've ever seen; they should just write down litter. Give them some time to make a list and then have each group write some items on the board. Are the signs that humans leave more abundant than signs that other animals leave? Do animals affect humans with the signs they leave behind? Do humans affect other animals with the signs we leave behind?

4. Animal tracking is one way to identify animals that have been around and to understand their habitat, food source, and behavior. Other signs that help identify the animal and its habits often accompany animal tracks. The best time to look for tracks is after a snowfall or during the spring when the ground is muddy. The first step for identifying what animal left its track is to figure out its pattern. There are four basic patterns: straight walkers, hoppers, waddlers, and bounders. The next thing to look at is the size of the track. Follow the tracks to look for other clues that might help in identifying the animal. If the tracks lead to a tree and disappear, you can rule out some possibilities. For instance, deer can't climb trees. Field guides to animal tracks are very helpful in identification.

5. Have the class line up alongside each of the following tracks one at a time. Proceed to the next track after the animal is identified, all the clues have been read, and everyone has followed the tracks. Although we ask students to follow the tracks using the animal's own gait, in some cases the student will not be able to reach and should simulate the track pattern in miniature.

White-tailed deer: Ask students if they know what animal made the tracks. Does this animal walk on two legs? How does it walk? Tell students this is an example of a straight walker pattern. Ask a student to try to follow the pattern on all fours. Then others can try. To walk along this pattern correctly, students should move their left hand and right foot at the same time. As their left hand moves forward their left foot should go where their left hand was. Tell the class what animal left the tracks if they haven't figured it out. What other animals are straight walkers? (housecat, bobcat, fox)

Gray squirrel: Ask students if they know what animal made the tracks. Which are the hind feet? The fore feet? Which direction is the animal moving? Tell students this is an example of a hopper pattern. Ask a student to try to follow the pattern on all fours. To walk this pattern correctly, the larger hind feet land in front of the smaller fore feet. The squirrel moves its front feet forward. The hind feet follow and swing around the front arms landing in front of the fore feet. Tell the class what animal left the tracks if they haven't figured it out. What other animals move like squirrels? (mouse, chipmunk, rabbit)

Black bear: Students will quickly recognize these tracks by their size. Ask a student to try to follow the pattern. To correctly walk this pattern, the weight of the animal shifts to the left as the right hand and right foot move forward simultaneously. Then the weight shifts to the right, and the left feet move forward. Waddlers are usually slow-moving animals that have others means of defense besides running away. Tell the class what animal left the tracks if they haven't figured it out. Ask the students to name some other animals that have a means of defense without running away. Porcupines and skunks are also waddlers.

Weasel: Ask the students if they know what animal made these tracks. Ask a student to try to follow the pattern. To correctly follow this pattern, one must move all four feet at once. Weasels leap forward with their fore feet landing first, followed by their hind feet which land right behind their fore feet. The body moves like a slinky. Tell the class what animal left the tracks if they haven't figured it out. All members of the weasel family (mink, marten, fisher) are bounders with the exception of skunks.

6. Field trip: Take the class on an animal tracking field trip. Tracks can be found best after a snowfall or during the spring near muddy areas. Students should describe and draw in their Catskill journals all of the tracks and animal signs they find. They should write down when and where they saw each sign and record other pertinent information. The day before the field trip, you may wish to rake smooth an area of bare ground so tracks will show up better. You can even spread your own fine sand or soil to catch tracks, and you can use food to attract animals to the spot if it isn't too close to buildings.

Extension:

1. Plaster of Paris casts can be made from tracks found in good condition. Instructions can be found in most animal tracking field guides.

Assessment:

1. Give each student the quiz provided. In the blank boxes above each track, students should label the type of animal. On the back of their quizzes students should write the numbers one through four. Each number corresponds to the number for a track on the front. Next to each number students should write the type of stride and another animal sign they might find along with the track.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

Math, Science, and Technology
Standard 4 – Science: The Living Environment 1,7
Standard 6 – Interconnectedness: Common Themes: Models

Physical Education and Home Economics
Standard 1 – Personal Health and Fitness: Physical Education

Source: Adapted from activities in Shelburne Farms *Project Seasons*.

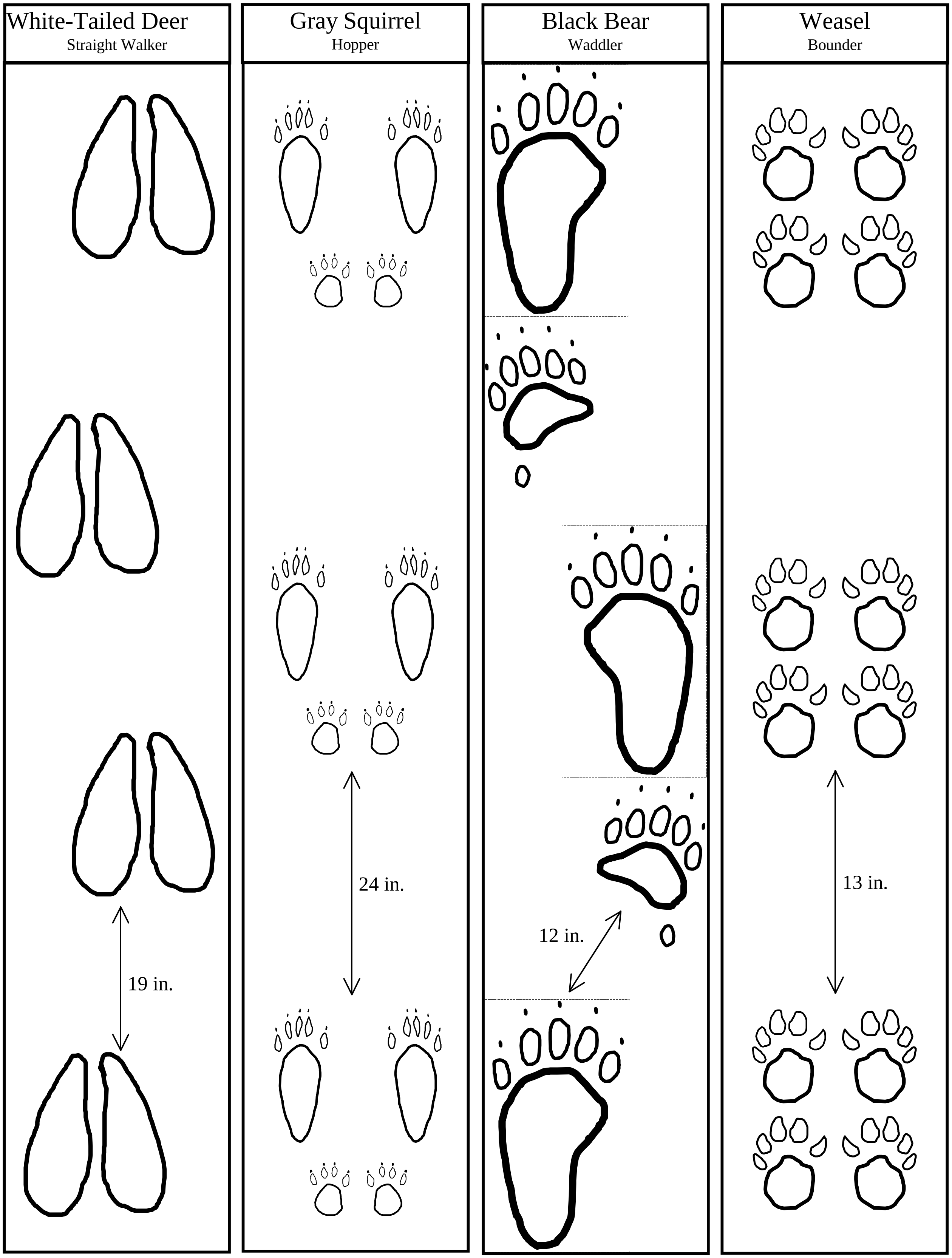
Animal signs

-*Scat*
-Tracks
-Broken acorn shells or other shelled seeds
-Scratch marks on trees from deer rubbings
-Claw marks from black bear and bobcat
-"Bear nests" - broken branches at the tops of beech or cherry trees
-Trails
-Broken branches from walking
-Browsed branches
-Antlers
-Nests (squirrel and bird)
-Woodpecker holes and chips on the ground
-Beavers signs such as: tree stumps, cut down trees, lodges, dams, and pond
-Snake skin
-Eggshells
-Eggs in ponds and ephemeral pools from fish, reptiles, and amphibians
-Feathers
-Owl pellets
-Exoskeletons
-Caddisfly cases
-Spider web
-Burrows in the ground
-Galls
-Cocoons
-Displaced seeds
-Displaced leaves where birds scratch for food
-Scratches in ground from bobcats covering up scat
-Decomposed leaf litter
-Leftover carcass or bones
-Worm castings
-Skunk scent
-Area where animals have bed down
-Fur along broken branches or tree trunks
-Overturned garbage cans from bears and raccoons

Human signs

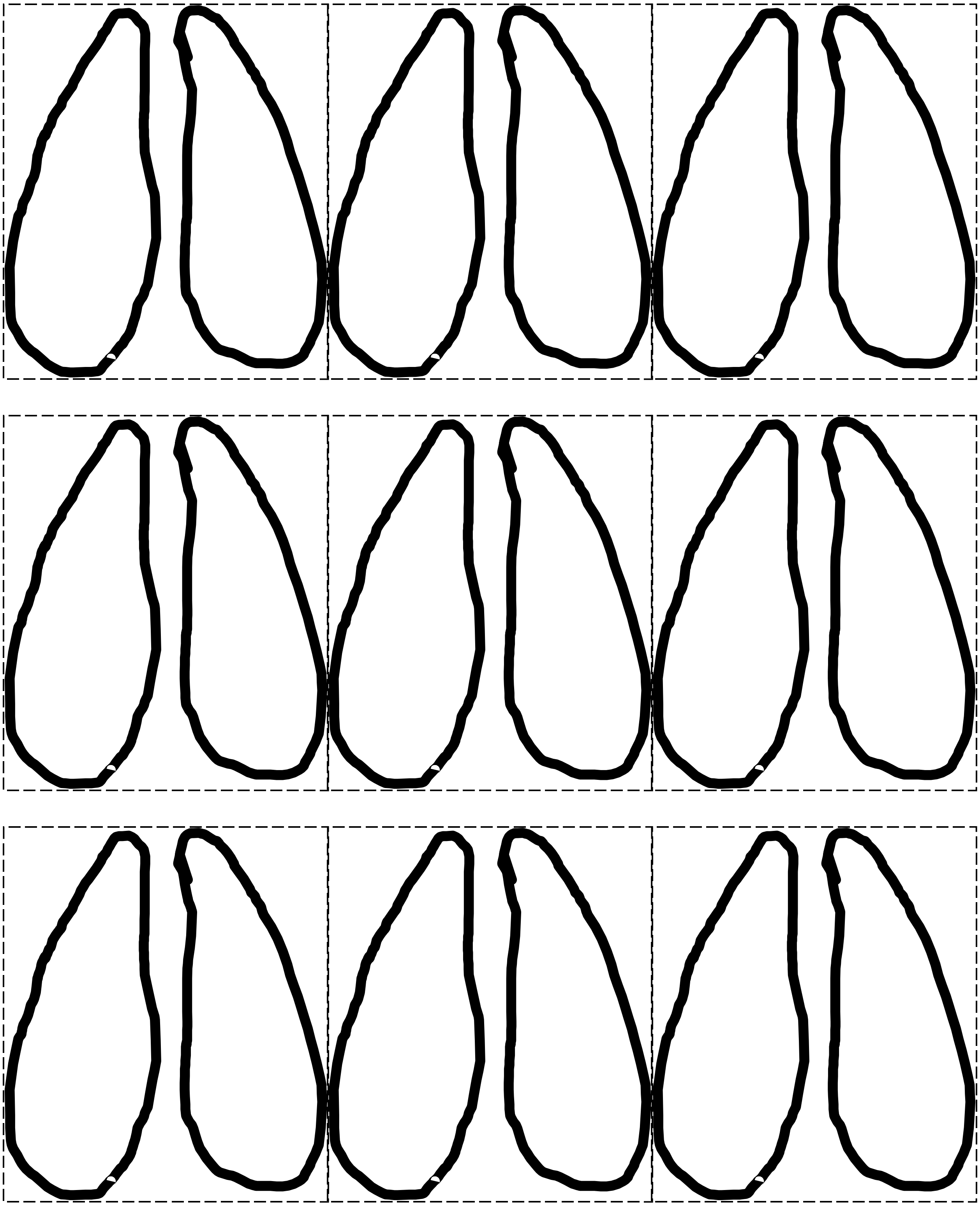
-Tracks (foot tracks, ski, snow mobile, off-road vehicle, bike, snow shoe)
-Trails
-Trail marker
-Registration box
-Lean-to
-Campfire
-Campgrounds
-Picnic areas (tables, grills)
-Beaches at lakes or campgrounds
-Bridges
-Rock steps
-Fire towers
-Cell phone towers
-Wells or structures around springs
-Litter
-Gun shells
-Hunting stands
-Guts from deer
-Fishing line and lures
-Gutted fish
-Fire
-Logging roads
-Logged forests
-Quarry roads
-Quarry mines and tailings
-Ski slopes
-Bird houses and feeders
-Stone walls
-Fences
-Grave stones
-Sap buckets or holes in maple trees
-Railroads
-Reservoirs
-Power lines
-Paved roads
-Road signs
-Covert pipes
-Aqueducts
-Land fills
-Buildings
-Parking lots

Stride Patterns



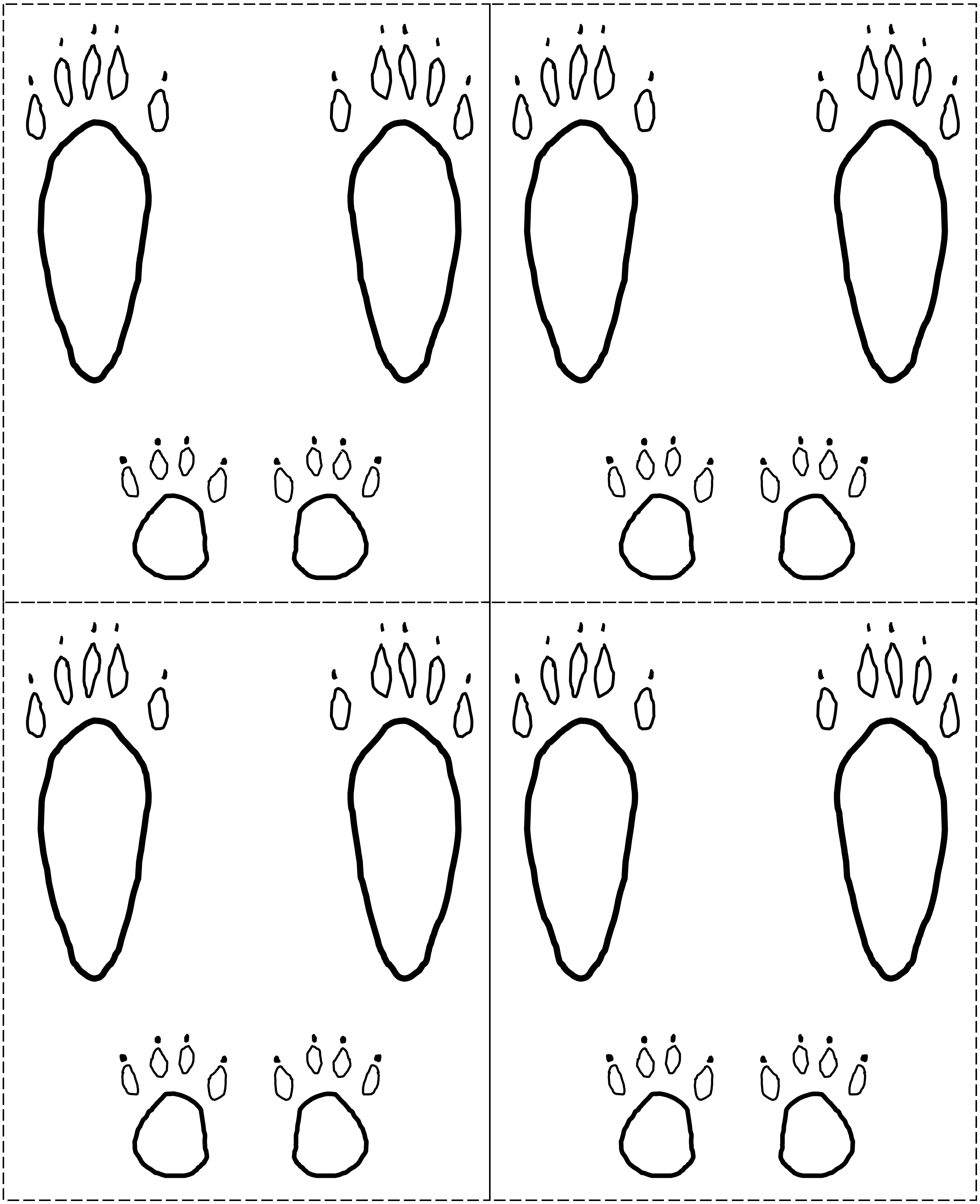
White-Tailed Deer

(Straight Walker)

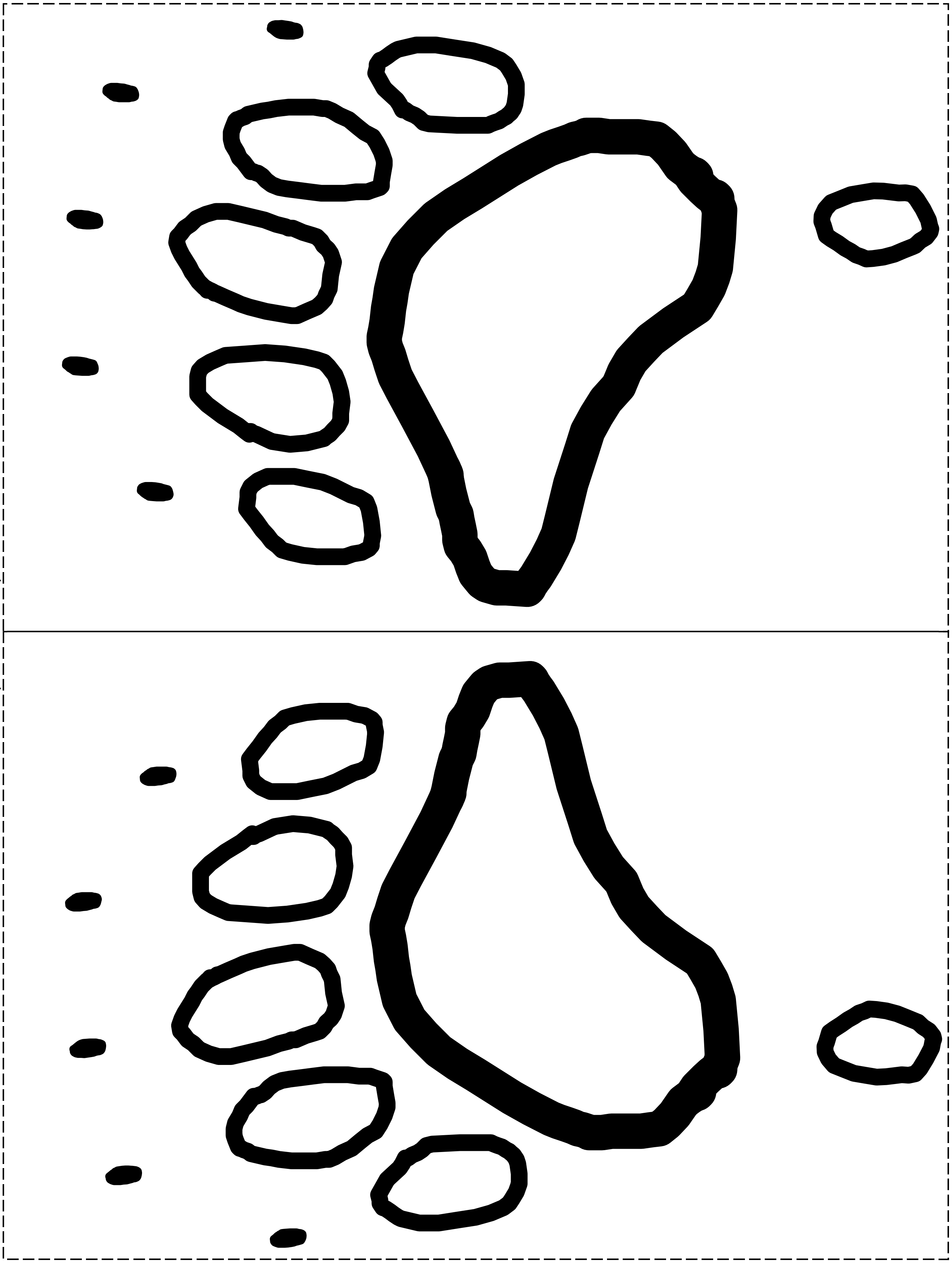


Gray Squirrel

(Hopper)



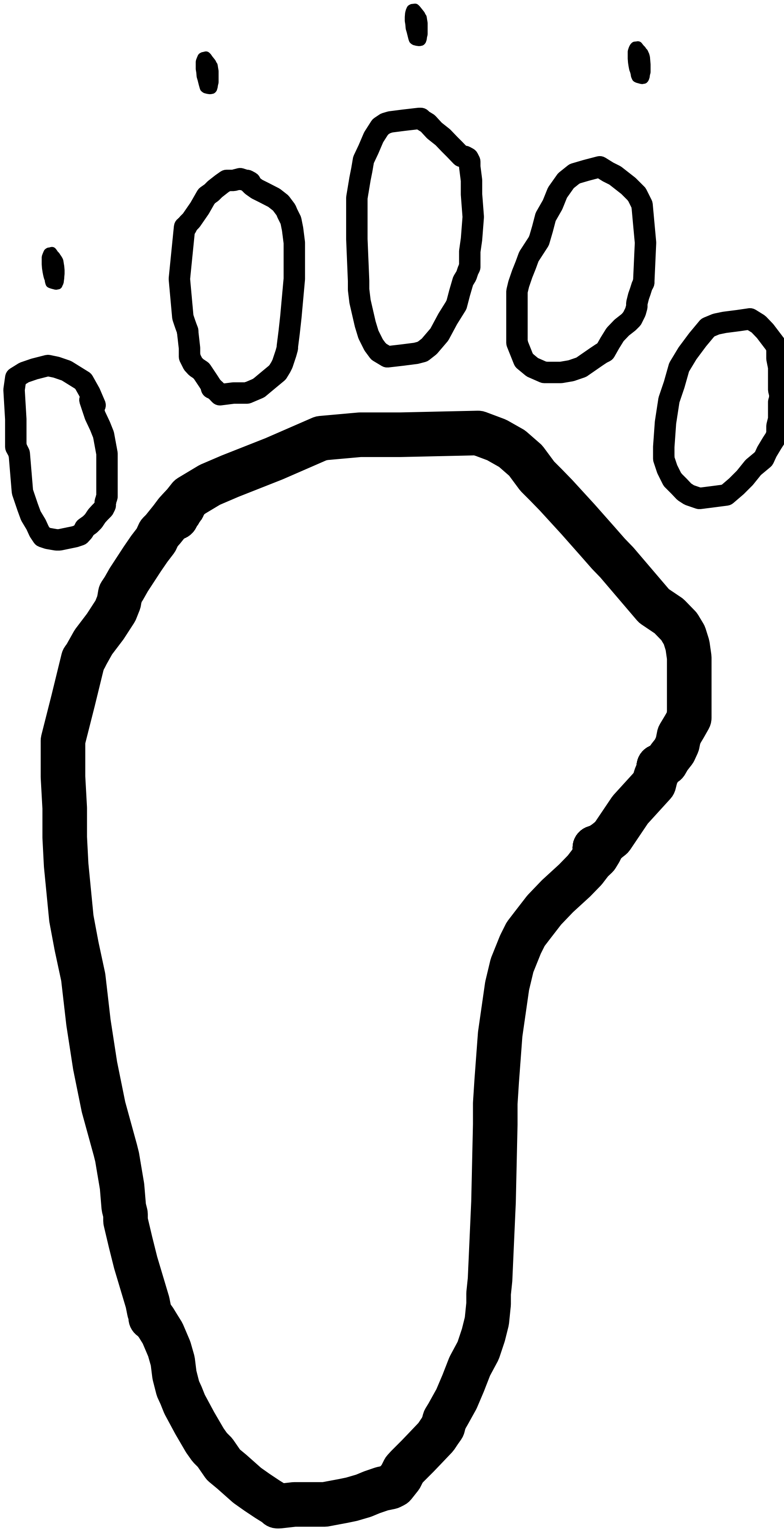
Black Bear (Waddler)



Right fore foot

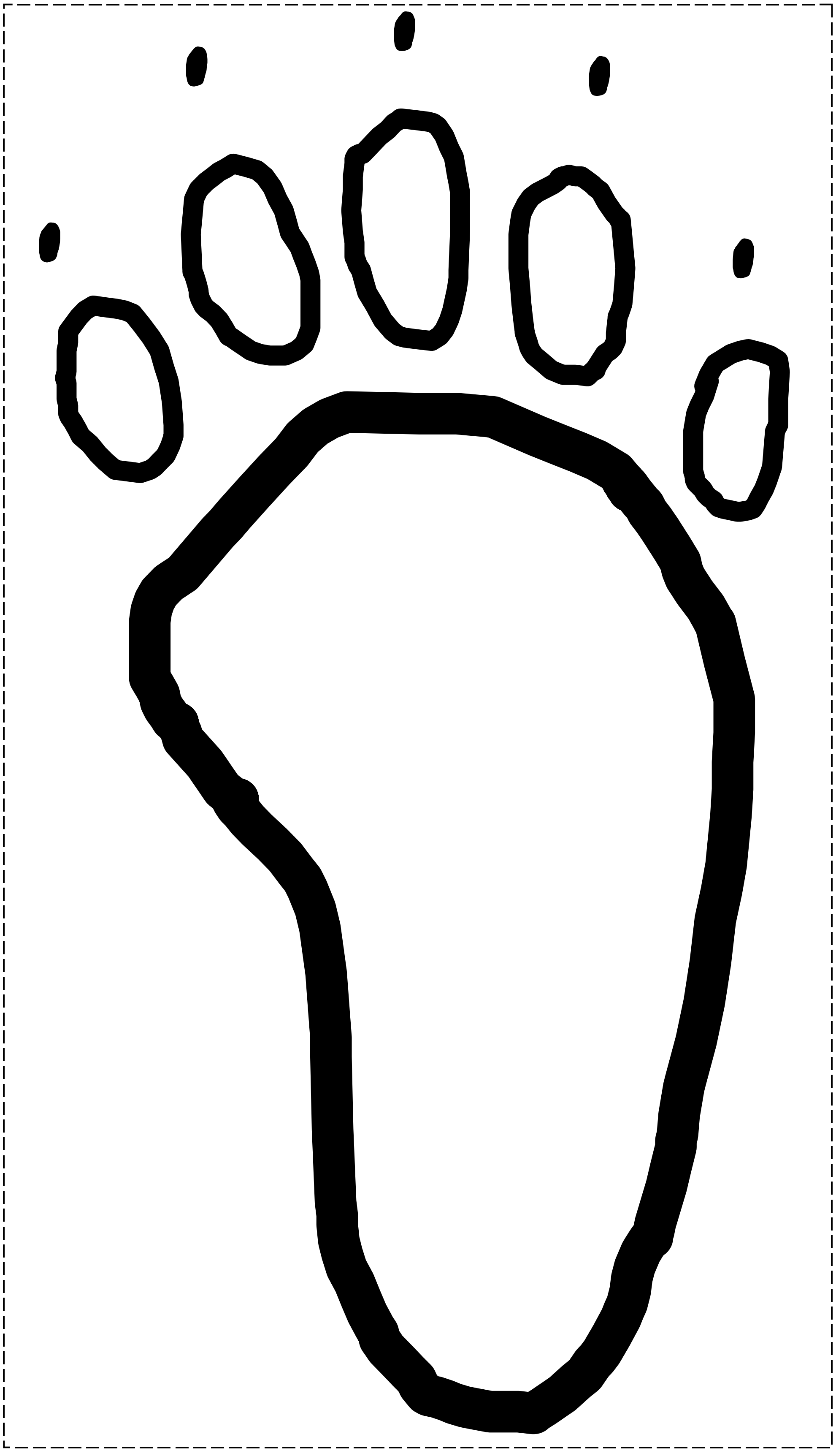
Left fore foot

Black Bear
(Waddler)



Left hind foot

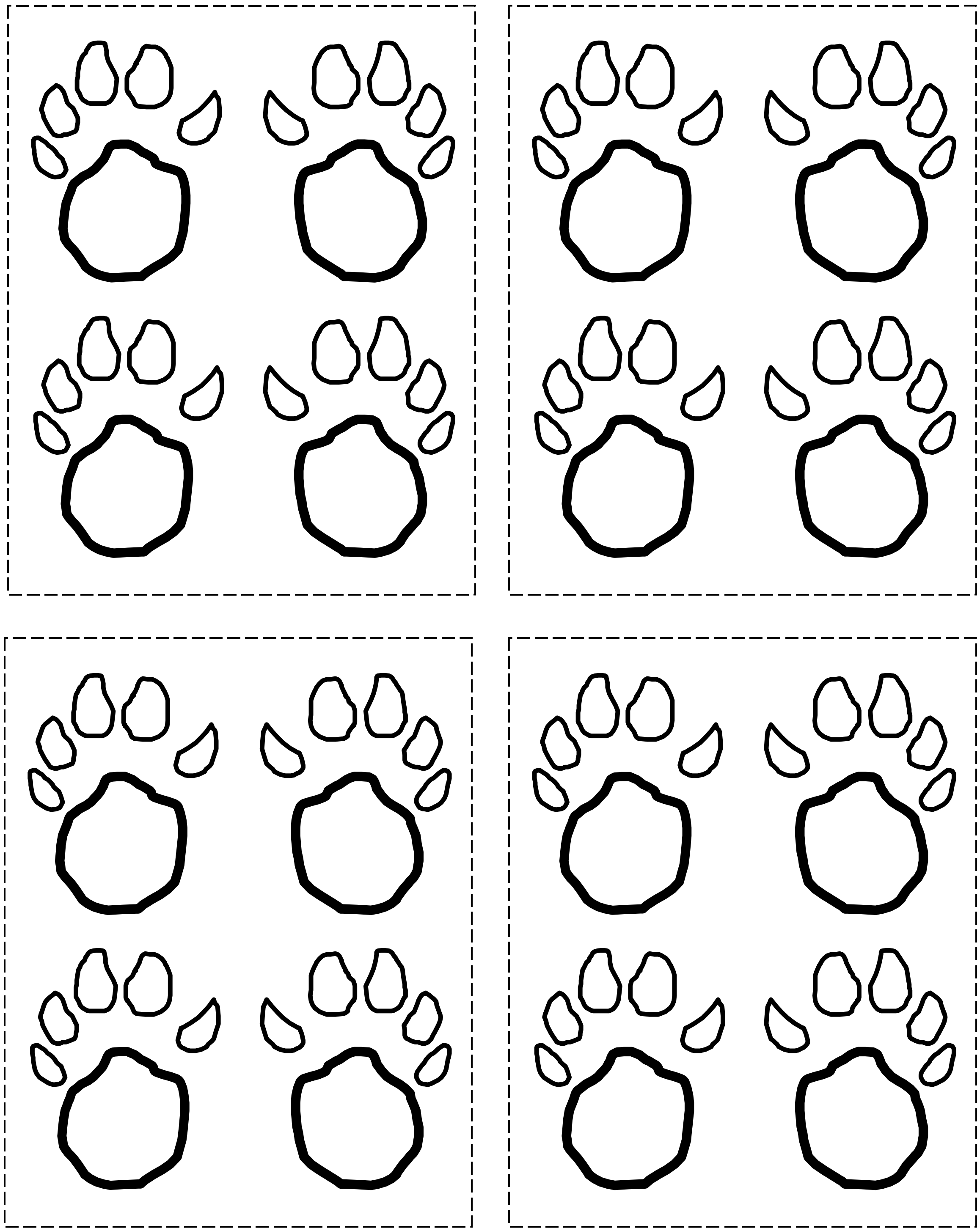
Black Bear
(Waddler)



Right hind foot

Weasel

(Bounder)



Life Cycle

Grades:

2nd - 5th

Objective:

Students learn how organisms reproduce and develop, often using different resources from the environment as they mature. Organisms change over time and differ from other organisms.

Method:

Students look up information on the life cycle of a particular organism. Then they depict the life cycle as a fictional story or in mixed media and relate it to the class.

Materials:

Reference books that contain information on life cycles, classroom internet access (optional).

Time:

Preparation time: 5 minutes
Class time: 40 minutes

Procedure:

1. Write the following organism names on slips of paper. Have students draw names out of a container so that each student is assigned one organism.

deer tick	tape worm	lichen	fern	mosquito
black bear	opossum	turkey	moth	beetle
sugar maple	mushroom	mayfly	crayfish	trout
hemlock wooly adelgid	aphid	ant	termite	wasp
beaver	deer	virus	bacteria	eagle
red-spotted newt	frog	salamander	cicada	cowbird

Some of the names refer to broad groups of organisms, such as mushrooms or beetles. The students may choose a specific mushroom or beetle, or they can describe what is typical of the group. The list of organisms above offers a variety of interesting life cycles.

2. Students go to the library or use books in the classroom such as encyclopedias to research the life cycle of their organisms. The internet will be helpful for the hemlock wooly adelgid, since it is a recent invader. The appendix includes info for trout and deer ticks.

3. While doing the research, each student must draw a circular life cycle diagram like those in the appendix. This step will clarify the life cycle and point out any gaps in the student's research.

4. Each student creates a story about the organism using words and pictures. The student can make a book, story wheel, or similar project. The student may write a fictional story about a particular member of the species and the adventures it has going through the life cycle, as long as life cycle events are emphasized.

5. Students present their stories to the class.

Assessment:

Older students can be quizzed on each other's presentations. Write questions on the board.

NYS Learning Standards:

Math, Science, and Technology
Standard 4 – Science: The Living Environment 1, 2, 3, 4, 5, 6

English Language Arts
Standard 1 - Language for Information and Understanding: Listening and Reading, Speaking and Writing

Build a Bird

Grades:

3rd - 6th

Objective:

Students learn what a *habitat* is. Students learn various bird *adaptations* (beaks, feet, wings, etc) that are suited for particular habitats.

Method:

Students are given a habitat and a food source as a basis to draw an imaginary bird that will have body parts that are well adapted for its environment.

Materials:

"Habitat/food source" cards (enclosed), drawing paper, and drawing utensils.

Time:

Preparation time: 10 minutes
Class time: 45 minutes

Procedure:

Preparation: Photocopy the "habitat/food source" cards twice, cut them out, and gather supplies.

1. Ask the class what a habitat is. Ask the class to give different examples of habitats and write them on the board. Ask the class what an adaptation is. Ask the class to give some examples of adaptations of animals that help them get and eat their food. How are organisms adapted for their habitats? Have the class give some examples.

2. Place the habitat/food source cards in a container and stir. Each student should take one card. Tell the students they will be asked to draw a bird that can live in the habitat and eat the type of food named on the card. Write the following questions on the board. Students should answer these questions in their journal before beginning to draw their animal.

Specifically, where will your animal find its food?
What difficulties might it have in obtaining food?
Does your bird get its food by using its beak, feet, or both?
What kind of beak or feet will it need?
Does your bird get from place to place mainly by flying, swimming, or walking?

What kind of legs, feet, and wings will it need?

4. When all students have drawn their birds they should present them to the class and describe how the bird is adapted to the habitat and how these adaptations help it obtain its food source.

5. Provide students with books illustrating real birds. Each student should look through the books and try to find a bird that lives in the same habitat and eats the same food as listed on his or her card. Next, students should compare these birds to their own drawings. What is similar? Different? As in nature, there may be various ways of adapting to the same habitat, so the student drawings will not necessarily look like the real birds.

Extension:

1. Students build models of their birds using craft materials. A potato can be used as the body.

2. Repeat this activity, using insects instead of birds. Students should consider various options for mouth parts (piercing, sucking, chewing), legs (walking, hopping, grasping, fast running), wings (large like a butterfly's or small like a bee's), and what the insect's life cycle is like.

3. Give each student the name of an animal that lives in the Catskill Mountains. Students should be able to recognize adaptations the animal has for surviving in its environment.

Assessment:

1. Do student drawings and presentations show an understanding of how body parts such as the beak and feet are shaped according to their functions?

2. Do students understand that differences among species relate to their different habitats and food sources?

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 1,2
Standard 6 – Interconnectedness: Systems Thinking; Models

Source: Kevin LaMonda, Phoenicia Elementary School, adapted.

Habitat: Lives in a wetland **Food Source:** Eats insects from the mud	**Habitat:** *Lives in a wetland* **Food Source:** Eats insects off the top of the water	**Habitat:** Lives in a wetland **Food Source:** Eats other birds
Habitat: Lives in a wetland **Food Source:** Eats fish	**Habitat:** Lives in a wetland **Food Source:** Eats underwater plants	**Habitat:** Lives in a wetland **Food Source:** Eats plants along the shore
Habitat: Lives in a forest **Food Source:** Eats insects off the bark of trees	**Habitat:** Lives in a forest **Food Source:** Eats small ground animals	**Habitat:** Lives in forest **Food Source:** Eats small ground animals at night
Habitat: Lives in a forest **Food Source:** Eats seeds and nuts off trees and shrubs	**Habitat:** Lives in a forest **Food Source:** Eats seeds and nuts off the ground	**Habitat:** Lives in a forest **Food Source:** Eats other birds
Habitat: Lives in a forest **Food Source:** Eats insects from the ground	**Habitat:** Lives near a field **Food Source:** Eats small ground animals	**Habitat:** Lives near a field **Food Source:** Eats other birds
Habitat: Lives near a field **Food Source:** Eats insects	**Habitat:** Lives near a field **Food Source:** Eats plants	**Habitat:** Lives near a field **Food Source:** Eats nectar from flowers

Catskills Critters Classification

Grades:

5th - 10th

Objective:

Students learn about similarities and differences among *species*, and how groups of *organisms* change over time, sometimes forming new species. This serves as a basis for understanding *taxonomy*.

Method:

Students classify a group of organisms (pictured on cards) based on their characteristics, constructing a *phylogenetic tree*. Students then assign names to the families, genera, and species in their classification system.

Materials:

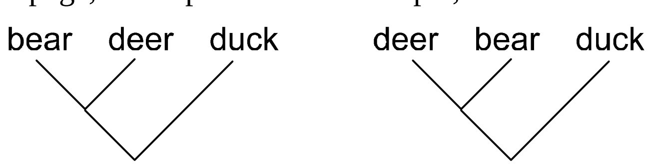
Copies of the appropriate critter sheet, enclosed, one copy for each group.
Use Set 1 for elementary school or Sets 1 and 2 for high school.
Large construction paper (one for each group) scissors, glue.

Time:

Preparation time: 15 minutes
Class time: 45 minutes

Procedure:

1. Explain to students how a “tree” diagram is used to show how species are related to each other. All species should be at the top of the page, with connections drawn between them as in the examples below. Show this on the board. Explain that the connections among species, and not their locations on the page, are important. For example, these trees both mean the same thing:



Older students can learn that scientists call these phylogenetic trees. *Phylogeny* refers to evolutionary descent.

2. Divide the students into groups of about 3 or 4. (Some of the optional variations listed below may require larger groups.)

3. Hand out a set of critter cards to each group.

4. Instruct the students to arrange the cards on their construction paper and draw a tree to indicate the relationships among the species. They should think carefully about their tree before gluing down the cards. Students should discuss: How can you tell a good tree from a bad one? Students should name each genus and species.

5. For high school students, use Set 1 for practice and then use Set 2. Students should name each family, genus, and species.

6. Each group should show the class their work. The class can then discuss any differences among the answers, and if they all got the same tree, they can discuss how they obtained the answer. Are some characteristics a better guide to relatedness than others are? Do all characteristics suggest the same tree?

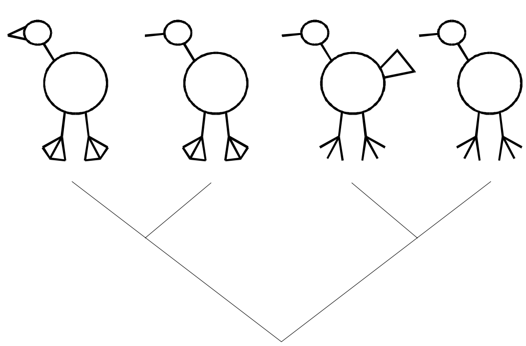
For high school students, explain that derived traits (those which evolved from an older, ancestral condition) are unlikely to have appeared independently in separate branches of the tree. Unusual or specialized adaptations most likely came from one common ancestor. Students should choose the simplest (most parsimonious) of the possible phylogenies, minimizing the number of times new traits must evolve independently in different branches of the tree.

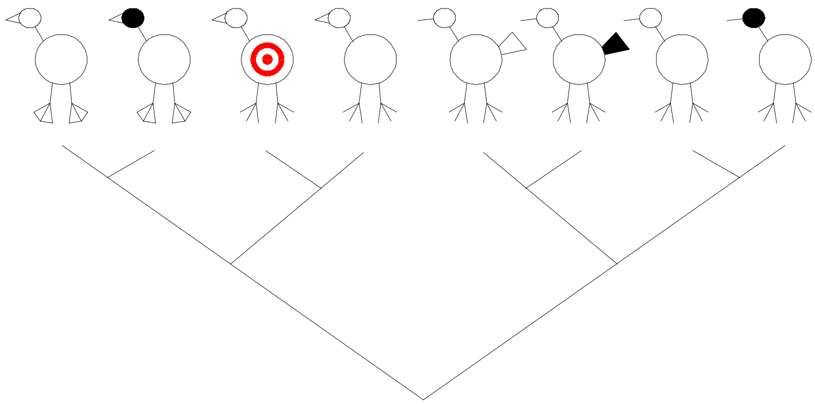
Options:

You could have the students invent and draw their own creatures for this activity. Have each student draw one creature. Then students work in groups to classify the creatures. This option sacrifices some realism because the creatures are created independently rather than having any real relationship to each other. Consider having students copy features from their neighbors to develop such relationships among species and to make them more aware that such relationships exist in nature. You could also use the creatures your students made in the Build a Bird activity.

Assessment:

1. Grade the phylogenies for accuracy, assigning points for each correct pairing. Correct answers are below. Keep in mind that there are several different correct ways to draw the same tree.





Note that the two birds with black heads are not in the same group. They *differ* with respect to foot type *and* beak type, so this is the most parsimonious of the possible phylogenies.

2. Student discussion and answers should show an understanding of descent with modification.

NYS Learning Standards:

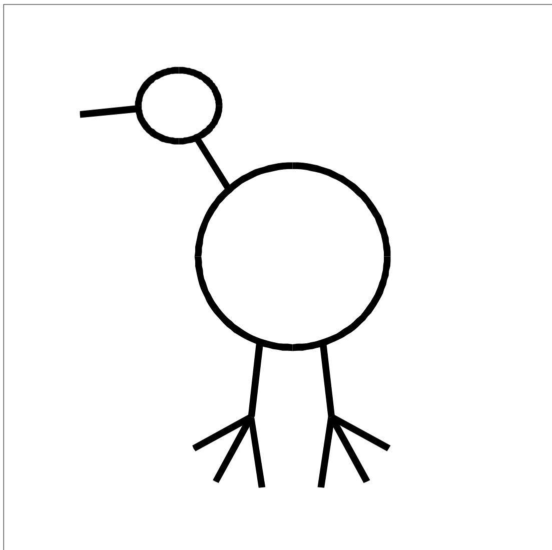
English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

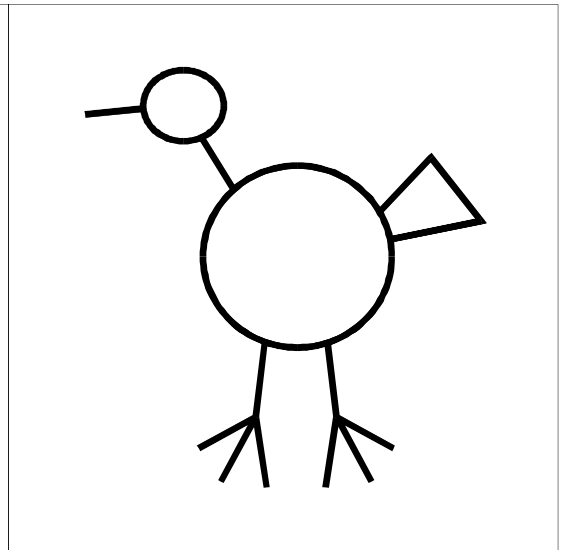
Math, Science, and Technology
Standard 4 – Science: The Living Environment 1, 2, 3

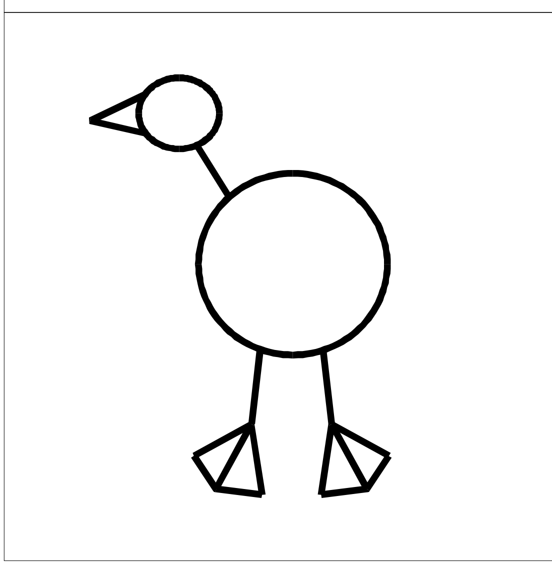
Source: Activity developed by Nathan Chronister.

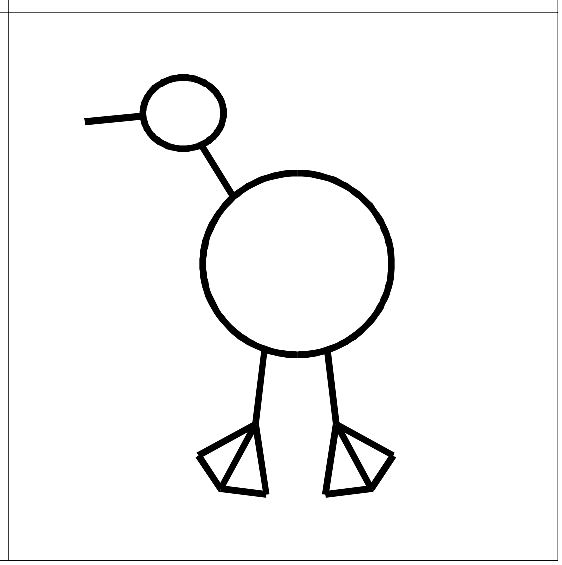
Critter Classification Cards – Set 1

You've just discovered the lost notes of Charles Darwin, describing his little-known visit to the Catskill Mountains in 1835. He wrote about a group of now-extinct bird species he called "Catskills Critters". Your task is to classify these elusive critters. First, cut out the cards. Then, draw a "family tree" that shows how the species are related to each other. Glue each picture to the correct place on the tree. Finally, decide on a name for each creature.



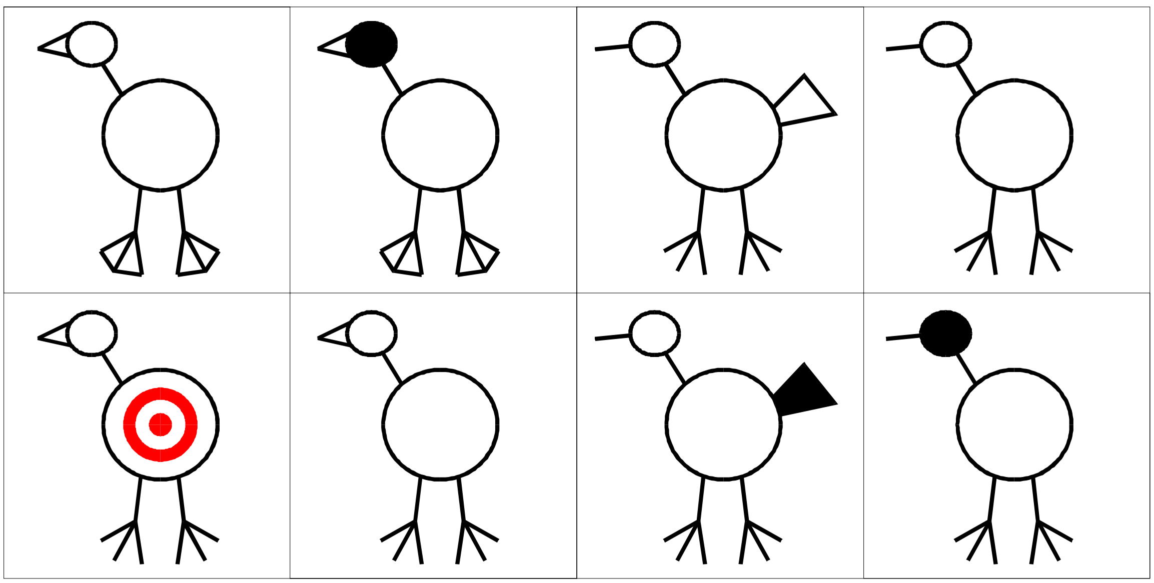






Critter Classification Cards – Set 2

First, cut out the cards. Then, arrange the cards on a piece of paper and draw a phylogenetic tree that shows how the species are related to each other. Then, decide on a name for each creature. You should use a binomial (two-part) name for genus and species. Also come up with a name for the family these creatures belong to.



Ecosystem Functions

In this lesson, we extend our study of Catskills organisms to look at the complex and fascinating matter of what happens when living things interact with other living things. To get what they need to survive and reproduce, organisms are tightly bound in a web of interdependence with other species. Interdependence results from specialization. Since each species has its own survival needs and its own ways of meeting those needs, situations often arise where one species depends on another to survive or even to reproduce. Interactions between species are diverse and can be categorized according to what effect the species have on each other.

Predator-prey interactions occur when a species uses another for food. We include in this category not only animals eating other animals but also animals eating plants, parasites that feed on an organism without killing it, or any relationship where an organism derives energy and materials from another live organism at the expense of the victim. Predators are also known as *consumers*, and prey organisms are called resource species.

Competition between species occurs when two or more consumer species each use the same resource and the survival of consumers is affected by the availability of the shared resource. For example, coyotes and foxes both compete for small mammal prey, and if there are too many coyotes, there might not be enough food for foxes or vice versa. In most cases, consumers compete indirectly for resources with no actual struggle between them. However, if the resource is defensible, direct competition may result. For example, coyotes might kill fox pups or drive foxes from their range to prevent foxes from eating their food.

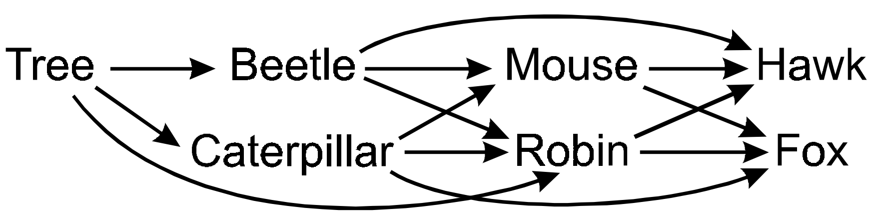
Commensalism, another type of relationship between organisms, occurs when one organism associates with another for its own benefit without having much effect on the host. *Detrivores*, for example, are organisms that feed on the already dead material produced by another species. Detrivores may feed on fallen leaves, carcasses, animal waste, or other leavings. They do not have a detrimental effect on the organisms that provide their food. Birds nesting in trees are also commensal. The bird benefits, but there is no obvious effect on the tree.

A closer look might reveal that tree in fact does benefit, for example if the bird eats insects that would otherwise damage the tree. Such mutually beneficial relationships between species are examples of *mutualism*. In the Catskills of old, ravens used to alert wolves to the location of potential prey, and in turn the ravens had access to the leftovers. Where wolves still exist today, ravens also help them find carrion because ravens cannot tear through the tough hides of large animals. Pollination by insects is another local example. Plants don’t have the ability to transport their pollen to other plants, but insects can do that very well. Plants offer payment in the form of nectar for the insects’ services. Individual bees tend to visit flowers of a particular species for a time, with the result that the pollen is not wasted on the wrong kind of plant.

Several types of interactions between species involve particularly close associations known as symbioses (singular, *symbiosis*). In a symbiosis, two species live together in close contact, often one inside the other. Vertebrates, including humans, are symbiotic with intestinal bacteria that produce certain vitamins and help us digest our food. Soil is full of important symbiotic relationships. *Nitrogen-fixing bacteria* associated with the roots of plants convert atmospheric *nitrogen* into a form, nitrate, that plants can use. Fungi also live among the roots of plants. They extract nutrients from the soil that the plant needs, and like the nitrogen-fixing bacteria, they receive *carbohydrates* from the plant. Even more amazing is that the mitochondria that carry out respiration in our cells are the descendants of free-living bacteria. Every eukaryotic (nucleate) cell is actually a colony of microbes living together. These organelles are such an integral part of us that it is difficult and perhaps misleading to think of them as separate organisms. The combined growth of algae and fungus known as a lichen is another example of two organisms merged into one. Symbioses are not always mutualistic, though. Internal parasites such as roundworms also fall into this category.

The *food web* is a simplified way of looking at how species interact. Here we look only at what eats what, and we ignore many other interactions among organisms. If you don't know what a food web is, you probably are familiar with a *food chain*. They are basically the same thing, but a food chain considers only one possible series of organisms eating other organisms, consumers eating producers, like this:

A food *web* is more complex and more realistic. As in real life, it shows how each producer or consumer can be eaten by a variety of other species:



In speaking about food chains, sometimes scientists speak of primary and secondary consumers. A primary consumer is one that eats a producer. A secondary consumer is two levels removed from the producer and eats primary consumers. A tertiary consumer eats secondary consumers, and so on. However, because of the complexity of food webs, a particular consumer may not always eat at the same level in the food chain, the same trophic level. A robin might eat an insect that has fed on trees, acting as a secondary consumer, or it might eat sumac berries, acting in a primary consumer role. Plants and some bacteria make their own food, so they are called *autotrophs*. Animals, fungi, and some microbes use energy from other organisms, so they are called *heterotrophs*.

The food web is an important part of the complex ecosystem of the Catskills, but it is not the whole story. Living things need many specific materials to survive. We need a variety of nutrients and they must be in a form we can use. The chemical elements that make our food are constantly recycled among various organisms from one form to another. For example, our bodies convert *carbohydrates* (sugar and starch) in the food we eat into carbon dioxide and water. We breathe out the carbon dioxide, and eventually it is used by plants to make more sugar. This recycling of *carbon* between carbohydrates and carbon dioxide is known as the *carbon cycle*.

Other materials, such as *nitrogen*, undergo similar cycles. In the nitrogen cycle, atmospheric nitrogen is converted to ammonia by *nitrogen-fixing bacteria* that live in the soil. Other soil bacteria, called *nitrifying bacteria*, then convert it to nitrate or nitrite. In these forms it can be used by plants, which use it to make proteins, nucleic acids, and other molecules. Animals take in nitrogen in the form of protein when they eat plants (or when they eat other animals). When plants and animals die, the bacteria that break down their bodies convert their proteins back to ammonia. We also excrete ammonia. Nitrogen can be returned to the atmosphere by *denitrifying bacteria*, which break down nitrate in the soil in order to obtain energy.

Other elements used by organisms also undergo cycles, but we won't discuss them all here. The important thing students should learn is not how a particular nutrient is cycled, but that organisms are specialized to use particular materials that are often the waste products of other species, and that continued cycling is a necessary condition for the ecosystem to remain in balance.

When natural cycles are disturbed, organisms tend to die. For example, when too much nitrate and phosphate from sewage are added to a pond, these necessary nutrients in abnormal amounts can cause the algae population to explode. Once these rapidly reproducing plants use up the supply of nutrients, they suddenly die off, and the resulting decomposition can use up all of the oxygen in a lake. Fish and insects that depend on high oxygen levels can die even if anoxic conditions do not persist. This process, called *eutrophication*, is an example of how an important natural cycle can go awry through poorly planned human activities. The final lesson in this module will further address human interactions with the ecosystem.

Stressed Out Trout!

Grades:

4th - 7th

Objective:

Students learn how environmental stressors affect mayfly and trout *populations*.

Method:

Students represent environmental stressors, mayflies, trout, and flyfishers during a physically interactive game.

Materials:

Data sheet and blank graph for each student, overhead of datasheet, pencils, markers.

Time:

Preparation time: 20 minutes
Class time: 40 minutes

Procedure:

1. Ask students to share what they know about stressors. People can undergo stress. So can physical structures or any balanced system. Environmental stressors are things that tend to upset the normal cycles of an ecosystem, often leading to changing species populations.

Ask students what an aquatic organism such as the mayfly needs to live. Mayflies live on the bottom of stream under rocks, where they breathe oxygen from the water. Have students give some examples of environmental stressors that might affect organisms in a stream. How can runoff affect the amount of oxygen in the water? Runoff from urban and agricultural areas often brings sewage and fertilizers to streams. The sewage and fertilizer contains high amounts of nutrients that algae and bacteria thrive on. The algae and bacteria use up the oxygen in the water, making it unavailable for stream insects such as mayflies. If the mayflies do not have enough oxygen they will not survive. How will the decrease in mayflies affect the amount of fish in the stream? The fish that feed upon these insects will also be affected because their food source (and oxygen) will be depleted. How can runoff destroy a mayfly's habitat? Runoff carries sediments from poorly maintained cropland and sparsely vegetated stream banks. This sediment covers up the rocky areas where the mayflies live and smothers them.

2. Bring students to an open, grassy playing field. To avoid injuries such as scraped knees, do not

attempt this activity indoors or on a surface other than grass. Tell the students they will be playing a game in which they will portray environmental stressors, mayflies, trout, or flyfishers. They will be playing a physically interactive game in which they will be chasing and tagging each other. Explain that students are not allowed to tackle, trip, push, or do any activity that could cause a classmate to fall, on penalty of removal. The playing area is a rectangle with two long sides and two short sides. Establish boundaries using trees or any object that students won't trip on. If a student runs outside of the boundaries it is the same as being caught.

Control Round (no environmental stressors): Assign two students as flyfishers, six students as trout, and the rest as mayflies. Line the mayflies along one short end of the playing area. Line the trout along the sidelines, mid-field. At your signal, the mayflies are to run to the other end and try to avoid getting tagged by the trout. If a mayfly gets tagged, he or she should stand still until the tagged mayflies have been counted. After all of the untagged mayflies have made it to the other side, instruct them to go to the sidelines. The mayflies that got tagged should move to the sidelines after they have been counted. Record the number of mayflies caught. All trout that did not catch a mayfly die and also move to the sideline. Line the trout that survived at the same end of the field that the mayflies started at. Position the flyfishers mid-field on opposite sides. At the signal, the trout are to run from one end of the field to the other. If tagged, they should remain still until they have been counted. Record the number of trout caught.

Note: Now we add environmental stressors, in addition to flyfishers, trout, and mayflies. As the number of stressors increases, the beginning number of mayflies decreases.

Round 1: Assign two students as flyfishers, six students as trout, one as an environmental stressor, and the rest as mayflies. (Results will probably be more consistent if you keep the same students as flyfishers and trout. Don't let the students change roles.) Line the mayflies along one end of the playing area. Position the environmental stressor mid-field. At the signal, tell the mayflies to run from one side to the other and try to avoid being tagged by the environmental stressor. If they are tagged they are to go to the sideline. After all of the untagged mayflies make it to the other side, tell them to line up again. Line the trout up mid-field. At the signal, have the trout try to tag the mayflies. Any trout that tag mayflies then have to run past the flyfishers, as in the control round.

Round 2, 3, 4, etc.: Use two, three, four, etc. environmental stressors and proceed to play following the rules of round one. Each round, add another environmental stressor. The number of rounds played will be limited by how many stressors it takes to catch all of the mayflies so there won't be any food for the trout. The number of rounds played will vary depending on the class.

3. Use the blank data sheet provided to keep track of the number of mayflies and trout caught during each round.

4. After all rounds have been played, return to the classroom. Hand out copies of data sheets and blank graphs. Ask students: What effect did the environmental stressors have? When was it easiest to catch mayflies? When was it easiest to catch trout? Display the data sheet overhead.

Instruct students to copy the data onto their own data sheets as you write it on the overhead. Instruct students to plot the data on the blank graph paper. They can make a line or bar graph. They should use two different colored pencils or markers for mayflies and trout. They should color in the boxes in the legend the color they will use to represent the number of mayflies and trout caught. Students should also answer the questions at the bottom of the data sheet.

Extension:

1. Conduct a study of a nearby stream by following the Lesson 2 activities in Module I: *Water Resources.*

2. Students or groups of students can research a type of fish that lives in Catskill Mountain streams give a classroom presentation about the fish. They should discuss where it lives in the stream (pool, riffle), and what it eats. They should also address what types of environmental stressor affect the fish both directly and indirectly through its food source. Can they do anything to decrease the environmental stressors?

Assessment:

1. Grade students on their graphs and the questions at the bottom of the data sheet. Answers to questions are as follows:

    1. Sewage decomposition uses up the oxygen so mayflies don't have enough to survive.
    2. There will be few or no trout if their food source is depleted.
    3. A drought can decrease the population of mayflies. The drought will decrease the water level of the stream and therefore some of their habitat will dry up. A drought is usually accompanied by high water temperatures, which will decrease the oxygen levels.

2. Students should be able to relate events in the game to real life events such as predation, death of organisms due to environmental stress, or changes in population.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Health, Physical Education, and Home Economics
Standard 1 – Physical Health and Fitness: Physical Education

Mathematics, Science, and Technology
Standard 3 – Mathematics: Modeling/Multiple Representations
Standard 4 – Science: The Living Environment 4-7

Source: Activity developed by Nathan Chronister and Marie Ellenbogen.

Name:_____________________________ Teacher:__________________ Date:___________

	Number of Mayflies Caught By Trout	Number of Trout Caught By Flyfishers
Control Round - No Stressors		
Round 1 - One Stressor		
Round 2 - Two Stressors		
Round 3 - Three Stressors		
Round 4 - Four Stressors		
Round 5 - Five Stressors		
Round 6 - Six Stressors		
Round 7 - Seven Stressors		
Round 8 - Eight Stressors		
Round 9 - Nine Stressors		
Round 10 - Ten Stressors		

1. Give an example of an environmental stressor and describe how it will affect the mayflies.

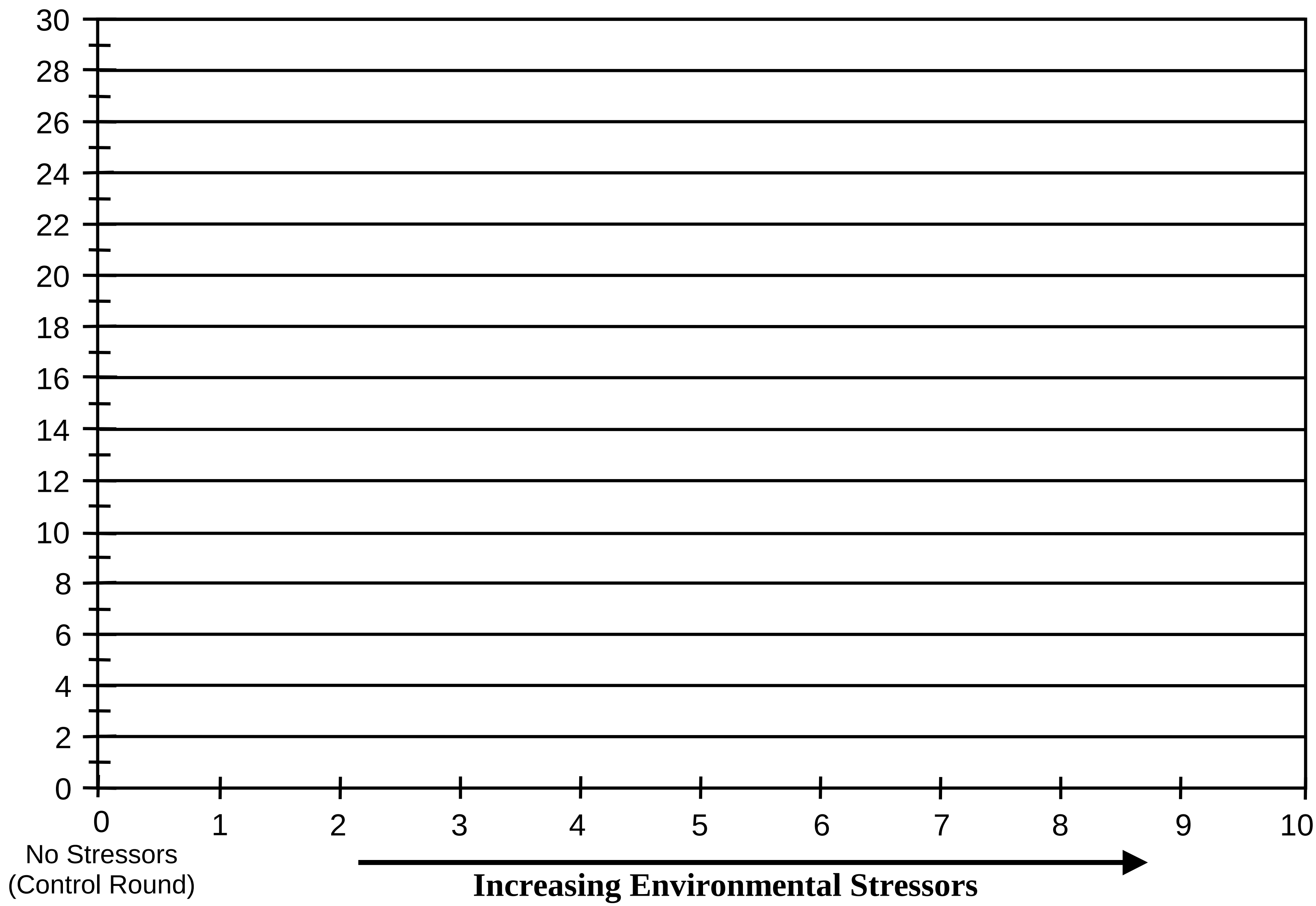
2. What will happen to the trout if their food source is no longer available?

3. Give an example of a natural factor that would change the mayfly population. How will it change the mayfly population?

The Effect of Environmental Stressors on the Number of Mayflies and Trout in a Stream

Name:_______________
Teacher:_____________
Date:___________

□=Number of Mayflies Caught by Trout
□=Number of Trout Caught by Flyfishers



Population Fluctuation

Grades:

3rd - 6th

Objective:

Students learn the necessary elements animals need to survive and how these elements can limit a *species population* size.

Method:

Students play an interactive game in which they represent deer and elements of a *habitat*.

Materials:

Data sheet and graph (enclosed), pencils, markers, acorns, paper cups, and small twigs, one for each student. Overhead of data sheet.

Time:

Preparation time: 20 minutes
Class time: 40 minutes

Procedure:

1. Ask the class what four things all animals need to survive. List the four necessary habitat elements on the board: food, water, shelter, and space. What would happen to a population of deer if there were an abundance of food? Would the population continue to increase forever? Eventually, the population would decrease because there would not be enough food for all of the deer. Food, water, shelter, and space can all limit the size of a population. There are other natural factors that limit population size such as disease, varying weather conditions, and predator/prey relationships. There are also cultural factors such as pollution and habitat destruction.

2. Bring the students to an outdoor playing field. Choose one fourth of the class to be deer. The rest of the class will be habitat elements: food, water, shelter, or space. Place the deer about thirty feet from the rest of the class. Tell the deer that they need to find one of the necessary elements in order to survive. If they want food, they will hold up an acorn. If they want water, they will hold up a cup. If they want shelter, they will hold a piece of the small branch over their head. If a deer wants space, it should hold it empty hands. The students that are habitat elements will use the same symbols. The deer and the elements turn their backs to each other. The deer decide which element they need and use the proper symbol. The elements decide which one they will be and

use the proper symbol. When everyone is ready, tell the deer and the elements to face each other. The deer have to match their symbols up with the elements that have the same symbol. Only one deer can match up with an element. They cannot change their symbols during the round, only between rounds. If a student matches up with an element, this symbolizes survival of that deer. The element becomes a deer to symbolize reproduction. If a deer did not find its symbol, it dies and becomes an element. Play about ten rounds and record the number of deer each round.

3. After about ten rounds, bring in a natural limiting factor, the coyote. The coyote stands midway on one side. When the deer go by, the coyote tries to hunt one down. If a coyote catches a deer, the deer becomes another coyote. If a coyote does not catch a deer, it becomes an element. Keep track of the deer and coyote populations on the data sheet.

4. Instead of the coyote, you can use a cultural limiting factor such as a hunter. The hunter gets one shot per round using a nerf ball as a bullet. If a deer is hit, it becomes an element.

5. After the game, reassemble in the classroom. Ask the class to describe what happened during the activity. Did the deer population stay the same or did it change? What caused it to change? Was the coyote a limiting factor? The hunter? Hand out data sheets and blank graphs. Display the data sheet overhead transparency. Write in the numbers you recorded when playing the game. Have the students copy the numbers. Instruct each student to draw a line graph on the blank graph provided. Remind them to use a different color for the deer and the coyote. After the graph is complete, they should answer the questions at the bottom of the data sheet.

Extension:

1. Students can research deer populations in the Catskills over the past 10, 20, 30, etc. years.

Assessment:

1. Grade students on their graphs and on the questions at the bottom of the data sheets.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Health, Physical Education, and Home Economics
Standard 1 – Personal Health and Fitness: Physical Education

Mathematics, Science, and Technology
Standard 3 – Mathematics: Modeling/Multiple Representation
Standard 4 – Science: The Living Environment 4-7

Source: Adapted from the Project Wild activity “Oh Deer!”.

Name:____ Date:_____/_____/_____
Teacher:____ Grade:______________

	# of White-Tailed Deer		# of White-Tailed Deer	# of Coyote
Year 1		**Year 11**		
Year 2		**Year 12**		
Year 3		**Year 13**		
Year 4		**Year 14**		
Year 5		**Year 15**		
Year 6		**Year 16**		
Year 7		**Year 17**		
Year 8		**Year 18**		
Year 9		**Year 19**		
Year 10		**Year 20**		

1. What are the four things that an animal needs to stay alive?

2. Do populations remain the same or change over time?

3. What is an example of a natural limiting factor?

4. Give one natural factor that could affect the deer population? How will it affect it?

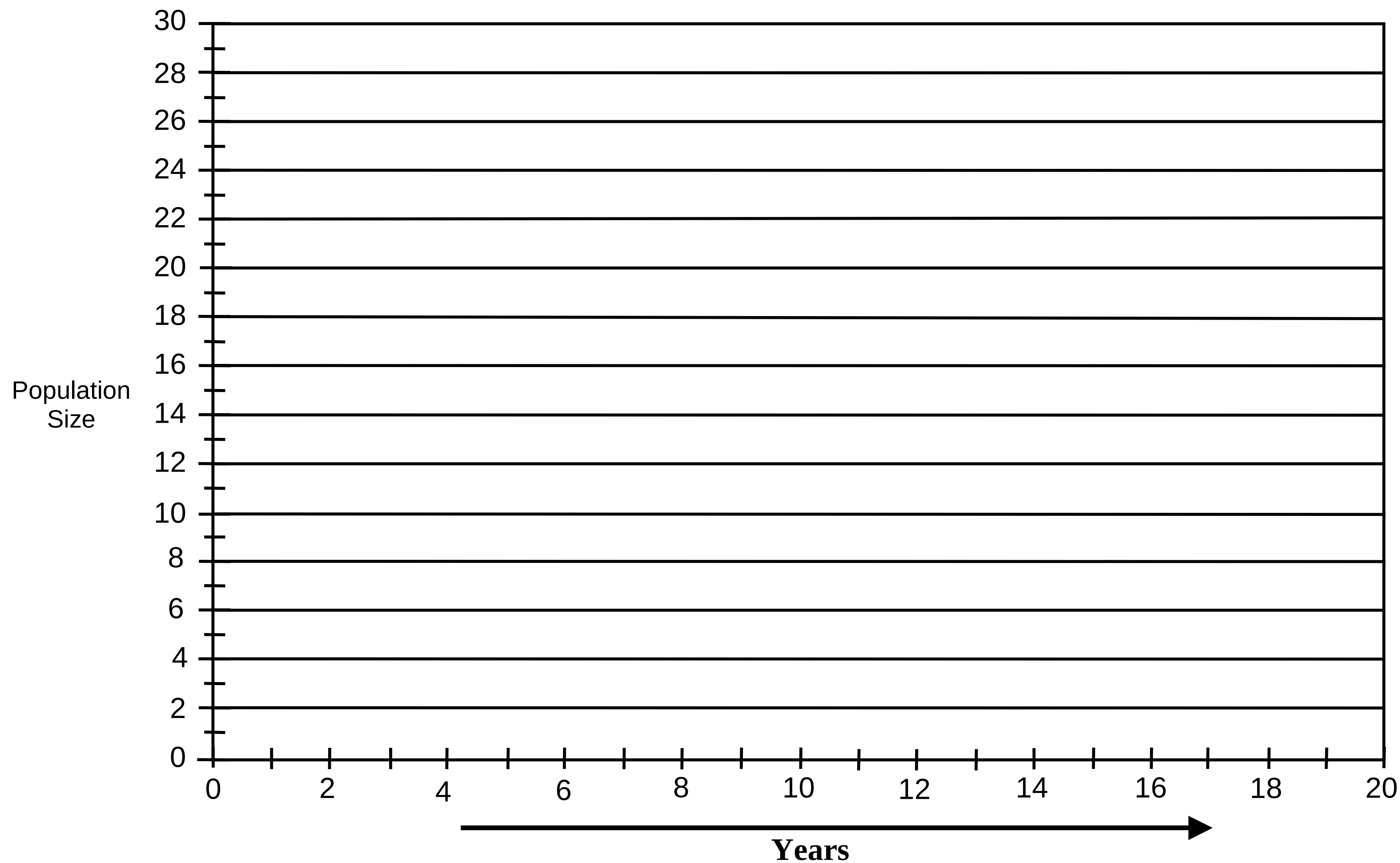
5. Give one cultural factor that could affect the deer population? How will it affect it?

6. What would happen to the coyote population if a disease wiped out more than half of the deer population?

Population size of prey species with and without the affect of a predator species

Name:________________
Teacher:______________
Date:____________

☐= Number of White-Tailed Deer
☐= Number of Coyotes



Virtual Ecosystem

Grades:

3rd - 12th

Objective:

Students will understand competition between different *species* in an *ecosystem*. They will learn how disturbances can affect the balance of an ecosystem.

Method:

Students will simulate an ecosystem by playing a game. In the game, each student represents one of the plants competing for space in a *habitat*. Students then discuss how the simulation relates to a real ecosystem.

Materials:

Role cards, worn around the neck:

Copy the enclosed aster drawing onto one side and the sorrel drawing onto the other. Tie yarn, about 2 feet per student, to the cards so they can be worn around the neck.

Die, made of cardboard, from enclosed pattern.

Tokens to represent energy, 10 per student. Peanuts, macaroni, beads, etc. can be used.

Time:

Preparation time: 30 minutes

Class time: 55 minutes

Procedure:

Ecosystems in the Catskills, and everywhere else for that matter, result from complex interactions among the thousands of species that live in an area. Ecosystems are in constant flux as organisms compete for limited resources. Some communities, like our hardwood forests, are stable for a long period of time unless destroyed by an outside agent. Others, like old fields in the Catskills, automatically give way to more stable habitats such as forest. The process is called *succession*. The resulting stable communities are called “*climax*” communities. Even climax communities are not permanent, though. Any ecosystem can change when a new species appears or when the physical environment changes, as it has throughout the history of the Earth. Disturbances, natural or human-induced, keep ecosystems from going very long without change.

This activity is a game in which students model the dynamics of a simplified ecosystem. It is designed for upper elementary students, but it can be played by older students, who should be able to relate the game to real ecosystems at a deeper level.

1. Prepare students by discussing photosynthesis. Ask students to name some things that plants need to live. They should name sunlight, water, air, and soil. Plants use sunlight to convert water and carbon dioxide from the air into sugar. To survive, they also need nutrients from the soil and oxygen from the air. (Oxygen is produced as a by-product of photosynthesis, but the plant also needs atmospheric oxygen at night and for the roots and stems.) Ask the students if there is such a thing as too much sun for a plant. Why would a plant die from too much sun?

2. Introduce the wood sorrel and New England aster by showing pictures and describing them to students. The sorrel has broad, soft leaves and a white flower veined with pink. The aster has purple, daisy-like flowers with a yellow center. The leaves are narrow and relatively small. See if the students can figure out which one is adapted to life in the shady forest and which one to open, sunny areas. The sorrel's large, delicate leaves can operate in shade but would lose too much water in full sun.

The students will pretend to be plants and will have to make decisions that affect their survival. When one of the teams, aster or sorrel, becomes dominant in the game, this represents a species becoming ecologically *dominant*. The success of a particular species in the game depends on the decisions students make and the conditions around them – other students, and environmental factors determined by the teacher. Students should understand that, while plants do not think about how to use their resources, the correct responses are built into the plant. If the built-in responses are not suitable for a particular environment, the species will probably be replaced by one that is better-adapted.

3. Have students sit in a circle on the floor, or have them sit at their desks in a circle. Hand out a sorrel/aster card to each student and tell each student which side of the card to use. Asters and sorrels should alternate so their numbers are about equal. Give each student two tokens to start with, explaining that this is the energy their plant gets from seed when it begins life.

4. Choose someone to start the game and explain how the game is played. Each place where a student is sitting represents a patch of ground where plants can live. The game takes place in a cool, shady forest. On his or her turn, each sorrel gets two energy tokens and each aster gets only one because asters need full sunlight.

5. Then the student rolls the die to see if he or she is attacked by a *herbivore* such as a deer or insect. The plant has to give up tokens in the number rolled on the die. If the student has no tokens left, the plant is dead and the student must take off his or her card.

6. Each time you go around the circle, write on the board how many asters and sorrels are remaining still alive. You should see the number of asters decrease more quickly than the number of sorrels.

7. Establishing a seed: Beginning with the second round, a student can start a new plant on his or her turn. The student gives the teacher four tokens and chooses a patch of bare ground to start the new plant. The teacher gives two of the tokens to the new plant, who then puts his or her card back on so that it shows the same type of plant as the one starting the seed. (The other two tokens are not used and represent failed seeds or other energy required for reproduction, which might include production of flowers, pollen, fruit, and nectar.) Students may start more than one new plant in a given turn, if they have enough tokens, or they can choose to save their tokens. The student rolls the die after deciding whether to start a seed.

8. As soon as the trend to lose asters is apparent, announce that the forest has been cleared. Now sorrels get only one token at the start of each turn, and asters get two. Sorrels do poorly because they lose too much water through their large, soft leaves.

9. The goal for each student is to make his or her own team do well. Students will have to think about whether it is better to save up tokens or use them right away to make seeds.

10. The teacher may stop the game at any time to discuss what is happening and how it relates to natural ecosystems. Some discussion questions follow.

Discussion Questions:

1. Considering that (in the simulation at least) either type of plant could survive in either habitat, why did one species tend to replace the other? (Because of different rates of reproduction.)

2. What resource are the plants competing for? (Space)

3. What would happen if all of the plants of a given type died? (Extinction)

4. Ask students if they have noticed differences in the kinds of plants that live in different habitats. This point is closely related to the Lesson 1 activities in which students compare plants from a field and a wooded area.

Assessment:

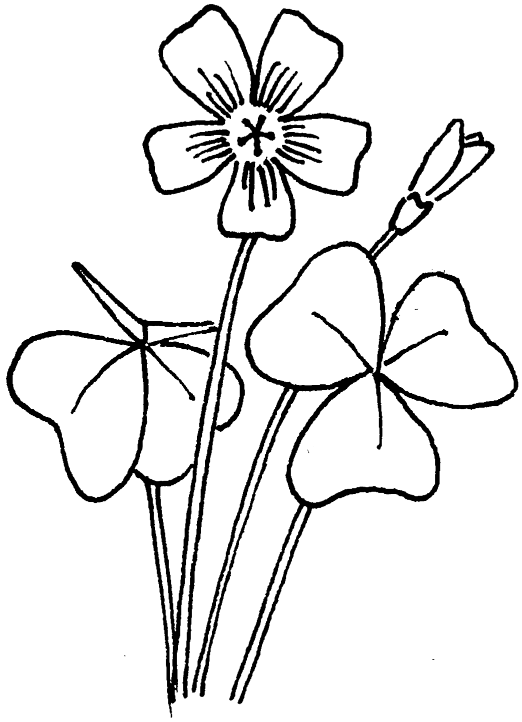
Understanding of concepts is indicated if students try to optimize their strategy, either saying during the game that certain actions will help the team, or by tacitly using a strategy. The optimum strategy for this game will depend on whether the game is almost over and how well the opposing team is doing. In general, it is best to conserve resources when light conditions are not favorable and to produce seeds when conditions are favorable. For a written assessment, have students write a paragraph with the theme, “If I were a plant, this is what I would do to make sure I could make a lot of seeds.”

New York State Learning Standards:

Math, Science, and Technology
Standard 3 – Mathematics: Number and Numeration, Operation, Modeling, Uncertainty
Standard 4 – Science: The Living Environment 1-6
Standard 6 – Interconnectedness: Systems Thinking, Models, Equilibrium and Stability, Patterns of Change, Optimization
Standard 7 – Interdisciplinary Problem Solving: Connections

Health, Physical Education, and Home Economics
Standard 3 – Resource Management: Students will understand and be able to manage their personal and community resources

Source: Activity developed by Nathan Chronister.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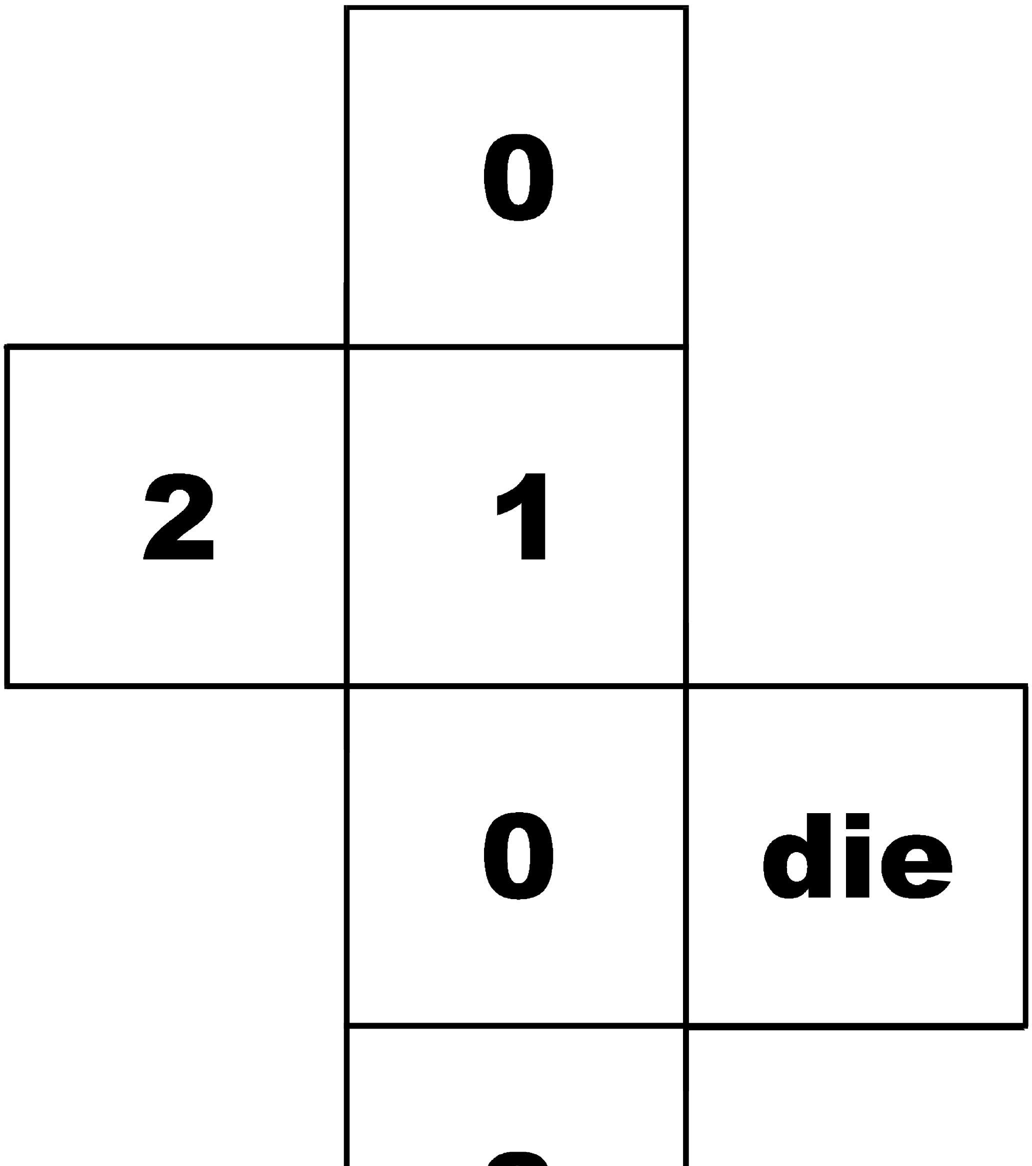
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Wormicompost

Grades:

3rd - 12th

Objective:

Students learn how organic matter is recycled in the soil.

Method:

Students create a classroom compost bin using soil *organisms* (worms), soil, leaf litter, newspaper clippings, and lunch scraps.

Materials:

Ten-gallon container (cardboard box, fish tank, plastic tub, etc), soil collected from outside (do not use sterile potting soil), earthworms (Georgia red wigglers - *Eisenia foetida*), newspaper (no color because it may be harmful to the worms), food scraps (fruit and vegetable), yard waste (leaf litter, grass clippings), spray bottle for water, postal scale for worms (optional).

Time:

Preparation time: 10 minutes to gather materials
Class time: Two class periods and ongoing maintenance

Procedure:

1. Ask the class what happens to the leaves that fall from the trees every year. What breaks the leaves, twigs, etc, down into smaller pieces? What happens to animals that die? Such organisms as earthworms, insects, millipedes, isopods, fungi, and bacteria break down plant and animal matter. Could they do the same thing to help us reduce our food waste? If we were to put our food waste in a bin, what would we have to add to help it decompose and turn into compost? Have each student draw a sketch of what an indoor compost bin might look like.

2. *Set up (do this with the students):* The bin should be cleaned of any residue before turning it into a composting unit. Make holes along the top edge or on the cover or use a cloth cover to allow airflow. Collect soil and leaves from outside. Shred up newspaper into one-inch-wide strips. Place a sheet of plastic, such as a garbage bag, at the bottom of the bin, followed by newspaper strips. Add water until the bedding is moist. If the bedding gets too wet, add more newspaper. Fluff up the strips to allow airflow. Add soil to cover the newspaper. Add leaves and/or grass clippings. Weigh and count the worms. Add the worms. Wait about an hour for

worms to crawl into the litter. If you added one pound of worms, you should add about three pounds of food scraps each week. You may add a little each day or add the scraps once a week. Students should be encouraged to save the fruit and vegetable scraps from their lunches. Do not add meat, bones, onions, broccoli, citrus, dairy, or oily products. These items can smell bad or slow the decomposition process. Cover the litter with entire sheets of newspaper to keep in moisture. Cover the bin. Store away from sunlight between 50 and 70 degrees Fahrenheit.

3. *Follow up:* Check the compost bin each week. Make sure the litter is still damp. Use a spray bottle to moisten if needed. Fluff the litter up to allow airflow.

4. *Collecting the compost:* The compost created by the worms is called vermicompost. Every two months, harvest the vermicompost. Empty out the contents of the bin onto newspaper or plastic. Have half of the class prepare the compost bin as they did the first time. The other students should remove all of the worms from the compost. Weigh and count the worms. Are there more than when you started? Did the worms grow? To begin with one pound again, set aside the desired weight of worms and put the rest outside.

5. *Using the end product:* The compost can be used right away or stored in plastic bags. The compost should be mixed with potting soil when used for indoor plants. It can be directly added to gardens. The compost is so rich in organic matter that a little goes a long way. The compost can also be mixed with water to create "compost juice”. Add about one or two inches of compost for every gallon of water. Shake it up and let it sit for a couple of days before using it.

6. Create groups of four. Each group should present the compost bin to another class. They should discuss how to construct and maintain the compost bin. They should also discuss the importance of recycling. If other classrooms decide to create a compost bin, the group of students that presented to them may help with the set-up. Students should be encouraged to start their own compost bins at home.

Extension:

1. The compost bin shows how the forest recycles its wastes, but how else can we recycle ours? Ask the students how they can reduce the amount of waste going into landfills. Before sending glass, plastic, cardboard, and paper to be recycled, they should first try to reuse these materials. Ask them to give examples of how to reuse glass bottles, plastic containers, cardboard, and paper. Students can bring in objects from home that were going to be thrown out and make a list of how each one can be reused.

2. *Making recycled paper:* Set up two bins in the classroom. One is for paper that has only been used on one side and can be used again. Place a sign on it that says "Reuse”. The other is for paper with writing on both sides. Place a sign on it that says "Recycle”. Put duct tape along the edges of a square piece of window screen or staple a piece of screen to a wooden frame. Have students tear the paper from the "Recycle" container into small pieces (1 inch square). Fill a

blender halfway with water. Put the pieces of paper into the blender. Blend at an intermediate speed until you have a soupy consistency or pulp. Pour into a tub. Slide the screen into the tub, lift up, and allow to drip. Press down with your hand to squeeze out excess water. Flip the screen upside down onto newspaper or towel. Let the paper dry. It will dry the fastest if laid on the ground in the sun.

Variations: Add dried flower or leaves to pulp or sprinkle wildflower seed onto wet paper. Students can make cards out of the paper and the ones with wildflower seeds can be planted.

Note: This activity is recommended for the outdoors on a warm spring day. Use a picnic table for the workspace and place the paper on the ground for the sun to dry it.

Assessment:

1. Grade students on the quiz provided. Answers to quiz are as follows:
    1. Drawing should include newspapers, soil, worms, fungi and bacteria in soil, water, airflow, and food scraps.
    2. Any three of the following: worms, millipedes, isopods, insects, fungi, bacteria.
    3. It would take 5 weeks.
    4. The end product (castings) are so high in nutrients that you do not need to add a lot in order to fertilize the soil.
    5. If you add too much fertilizer, the excess will be carried away by runoff and may contribute to algal blooms in streams and lakes.

NYS Learning Standards:

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment: 1, 4-6
Standard 6 – Interconnectedness: Systems Thinking, Models

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Source: Adapted from June 1995 *Conservationist* magazine and Cornell Cooperative Extension web site info. Papermaking is adapted from PLT.

Wormicompost Quiz

Name:_____________________________ Teacher:____________________ Date:______________

1. Draw a sketch of a compost bin. Label all parts.

2. List three types of organisms that break down plant and animal material in the soil.

3. How many weeks will it take one pound of worms to turn fifteen pounds of food scrap into compost?

4. Why do you only need to use a small amount of compost on houseplants or in the garden?

5. What can happen to streams and lakes when too much fertilizer is used on land?

Soil Study

Grades:

5th - 12th

Objective:

Students learn techniques on how to collect and observe physical, chemical, and biological information from the soil.

Method:

Students conduct physical, chemical and biological tests of soil.

Materials:

Daily data sheet, monthly data sheet (optional), worksheet #1 (younger students) or #2 (older students) (all enclosed), acid rain sheet (appendix), air thermometers (with Celsius), soil thermometer (with Celsius, can be found at a garden supply store), soil pH kit (also can be found at a garden supply store), meter tape, meter stick, stopwatch, two glass jars with lids, empty soup can with both lids taken off, plastic soda bottle, cheesecloth.

Time:

Preparation: 20 minutes, copying
Class Time: Two 40-minute class periods

Procedure:

1. Ask the class what makes up soil. Soil is made up of minerals from underlying bedrock, organic matter, living organisms, and is the foundation for plant growth. See if students can name organisms that live in the soil.

2. Give each student a daily data sheet. Fill in the heading together. Why is the location important? When scientists collect data, they record the location so other scientists know where the experiment took place and if they wanted to repeat the experiment they could return to the same location. The most accurate way to give the location, as described in Module 2, is to obtain coordinates from a GPS receiver. When students arrive at their field site, they should describe their location as precisely as possible.

3. Before bringing the class to the field site, go over the following data and how to collect it:

Sample Site: Ask the class what a sample is. Why don't we study the entire area we are interested in, such as a forest or field? It would take too long to study all of the soil in the area, and it would be destructive. Scientists usually choose several sample sites to make their observations. The more sample areas they study, the more representative their results will be.

Air Temperature: How might air temperature affect the soil? At the field site, students will measure the air temperature at the surface of the ground and 1 meter above their heads. Students should make predictions in their journals of what the two measurements might be. Will one be higher than the other or will they be the same?

Precipitation: How might precipitation affect the soil? Precipitation can change the physical, chemical, and biological characteristics of the soil. Raindrops break up and detach soil particles that are taken away with the surface runoff. Runoff will also carry nutrients from the soil away. Water that goes into the soil percolates down and remains as groundwater or is taken up by roots. The water may also rise back to the surface and evaporate back into the atmosphere. Precipitation can also affect the soil temperature.

Soil Temperature: The temperature of the soil affects the physical, chemical, and biological features of the soil. Freezing and thawing will change the physical properties by breaking the soil particles up. They also disturb roots, foundations, fences, etc. Warm temperatures increase chemical and biological rates. Decomposition speeds up, releasing nutrients into the soil such as nitrogen and phosphorus. The soil temperature affects plant processes. Different plants require different temperatures for seed germination, root growth, and vegetative growth. For example, apples will grow when the soil temperature is 18 °C but citrus will grow when the soil is 25 °C.

What differences will we see when measuring the soil temperature at different depths? In the spring, will the subsoil be warmer or cooler than the soil at the surface? What about in winter? Where do organisms go in the winter? Do they stay close to the surface or burrow deeper into the soil? The subsoil temperature is cooler than the topsoil in the spring because there is a temperature lag. The subsoil is still responding to the winter weather while the topsoil is responding to the current air temperature. In the winter months, the subsoil is warmer because it is still responding to the summer heat. This is why soil organisms bury deep into the soil and why the roots of perennial plants do not freeze. At the field site, students will take two measurements: 2 cm deep and 7.5 cm deep.

Soil Compaction Test: A soil compaction test tells us the amount of space available between the soil particles. Do we want a lot of space or a little? Air and water must flow easily through the soil because soil organisms need air and water. Explain how students will perform this test at the field site. Push the point of a pencil down into the soil until you cannot push any more. Here in the Catskills, you may have to try this several times to avoid hitting rocks. Measure the amount of pencil sticking out of the ground. Subtract that from the length of the pencil to get the length of how much went into the ground. At different sample sites, try to use the same amount of force at each location. If there are many spaces between the soil particles, will the pencil go deep or shallow into the soil? Why?

Soil Percolation Test: The soil percolation test measures the rate at which water can flow through the soil, determined by the space between soil particles and the size of the soil particles. Ask students: If the soil particles are large will the water flow faster or slower? Why? Soil composed mostly of sand has a high percolation rate. Clay is composed of small particles and the percolation rate is lower. Explain how students will perform the test: Place the soup can one cm into the ground. Pour in a known amount of water. Use a stopwatch to measure the amount of time it takes for all of the water to enter the soil.

Soil Textural Class: Can students make a hypothesis of how much sand, silt, and clay the soil contains, based on the past two tests? Hand out soil type worksheets and refer to them when describing how to determine the soil textural class. Scientists use two ways to determine the soil textural class; a field method and a laboratory method. The field method (see worksheet, page 8, for procedure) is done with your sense of touch, and you get an immediate answer. The laboratory method requires placing a soil sample in a jar with water, shaking, and letting it sit for at least a day. The layers are observed and analyzed to determine the soil textural class. Can the students tell which layers are sand, silt, and clay? Students should measure the height of each layer, divide it by the total height of all three layers, and multiply by 100 to get the percentage of each layer. Students should use the percentages in conjunction with their charts to find out the soil textural class. Did they get the same answer as the field method? Are they close? Which test is more accurate? Why? If the laboratory test is more accurate, why do scientists often use the field method? Why is it important to know the soil textural class? The textural class determines how the soil can be used. It tells us if the soil is good for crops, foundations, septic systems, etc.

pH: Review acidity and the pH scale with your students. Distribute copies of the acid rain sheet in the appendix and discuss how acid rain gets into the atmosphere and eventually into the soil. What can change the pH of the soil? What can the pH of the soil tell us about the surrounding environment? How does acid rain affect the soil? Explain that there are more fungi in acidic soils while bacteria prefer more neutral soil.

Vegetation: Ask the class: How does vegetation affect the soil? Can you tell anything about the soil by the type of plants that are growing? Students should count how many different types of plant species are living in the study area. Students should identify all or some of the plant species and determine their percentage of cover. Students should describe and draw the plant species they have identified in their journals. Students should also observe mosses, lichens, and mushrooms. Students can research the plants they have identified to find out what types of soil conditions they grow best in and compare it to the soil data they collected.

Organisms: Ask the class: How do organisms living in the soil affect it? What do the organisms get from the soil? What do they contribute to the soil? What types of organisms live in the soil? Bacteria, fungi, nematodes, and insects are abundant in soil. Explain to students that at the field site they will collect and identify larger soil organisms. They will also take a soil sample back to the classroom to examine the smaller organisms that you can only see under a microscope.

Make a "Berlese funnel" for collecting soil organisms. Cut off the top of a two-liter soda bottle, right at the shoulder. Fill the bottom part of the bottle about halfway with water. The top, when turned upside-down, will be the funnel. Place the funnel into the bottom part of the soda bottle. Put cheesecloth inside the funnel. Place soil in the funnel. Then position a 25-watt light about 2.5 cm above the funnel. Turn on the light, and let it sit for a few days. The light will force tiny organisms out of the soil and into the water.

4. Take students to the field. For older students, you may want to divide the class into groups and have each group work independently with a different soil plot. Otherwise, conduct the study as a class, assigning students to particular tasks.

5. Assign some students to mark off an area of one square meter. Tell students to describe and draw the field site in their journals, including information on the plants that live there.

6. Begin collecting data. For the soil texture, all students can take some soil and feel it. Students should use the field method on their worksheet to determine the soil textural class. One student should be instructed to partially fill a glass jar with soil. The jar should be labeled with the date and location. The jar will go back to the classroom for the laboratory method of determining the soil textural class. Another pair of students should collect some soil in a jar for observing microorganisms. Make sure to label the jar. Other students can measure temperature and do the percolation test and soil compaction test. Use a soil test kit, if you have one, to measure the pH.

7. Back in the classroom. Ask a student to make the soil shake by adding water into the jar of soil, replacing the lid, shaking it, and setting it aside where it won’t be disturbed. Another student can set up the Berlese funnel.

8. *Follow up:* Two days after making the soil shake: As a class look at the various soil layers. They should measure the height of each distinctive soil layer. They should determine the percent of each soil layer by dividing the height of the layer by the total soil height and multiply by 100. After they have calculated percentages for each layer, they should use the soil chart to determine what type of soil they have. Use an eyedropper to collect organisms and water from the Berlese funnel. Squirt them into a petri dish under a dissecting microscope to observe and identify microorganisms.

Note: Contact your county Soil and Water Conservation District to request a soil survey for your county. You will be able to use the book to find information about the soil such as: geology, drainage, water supply, history, use and management of the soil, soil properties, and soil morphology. You can locate your field site on one of the maps.

Extension:

1. *Long term soil study:* Students observe the change of soil temperature in relation to the change in air temperature. A large graph should be constructed on a classroom bulletin board. Label the axes so that temperatures collected throughout the study period will fit. First you must decide how long the study will go on: month, quarter, or entire school year. Students should make predictions of what will happen to the temperature of the soil as the air temperature changes. Will it be the same? Each week assign a different pair of students to collect the daily air temperature 1 meter above the ground and soil temperature at 7.5 cm. Weekends can be excluded if no one wants to collect the data. The temperature readings should be taken at the same time each day and in the same location. The location at the field site should be predetermined so students know where to take the readings. At the end of each week, the pair of students who collected the data should record the data on the classroom data sheets and plot the data points on the graph. The data points should be connected. Be sure to use a different color marker for the air temperature than for the soil temperature. At the beginning of each week, the classroom should discuss the data from the previous week. Once students see what the relationship is, they can predict how the graph should look for an entire year. Why does the soil stay warmer than the air?

2. Do the same tests at a completely different site, and compare the two sites.

Assessment:

1. Grade students on their observations, journaling, and the quiz provided. Quiz answers:
    1. Minerals, organic matter, organisms.
    2. B
    3. 0------7------14
acidic neutral basic
    4. The soil percolation test will measure the space between the soil particles and the size of the soil particles.
    5. Silt loam.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Mathematics, Science, and Technology
Standard 3 – Mathematics: Modeling/Multiple Representation, Measurement
Standard 4 – Science: Physical Setting 2
Standard 4 – Science: The Living Environment 1, 6, 7
Standard 5 – Technology: Technological Systems
Standard 6 – Interconnectedness: Systems Thinking, Models

Source: Activity developed by Marie Ellenbogen.

Name: ______________________ Teacher: ______________________
Location: ______________________________ Date: __________

Field Site Information

	Dimensions			Perimeter	Area
	Length (m)	Width (m)	Height (m)	(2xlength+2xwidth)	(length x width)
Total Area					

Weather Conditions

Air Temperature (Celsius)		Precipitation	
Surface	1m	Now	Last 24 hrs

Soil Conditions

	Soil Temperature (Celsius)		Soil Compaction	Soil Percolation	
Location	2 cm	7.5cm	cm	cm/sec	pH

Soil Textural Class		
Location	Field Method	Lab Method

Macroorganisms					
Insects	Number	Non-Insects	Number	Microorganisms	Number
Ants		Earthworms			
Springtails		Pill bugs			
Earwigs		Centipedes			
May beetles		Millipedes			
Wireworms		Psuedoscorpions			
Grubs		Spiders			
Beetles		Mites			
Insect Larvae		Slugs			
		Salamanders			

Name: ______________________

Location: ______________________

Monthly and Hourly Data Sheet

Monthly

DATE	**Air Temp (Celsius)**		**Soil Temp (Celsius)**	
	Surface	1m	2 cm	7.5cm

Date: Hourly

TIME	Air Temp (Celsius)	Soil Temp (Celsius)
	1m	7.5cm

Date: Hourly

TIME	**Air Temp (Celsius)**	**Soil Temp (Celsius)**
	1m	7.5cm

Worksheet 1

Field method for naming soil class:

1. Soil is gritty. Tiny grains are visible.
   If Yes go to #2.
   If No go to #3.

2. Soil stays together in a firm ball.
   If Yes soil is **Sandy Loam.**
   If No soil is **Sand.**

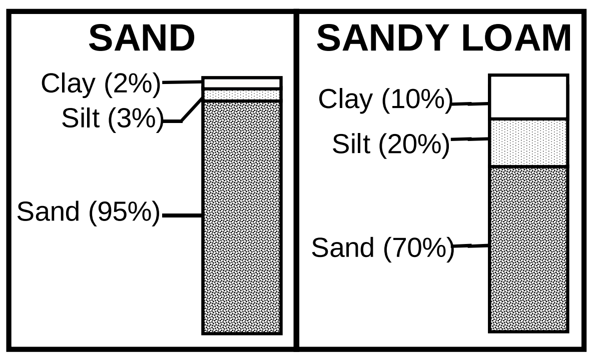
3. Soil is sticky.
   If Yes go to #4.
   If No go to #5.

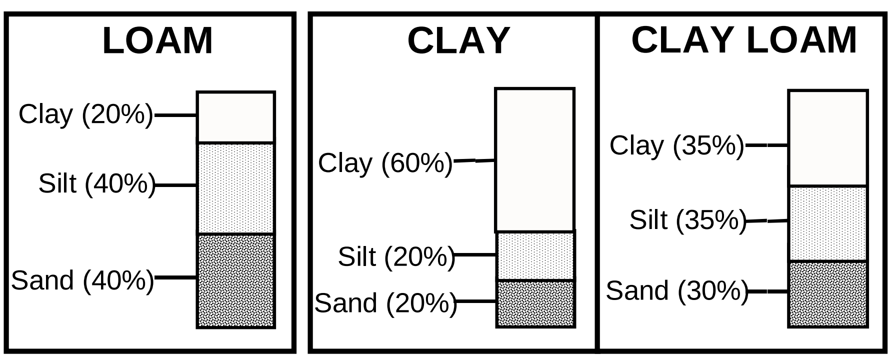
4. Soil is hard to compress.
   If Yes soil is **Clay.**
   If No soil is **Clay Loam.**

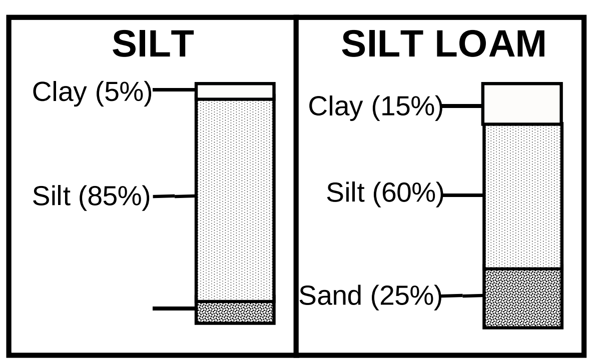
5. Soil is smooth and soft.
   If Yes soil is **Silty Loam.**
   If No soil is **Loam.**

Laboratory method for naming soil class:

Compare the different layers of the soil shake





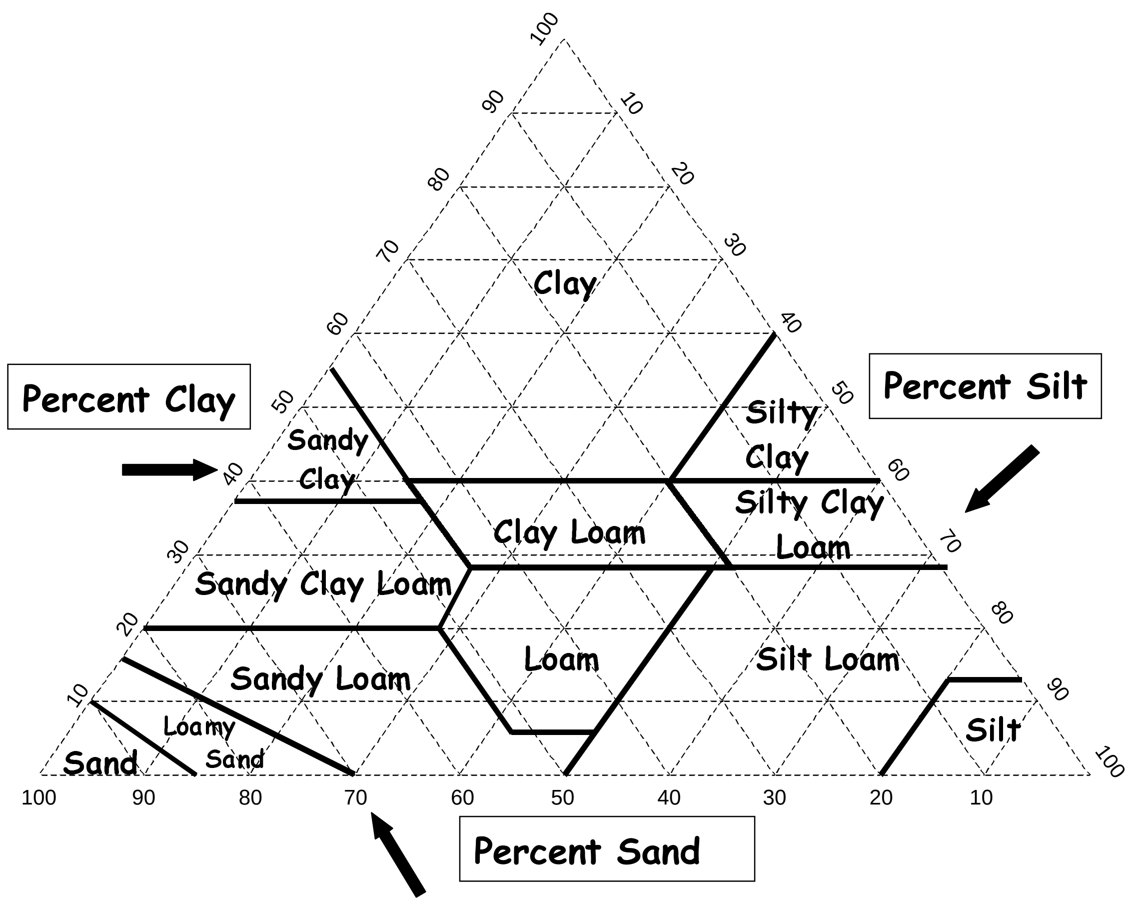


Worksheet 2

Field method for determining soil textural class:

	Sand	Sandy Loam	Loam	Silt Loam	Clay Loam	Clay
1. Grains visible to eye	Yes	Yes	Some	Few	No	No
2. Stability of dry clod	Cannot form	Cannot form	Break easily	Break moderately	Hard and stable	Very hard and stable
3. Stability of wet clod	Not stable	Slightly stable	Moderately stable	Stable	Very stable	Very stable
4. Stability of 'ribbon' when rolled between thumb and forefinger	Cannot form	Cannot form	Cannot form	Appears broken	Thin, may break	Very long, flexible

Laboratory method for determining soil textural class:



1) Find the percentage of clay. 2) Find the percentage of sand **OR** silt. 3) Follow the lines inward in the direction of the arrows. 4) The intersection of the two lines will give you the class name.

Soil Quiz

Name:__________________________ Teacher:______________________ Date:______________

1. List two things that soil is made of.

2. In the spring, the subsoil temperature is usually
   A) the same temperature as the topsoil.
   B) colder than the topsoil.
   C) warmer than the topsoil.

3. Draw the pH scale. Label which number is acidic, neutral, and basic.

4. What does the soil percolation test tell us about the soil?

5. Using your soil textural chart worksheet, what is the soil class of soil that has 15% clay and 25% sand?

Carbon on the Move

Grade:

7th - 12th

Objective:

Students learn how *carbon* passes through the living *environment*.

Method:

Students take a journey as a carbon atom cycling through the atmosphere, living *organisms*, and underground fossil fuel.

Materials:

Legends, example diagrams, and travel log (all enclosed), pencils, colored pencils, glue, 6 pieces of cardboard (8.5x11 inches), 6 paper fasteners, 6 large paper clips.

Time:

Preparation time: 15 minutes
Class time: 40 minutes

Procedure:

Preparation: Photocopy and cut out the legends (each group gets one legend); photocopy the travel log (one per student).

1. Ask the class what carbon is. They should be able to name some of its common forms, such as carbon dioxide or charcoal. Discuss various ways carbon travels through the environment. During photosynthesis plants take carbon dioxide from the atmosphere and use it to create plant materials such as carbohydrates. Some of these organic substances are broken down again and are respired by the plants back into the atmosphere as carbon dioxide. The rest will stay in the plant until it dies or is eaten by other organisms. When an animal eats a plant, the carbon becomes part of the animal's body, is respired as carbon dioxide, or is eliminated as waste. Decomposers such as fungi and bacteria in the soil break down the waste and dead plant and animal matter. The carbon remains in the decomposers as organic substances until they die, is respired as carbon dioxide into the atmosphere, or is eliminated as waste. Other decomposers break down wastes from decomposers and dead decomposers.

Carbon is constantly moving and moving quickly through the pathways described above. There is another place carbon can go which removes carbon from circulation for long periods of time or sometimes permanently. Sometimes partially decomposed plant matter (peat) becomes buried under sediment. Buried deep enough, the peat becomes coal, oil, or gas. The carbon is returned to the atmosphere (hopefully as carbon dioxide rather than soot) when humans extract it from underground and burn it as fuel.

2. Divide the class into six different groups. On the board, write the following places that carbon can be found: atmosphere, tree, caterpillar, bluebird, fungi/bacteria, and fossil fuel. Assign each group a different place as the subject of their diagram. Next they should write the names of the other five places on their diagram and draw arrows to show how carbon can enter or leave the place that is the subject of the diagram. Use the example diagrams as a reference. They needn't concern themselves with how carbon moves among the other five places. After students have completed their diagrams, have each group stand up in front of the class and explain how carbon enters and leaves their place in the carbon cycle.

3. Give each group the legend that goes with their place in the carbon cycle. Tell students to make a pie chart using the legend provided. The sections and percentages are different for each organism or place. Students should color in the pieces of the pie chart and the corresponding boxes on the legend. After students have made their pie charts, give each group a piece of cardboard, paper fastener, and paper clip. Explain how to make a spinner out of the pie chart. First, glue the pie chart to a piece of cardboard. Make a hole in the center of the pie chart with the paper fastener or a sharp object. Fasten the paper clip onto the spinner by passing the paper fastener through it. The paper fastener should be loose enough for the paper clip to spin freely.

4. Give each student a travel log. Have students place the spinners around the room or outdoors to form a large circle. Each group of students should line up behind their own diagram to start. Each student will spin the spinner and go where it directs them. If it says stay they should go to the back of the line. They should keep track of everywhere they go where in the spaces of the travel log. Each time a student stays in the same place, he or she should write it down again. They should always keep in mind that they are atoms of carbon.

5. After a given period of time, or when all forty spaces are filled in, students should return to their desks. They should total up the number of times they visited each place and record it in the space provided. They should also figure out the percent of the total time spent at each place and record it in the space provided. Students should create a pie chart in the circle provided that represents the percentage of time the carbon atom remained in each place. On the other side of the paper, students should explain why carbon spends more time in some parts of the cycle than others. They should use examples from their pie chart in their explanations.

Extension:

1. Students can draw a diagram of the entire carbon cycle.

Assessment:

1. Grade the travel log worksheet. Travel log should show repeat entries where students stayed in the same place. Percentages should add up to 100 and should reflect the number of visits to each place. The pie chart should match the calculated percentages. The written response should refer to rates of processes in the real carbon cycle and compare these to the simulation in this activity.

2. Students should understand that carbon atoms can change forms depending on other substances they combine with. These substances are suggested by the names of carbon compounds. Carbohydrate = carbon + water. Carbon dioxide = carbon + two oxygens.

3. Students should learn that the various carbon compounds help organisms meet their survival needs. Different organisms have different needs and use different forms of carbon.

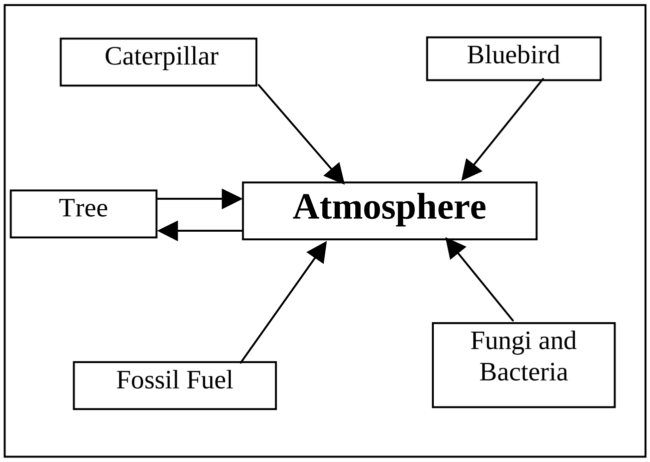
NYS Learning Standards:

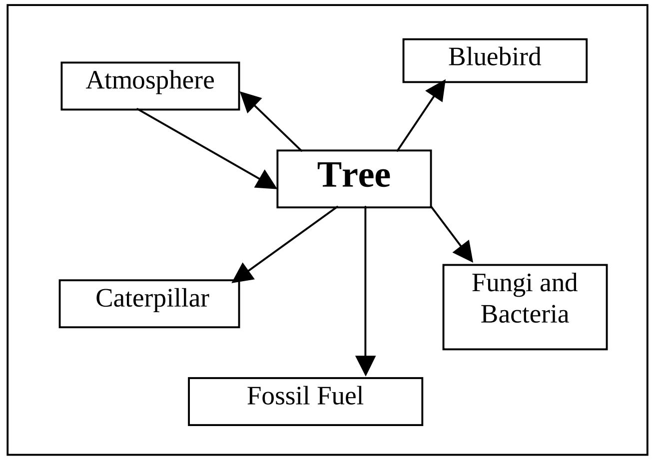
Math, Science, and Technology
Standard 3 – Math: Number and Numeration; Operations; Modeling/Multiple Representation
Standard 4 – Science: The Living Environment 1, 3-6
Standard 5 – Technology: Technological Systems
Standard 6 – Interconnectedness: Systems Thinking

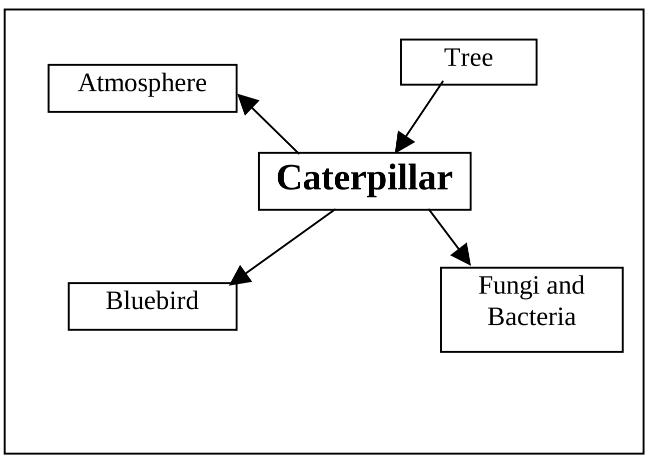
English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading; Speaking and Writing

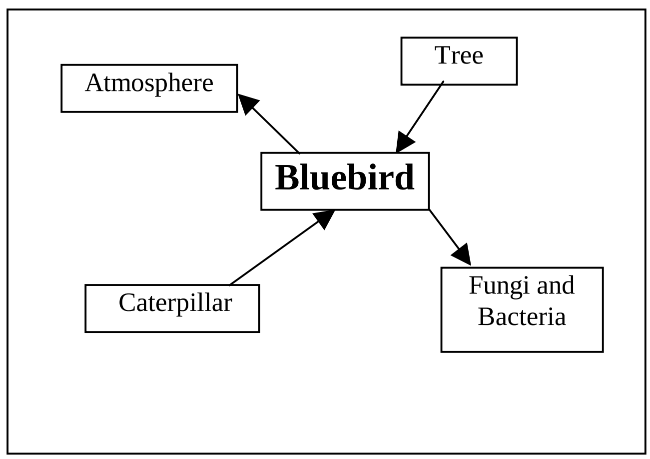
Source: Activity developed by Nathan Chronister and Marie Ellenbogen.

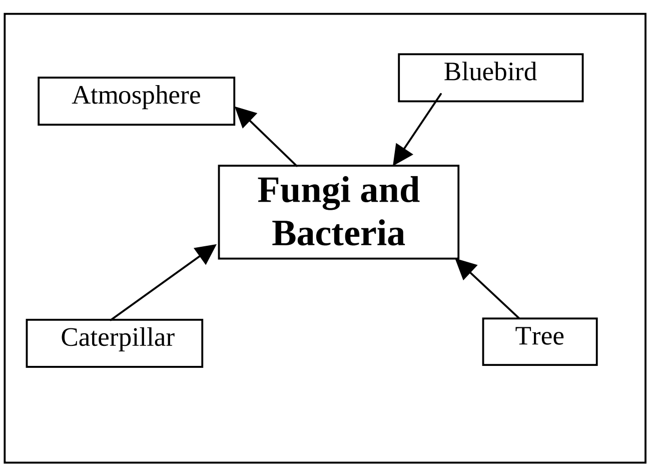
Example Diagrams

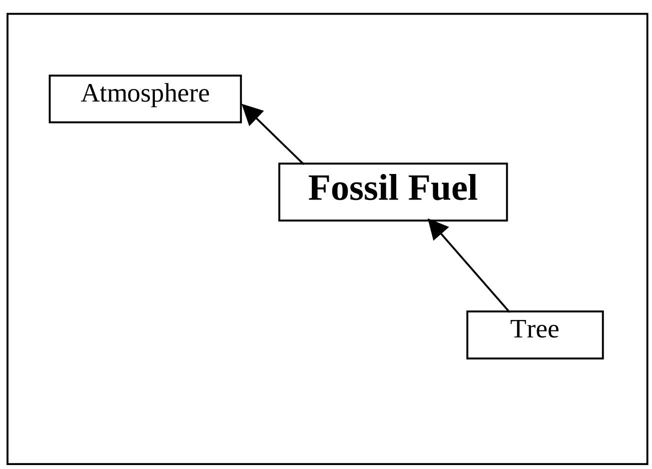








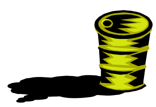




Atmosphere	☐	Stay in atmosphere – 70%
	☐	Taken up during photosynthesis; go to tree – 30%
Tree	☐	Stay in tree – 35%
	☐	Tree respires; go to atmosphere – 20%
	☐	Leaf eaten; go to caterpillar – 25%
	☐	Seed eaten; go to bluebird – 5%
	☐	Tree dies; go to fungi & bacteria – 10%
	☐	Tree dies; go to fossil fuel – 5%
Caterpillar	☐	Stay in caterpillar – 40%
	☐	Caterpillar respires; go to atmosphere – 30%
	☐	Eaten; go to bluebird – 10%
	☐	Caterpillar excretes; go to fungi & bacteria – 10%
	☐	Caterpillar dies; go to fungi & bacteria – 10%
Bluebird	☐	Stay in bluebird – 40%
	☐	Bluebird respires; go to atmosphere – 40%
	☐	Bluebird excretes; go to fungi & bacteria – 10%
	☐	Bluebird dies; go to fungi and bacteria – 10%
Fungi & Bacteria	☐	Stay in fungi and bacteria – 50%
	☐	Fungi & bacteria respire; go to atmosphere – 25%
	☐	Fungi & bacteria die; go to fungi & bacteria – 25%
Fossil Fuel	☐	Stay underground – 80%
	☐	Burned as coal, oil, or gas; go to atmosphere – 20%

Name:______________________ Teacher:____________ Date:________

Carbon Atom Travel Log

	Number of Visits	Percent of Total
	________	________
	________	________
	________	________
	________	________
	________	________
	________	________
	________	________

MMake a pie chart that represents the percentage of time carbon spent in each place.

On the back of this paper, explain why carbon in real life spends more time in some parts of the cycle than others. Does your pie chart accurately depict what would happen in real life?

Forest Ecology Investigation

Grades:

4th - 6th

Objective:

Students learn to recognize ecological interactions in the field.

Method:

Students are given a list of ecological principles. Then they search for real examples of those principles in the forest.

Materials:

A large board that can be written on, permanent markers, index cards, 3” self-stick notes.

Time:

Preparation time: 20 minutes
Class time: 30 minutes

Procedure:

Prepare the board by ruling it into a grid, with one cell for each student or pair of students. Write one ecological principle on each index card and affix a blank self-stick note to each card. Write the same principles on the board, one in each cell. You may use the examples shown here or come up with your own principles suited to the site you are using, the age of your students, or topics you want to focus on.

A plant depending on another plant.
A plant depending on an animal.
An animal depending on a plant.
An animal depending on another animal.
Signs that people have been here.
Something that could provide shelter for an animal.
Something that an animal could use for food.
Something you think is valuable, and explain why.

1. Bring students to a place in the woods (or field) where they can look for examples of these principles. Give each student or pair of students an index card with sticky note. Have the students

find an example of the principle written on the index card and then use the self-stick note to draw or describe their example. In this way, the index cards are reusable.

2. Call the students back. Students stick their notes to the large board.

3. Have each student describe what he or she found. Before going on to the next student, allow the class to discuss how the example relates to the concept listed on the board. If a student failed to locate a suitable example, it might be because none were present. On the other hand, students might surprise you by coming up with examples where you didn't see any yourself.

Variations: Instead of assigning each student one of the concepts, have them play Bingo using any examples they find to fill in the grid. In this case, each student needs one copy of the grid, but no index cards or sticky notes are used. The first student to find the necessary examples to fill in one row wins, provided that the teacher approves of the examples. Afterwards, invite students to describe some of the examples they found.

Assessment:

1. Did students choose appropriate examples?

2. Did students see new ways organisms interact that they wouldn't otherwise have noticed?

NYS Learning Standards:

Math, Science, and Technology
Standard 4 – Science: The Living Environment 1, 5, 6

Source: Developed by Richard Parisio, NYSDEC.

Living in an Ecosystem

Despite the popular notion that humans are separate from nature, people and industry are actually part of the ecosystem. Many people are insulated from nature to some extent. They spend nearly all of their time indoors or in cars, and never see where their food comes from or where their waste goes. It's easy, therefore, to forget how connected we are with the natural world. As long as we take our food from the land and dump our wastes back into nature, we humans will remain very much a part of the ecosystem. Ironically, many environmentalists further separate us from nature by casting humans in the role of enemy to nature rather than one of Earth's creatures. Regarding human activities and nature as separate realms only tends to minimize one's awareness of important interactions.

When we say that humans and our activities are an integral part of ecosystems in the Catskills, we do not simply mean that humans can damage ecosystems. Rather, we affect and are affected by other species in many ways. We are part of the same network of interspecies interactions and natural cycles that connect other organisms. Even though our activities are often different than those of other species, we are still so much a part of the ecological community that it hardly makes sense to think of humans as separate from nature.

At the end of the last ice age, humans first entered our region on the heels of retreating glaciers, so in a sense, we have always been a part of the Catskills landscape. Native Americans changed their environment, clearing small areas for agriculture and burning off large areas to encourage blueberries and game animals. In the late 18th and early 19th centuries, rural industries of timber harvesting, tanning, and farming converted much of the area's old-growth, northern hardwood and hemlock forest to other uses. Later, as the *economic* base in most of the region shifted to tourism, forest species recaptured old farmlands that were no longer used. Changes on the land in the Catskills have been visible and profound.

Many elements of our culture give children the impression that people can exist without intricate ties to their natural surroundings, but that is an illusion that can lead to mismanagement of the environment. Earlier cultures such as the American Indians that lived in the Catskills did not have this same misconception because their lives were much less removed from important interactions with other species. We interact with nature still, depending on it for our most basic needs. Here in the Catskills, we are fortunate to have the space and opportunity to give students an outdoor experience with nature to witness how tightly integrated it is with our everyday lives. This lesson highlights some of the interesting ways in which we are connected to other parts of the ecosystem.

Two of the activities in this lesson deal with a most basic aspect of how humans relate to nature: how we obtain food. Even though most of what we eat is shipped in from outside the Catskills, that was not always the case. Native Americans and early European settlers in the Catskills obtained all of their food here. By farming (not an easy job on rocky Catskills soil), hunting, fishing, and gathering of foods found in nature, these people survived on what the mountains offered them. They never had bagged chips, bottled pop, or microwaveable, ready-made dinners. Traditional ways of survival can teach students about their history and about the ecosystem that supports us today. Most importantly, by seeing how they could derive some of their own food from nature, they will begin to restore their lost sense of connectivity to the life around them.

Ecosystems of the Catskills offer numerous recreational opportunities for tourists and for those fortunate enough to live here year-round. These opportunities exist through a combination of the unique natural features of the region and governmental efforts to improve access to those resources. Through the state forest preserve with its extensive network of trails, DEC fishing access locations, and smaller, privately-owned preserves, the forest and stream ecosystems of the Catskills provide limitless opportunities for enjoying nature. Ecotourism forms a major part of the Catskills economy, with people traveling here from far away for hiking, tubing, fishing, and other activities. No child should grow up in the Catskills without knowing about these opportunities right outside our back yards, nor should these things be overlooked because they are so close.

Wildlife management may seem unnecessary to some. We have set aside more than 450 square miles of Catskill Forest Preserve, with more land being purchased by the state or by New York City all the time for preservation purposes. Won't that land remain in a healthy, natural state without human intervention? Surprisingly, it won't.

Because human interactions with the environment extend beyond village boundaries, allocating land for conservation purposes must be followed by ongoing management of that land. One human impact that affects the forest is hunting. Hunting deer helps to keep their population in check so they do not overconsume food sources that are needed by other species. On the other hand, the hunting of wolves in the 1800s resulted in their extirpation from the Catskills. This eliminated an important predator of deer, so now we are forced to manage deer populations (through hunting) to prevent their overpopulation.

Department of Environmental Conservation (DEC) determines hunting laws for New York State. Keeping the population high, the way hunters like it, could mean that the population is large enough to damage the forest understory and pose a large threat to motorists. DEC regulations therefore must strike a balance between opposing demands. Because DEC limits the number of hunting licenses, and in particular the number of doe taken, hunting doesn't affect the population of the deer very much. DEC allows hunting only in the fall for safety reasons and so dependent offspring are not left on their own to starve. Since food is scarce in winter, the fall hunting season eases demand on the deer's food supply and therefore reduces the effect of hunting on the deer population.

The introduction of new species to the Catskills is another major way in which humans affect the ecosystem. So called *invasive* species are those which grow and reproduce so rapidly that they can move in on habitat previously occupied by other species. We call them "weeds". This process, often involving native species, is a natural part of the succession we covered in Lesson

3. Many invasive species, however, are not native to the Catskills. Since they were brought here from far away, their natural enemies may be lacking, and that allows them to move in on the territory of native species.

A wide variety of introduced species have thrived at the expense of native species in the Catskills. The common starling and the house sparrow (which is actually an old world finch, not a sparrow) are European birds that occupy tree nesting cavities otherwise used by local species such as the eastern bluebird. Another introduced species is the hemlock wooly adelgid. This tiny insect feeds on sap from the base of hemlock needles and is a serious threat to those trees. The American chestnut was nearly wiped out by a fungus species introduced from Asia, and the American Elm has become rare because of Dutch elm disease, brought with infected elm wood from Europe around 1930. Native species often lack resistance to pests introduced from other continents. Another introduced species is purple loosestrife, a wetland plant that tends to out-compete the native cattails and impact other plant and animal species that make up the cattail marsh community. Foreign species can be brought here accidentally or on purpose. Most of them are not well enough adapted to the Catskills to pose a serious threat, but others do extremely well here in the absence of their natural enemies. Problem species tend to appear in areas where humans are the most active, but they can also affect the forest preserve wilderness areas.

Controlling introduced species is usually very difficult and expensive. In some cases, a natural predator can be imported to control the introduced species, but even the biological control species can become a problem. Ever wonder why there are so many of those annoying, foul-smelling ladybugs around in the fall? A prolific Asian ladybug species was imported to control insect pests such as aphids. Even so, biological control is more effective and safer than insecticides. Widespread spraying campaigns, intended to eradicate such pests as fire ants, mosquitoes, Japanese beetles, and the elm bark beetle, which spreads Dutch elm disease, have used chemicals that kill beneficial species just as effectively as the intended target. Because of their short life cycles, pests often evolve resistance to pesticides, while their natural predators are wiped out by the spraying. In many cases, there is no practical way to control the more aggressive introduced species. At least we can find some peace in knowing that these new introductions, whatever problems they cause for particular species, are part of the constant change that takes place in any ecosystem.

Some new species arrive on their own, without our help. This can happen as a result of human-induced or natural changes in the environment. For example, when wolves were wiped out in the Northeast, this allowed coyotes to move into the area. Also, the northern cardinal is actually a bird of southern states that has moved into New York because of bird feeders and climate change. Natural events also cause the ranges occupied by species to shift over time. All of what we call native species have actually moved into the Catskills in the last 15,000 or so years as a result of the glaciers melting and the climate warming after the last ice age.

Fly Tying

Grades:

3rd - 12th

Objective:

Students learn about fly fishing techniques and ecological factors, such as *benthic macroinvertebrate* population levels, that affect the availability of fish.

Method:

Students match pictures of adult macroinvertebrates to the correct larvae. Students match fly fishing lures to the macroinvertebrates. Students construct fly fishing lures that resemble the larval or adult forms of stream insects.

Materials:

All students: worksheets 1, 2, and answer key (all enclosed).
Younger students: pipe cleaner, yarn, thread, tinsel, craft feathers, beads, cotton balls, scissors.
Older students: size 2 fish hooks (prior to this activity, use pliers to flatten the barbs on the hooks), clothespins, tweezers (one per group), scissors (one per group), assorted colored chenille, assorted colored feathers (craft feathers or those found in a sports store that are used specifically for fly tying), tinsel, assorted colored embroidery floss, adhesive tape.

Time:

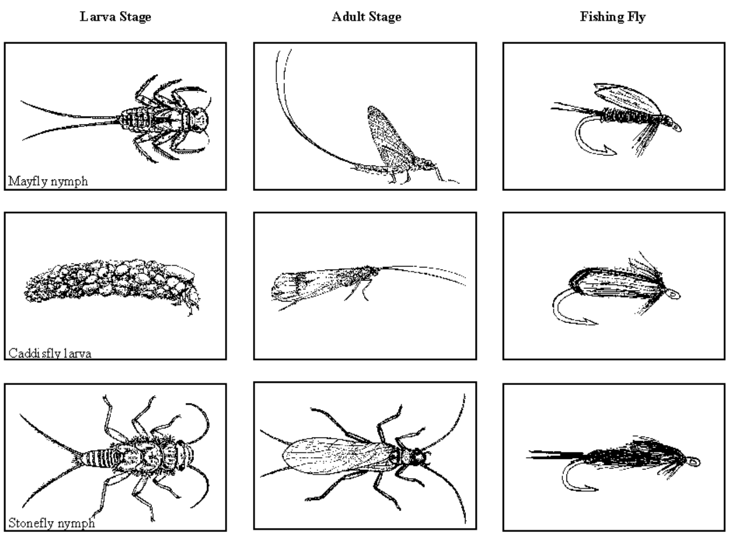
Preparation time: 20 minutes
Class time: 45 minutes

Procedure:

Note: Activities from Module I: Water Resources (Lesson 2, Activities 2 and 3) can be used to familiarize students with benthic macroinvertebrates to prepare for this activity.

1. A few of your students can probably inform the rest of the class on fly fishing. Ask the class: Does anyone fly fish or know someone who does? What is the "fly" in fly-fishing? Why are there different types of fishing lures? Different species of mayflies, stoneflies, caddisflies, etc. emerge at different times of the year, and certain lures work best depending on the hatch. Wet flies represent organisms in the water such as larvae, fish, and eggs. Dry flies represent organisms found out of the water or on the surface such as adult mayflies and stoneflies. Ask the class if they know anyone who ties their own fly-fishing lures. What supplies do they use?

2. Divide the class into groups of three or four. Hand out one copy of worksheet 1 to each group. Ask the class what the three pictures show and where these creatures can be found. Tell each group to label the three insects. Hand out worksheet 2. Instruct each group to cut out the adult stage pictures and match them next to the larval stage on worksheet 1. Check their work before they glue them down. Encourage students to use physical traits and process of elimination to determine the correct match. Meanwhile one student should cut out the fishing fly pictures. They should match the fishing fly pictures with the stream insect photos. Some match the larva, others the adult. Check their work before they glue them down.



3. *Younger students:* Give each group pipe cleaners and craft materials. Students are going to make a larger than life fishing fly that will resemble an insect that lives in the Catskills. Provide them with books with pictures of insects in their larval and adult stages. The fishing fly they make should resemble the larval adult stage of an insect of their choice. Students should first shape the pipe cleaner into a hook. This is done by folding the pipe cleaner in half and twisting the two halves together. A hole at the folded end should be left for the "eye" of the hook. The other end can be bent to make a hook shape. Students should use string, yarn, or thread to tie the feathers and other materials onto the hook. They should not use glue.

Older students: Divide the class into groups of four. Hand out fish hooks and clothespins to each student. Provide each group with scissors, tweezers, thread, feathers, and any other materials that may be used for fly tying. Also give them tape. Students should tape the clothespin onto their desks and use it as a vice for holding the hook. Provide students with books that illustrate insects that inhabit streams. They should try to make a fly that imitates an insect of their choice. They should decide whether their fly would imitate an insect that is found in or on top of the water. After they have completed their fly, provide books illustrating different fly fishing lures. See if they can find flies similar to the ones they made; students compare and contrast flies they made with flies in the book.

Extensions:

1. Any student who knows someone who fly fishes or ties flies could ask them to give a demonstration for the class. You can also contact resource people listed in the back of this book.

2. Students can practice casting. Resource people from Trout Unlimited or SAREP may be able to provide instruction and equipment, or you can order the Backyard Bass from Ironwood Pacific.

Assessment:

1. Do students make a connection between the appearance of the lure and that of the real insect?

2. Do students now see the importance of insects as food for fish?

3. Grade students on the quiz provided. The answers are as follows:
    1. Larva, adult
    2. B) thorax
    3. B) mayfly
    4. Drawing should depict craft materials instead of a real insect, and it should bear some resemblance in form to the real mayfly, having wings over the back, long tails, etc.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading
Standard 4 – Language for Social Interaction: Listening and Speaking

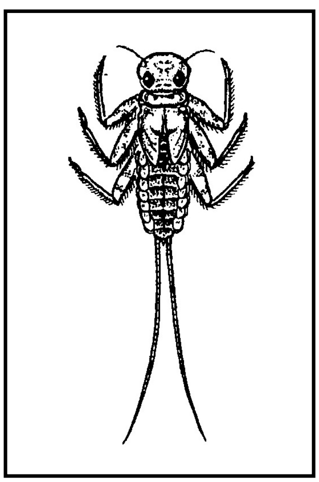
Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 1,3
Standard 6 – Interconnectedness: Models

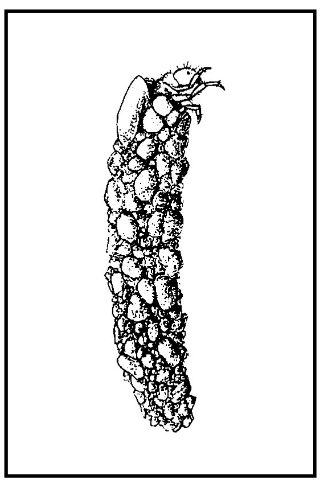
Source: Activity developed by Marie Ellenbogen. Insect drawings © Tamara R. Sayre.

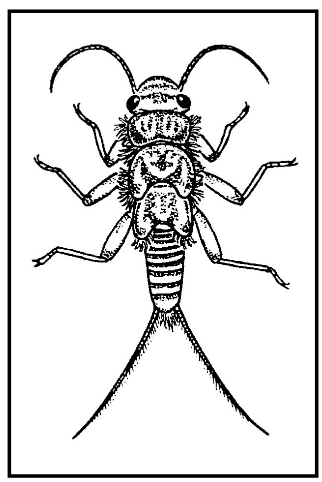
Fishing Fly

Adult Stage

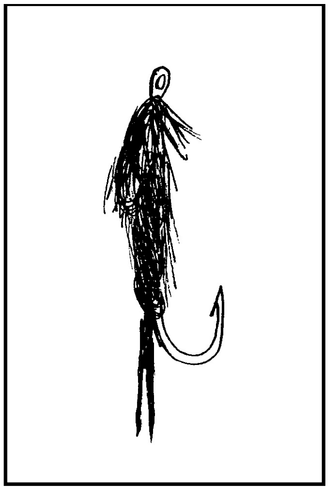
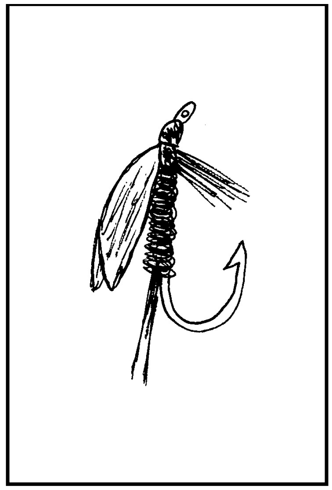
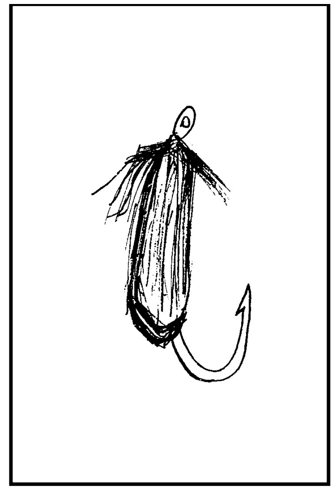
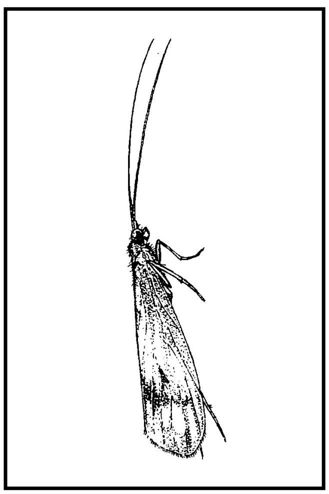
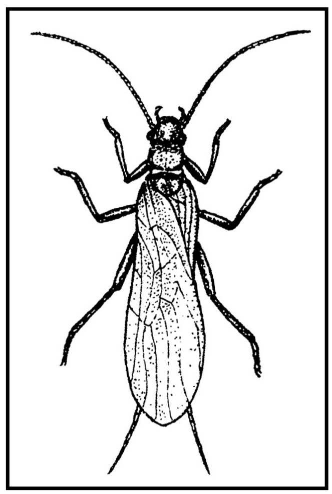
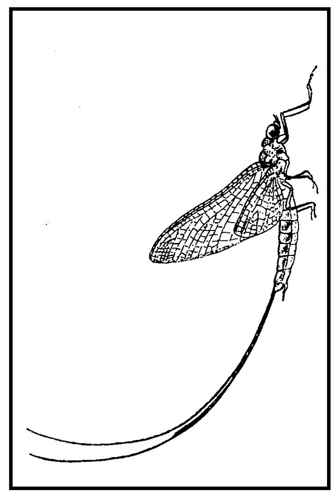
Larva Stage







Worksheet 1

Worksheet 2

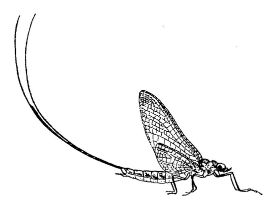
Fly Tying Quiz

Name:____________________________ Teacher:___________________ Date:_____________

1. List the two life stages of insects that you learned about during the activity.

2. The gills on a stonefly are on its __________.
   A) head
   B) thorax
   C) eyeballs
   D) abdomen

3. This is a picture of an adult __________.
   A) dragonfly
   B) mayfly
   C) stonefly
   D) cranefly



4. Draw a picture of a fishing fly made to resemble the adult insect shown above.

Maple Sugaring: It All Boils Down to Energy!

Grades:

3rd - 7th

Objective:

Students learn about the history of maple sugaring, *photosynthesis*, the biological process of sap production, and methods of collecting sap and making it into syrup.

Method:

Students read about the history of maple sugaring. They simulate photosynthesis using marshmallow molecular models. Students tap their own maple trees and make maple syrup.

Materials:

Enclosed worksheets, large marshmallows (4 bags), small marshmallows (1 bag), toothpicks, food coloring, spray bottle, metric tape, *spiles*, buckets or milk jugs, drill with 7/16-inch drill bit, crock pot, and butter.

Time:

Preparation time: 20 minutes
Class time: 4 class periods

Procedure:

Preparation: For older students, copy the worksheets on pages 5, 7, 8, and 11. For younger students, copy pages 5, 7, 8, and 9. Make one copy per group except crossword puzzle, one per student. Mix food coloring and water in a spray bottle and lightly spray one fourth of the large marshmallows. Allow all marshmallows to air dry for a few days beforehand so they are stiff.

Part I: History of Maple Sugaring

1. Give each group a copy of "A Short History of Maple Sugaring". Explain to the class that the paragraphs on the sheet tell the story of maple sugaring. The paragraphs are not in order. They must read them carefully and put them in the correct order by numbering them. Once they have put the paragraphs in order, they should cut each paragraph out along the dotted lines. They should glue the paragraphs in their notebooks in the correct order. Next to each paragraph they should draw a picture to illustrate the text. They can illustrate an important word or words if they cannot draw a picture to capture the entire paragraph.

Part II: Understanding Photosynthesis

1. Ask the class why they think maple syrup is sweet. Ask them where the tree gets its sugar. Explain the process of photosynthesis. The leaves take in carbon dioxide from the air. The roots take up water from the ground. The chlorophyll, green pigment in the leaves, captures the light energy from the sun. The light energy is used to put carbon dioxide and water together to make sugar and oxygen. The oxygen is used by the plant or put back into the air. Write the following on the board and have students copy it into their journals:

Photosynthesis

$$\text{carbon dioxide from the air} + \text{water from the roots} \xrightarrow[\text{light energy}]{\text{chlorophyll}} \text{sugar used for growth} + \text{oxygen}$$

2. After the students write down the photosynthesis equation in their journals have them draw a picture of a tree. They should write down all of the elements involved in photosynthesis. They should draw an arrow from each element showing what happens to it. For example, they should write the word water and draw an arrow showing it getting taken up from the roots. They can write the words "carbon dioxide" outside of the tree with an arrow pointing into the leaf. Under the words "carbon dioxide" they can write "from the air".

3. Divide the class into four groups. Give each group a copy of worksheet 1, six large colored marshmallows, 18 large white marshmallows, at least 12 small white marshmallows, and a box of toothpicks. Instruct students to look at the structures on worksheet 1. Instruct them to build all structures using the marshmallows and toothpicks. The dark shaded circles on the worksheet represent colored marshmallows. The small circles represent small marshmallows, and dark lines represent toothpicks.

4. Write on the board what each marshmallow represents: large colored = carbon, large white = oxygen, small white = hydrogen. They can label the atoms on the worksheet. Given this information, have the students figure out which molecules are hydrogen and which are carbon dioxide. They should have six of each.

5. Give each group a copy of worksheet 2. Take away all unused marshmallows. Students should use the structures they have to make the new structures. They will need to pull them apart and reassemble them. They should use up all of the marshmallows from the previous structures. They will use more toothpicks. After all groups have completed their structures, tell them they have just completed the process of photosynthesis. Ask the class what the two different structures on worksheet 2 are. (sugar and oxygen) Where did the energy come from to make the sugar and oxygen? They used energy like the leaves use the sun's energy to make sugar and oxygen out of carbon dioxide and water.

6. For fun, have the students make the original carbon dioxide and water molecules again. Have a race to see which team can make water and carbon dioxide the fastest. This process is respiration,

which plants and animals use to get back the energy stored in sugar. Give all of the students some fresh marshmallows as a reward!

Part III: Four Seasons of the Sugar Maple

1. Hand out "The Four Seasons of the Sugar Maple Tree". Go over the cycle with the students. Explain what happens in the tree during each season. Assign a season to each group. Provide them with drawing materials. Each group should draw a sugar maple tree, as it would appear during the season they were assigned. Encourage them to include people or other things in the tree's surroundings that would be typical of the season. They should write a short description of what is happening to the sugar maple tree during that season. When all drawings are complete, each group should show their picture to the class and explain what goes on in the sugar maple tree during that season. Hang all four pictures on the wall.

Part IV: Collecting the Sap

1. Now students know how trees get their sugar, so you can discuss how to get the sap from the tree. Why do we only take sap from the sugar maple? All plants produce sugar, so why don't we take sap from other trees? Only sugar maple trees have enough sugar in their sap at the right time of the year to make collecting it worthwhile. Some trees also have bad tasting chemicals in the sap besides water and sugar. There are two other trees that have good tasting sap, the black birch and the date plum. What makes the sap flow? The cold nights and warmer days freeze and thaw the sap. This freezing and thawing creates a special force (pressure) within the tree and helps the sap to flow out better when it is tapped.

2.Tap some maple trees. If there are sugar maple trees on school grounds, get permission to tap them. Positively identify that the trees are sugar maples by using field guides. (This can be done in the fall after completing the Maple Leaf ID activity in Lesson 1.) Tap only trees that are larger than 75 centimeters in circumference, measured with the tape. Drill a 7/16-inch hole about 7 cm deep, slanted just enough for the sap to drain out. Insert the spile. The spile should be snug enough to hold the bucket but not too snug or the hole will split. Hang a bucket on the spile, or use a milk jug, with a hole cut in one side to let the sap in.

3. Return to collect the sap in a day or two. Boil the sap in a crock pot with the lid off. The crock pot should be placed near a window with the window left open for the steam to escape. It will take a while for the sap to boil. Assign a student to sit near the crock pot to keep an eye on it. When it begins to foam up, the student should let you know so you can add more sap. Continue the process until all the sap has been added to the crock pot. When all of the sap has been put in and it foams up again, the syrup is ready. A thermometer may be used to show that the syrup boils at 103.9 °C (219 °F). Add butter to stop it from foaming over. Continue to boil if you want the syrup to be thicker; if not, turn off the crock pot. Let each student taste it after it cools a bit.

Extension:

1.Take a field trip to a local sugarhouse.

2. Contact Richard Parisio, DEC environmental educator at Belleayre Mountain, for a maple sugaring presentation. Contact information is given in the resource section of this module.

Assessment:

1. Use the crossword puzzle as a quiz. There are two different versions. One is for grades three through five. The other is for grades six and seven.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading, Speaking and Writing
Standard 4 – Language for Social Interaction: Listening and Speaking

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 1, 2-7
Standard 5 – Technology: History and Evolution of Technology, Impacts of Technology
Standard 6 – Interconnectedness: Systems Thinking, Models

Social Studies
Standard 1 – History of the United States and New York: 2
Standard 2 – World History: 2

Source: Activity developed by Marie Ellenbogen.

A Short History of Maple Sugaring

Wooden buckets were hung under the spile to catch the sap. Colonists boiled the sap in iron kettles over the fire. Later, buckets were made with lids to stop rain, dirt, and bugs from getting in.

The sap is moved from the large tank into an evaporator. An evaporator is a large, metal tank heated by gas, oil, or wood. Thermometers are used to find out when the syrup is ready. Syrup boils at 103.9° Celsius (219° Fahrenheit). There have been many changes in making maple syrup. It will always take time and hard work but will always have a sweet ending.

The Native Americans knew the sap was ready to be taken from the sugar maple tree when the days got warmer and the nights stayed cold. They called this time the “Season of the Maple Moon”. This season is during the months of February and March.

The Native Americans of the northeastern United States were the first people to make maple syrup. Legend says they learned about the sugar maple’s sweet sap from the red squirrels. They watched the red squirrels bite the buds off of the twigs and lick the sap that oozed from the wound.

Today, large sugar bushes are tapped by a plastic pipeline system. Plastic tubing is attached to plastic spiles. The tubing runs from the trees into a large tank in the sugarhouse.

Sap is mostly water with a little bit of sugar. The water must be boiled off to make maple syrup. They could not boil sap over the fire because they did not have metal pots. They heated rocks in the fire. They used two sticks to pick up the hot rocks. They put the rocks in the hollowed out logs that held the sap. This boiled the sap and turned it into syrup.

Sugarhouses were built to keep dirt out of the sap as it boiled. The sugarhouses were built at the bottom of the hill from the “sugar bush”. (A sugar bush is an orchard of sugar maple trees.) The sap was either carried by people or pulled by horses to the sugarhouse. Soon, metal spiles were made and metal buckets were hung directly on them to collect the sap. The metal buckets were lighter and easier to carry than the wooden ones.

The Native Americans showed the European colonists the sweet sap of the sugar maple trees. The colonists used different ways to collect and boil the sap. They used metal drills to make holes in the bark. They made a spout to put in the hole of the tree to guide the sap out. They called it a spile. The first spiles were made from sumac twigs. They scraped out the inside of the sumac twig to make a spile. Later, spiles were made out of hand carved pieces of wood.

The Native Americans didn’t have refrigerators either. They could only use maple syrup during the Season of the Maple Moon. They made maple sugar to use during the rest of the year. To make maple sugar they had to boil the syrup until all of the water was gone. They kept the maple sugar in birch bark boxes called mokuks. The maple sugar was used on food to add flavor.

To get the sap from the tree, they cut the bark with hatchets. They used a wood chip or a piece of bark to guide the sap into holders made of birch bark. The sap was then put into a log that had been cut in half and hollowed out.

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9. Today, large sugar bushes are tapped by a plastic pipeline system. Plastic tubing is attached to plastic spiles. The tubing runs from the trees into a large tank in the sugarhouse.

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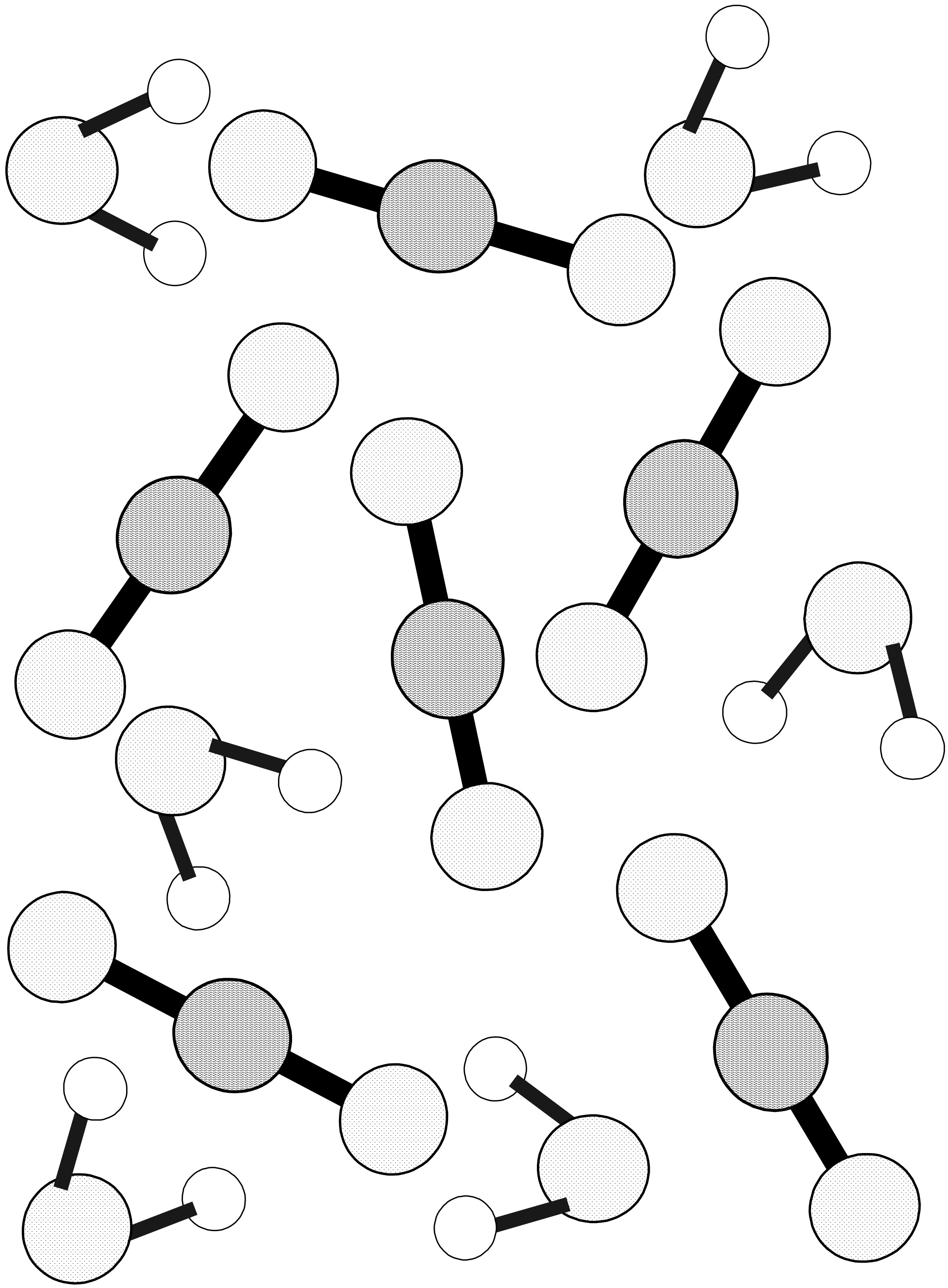
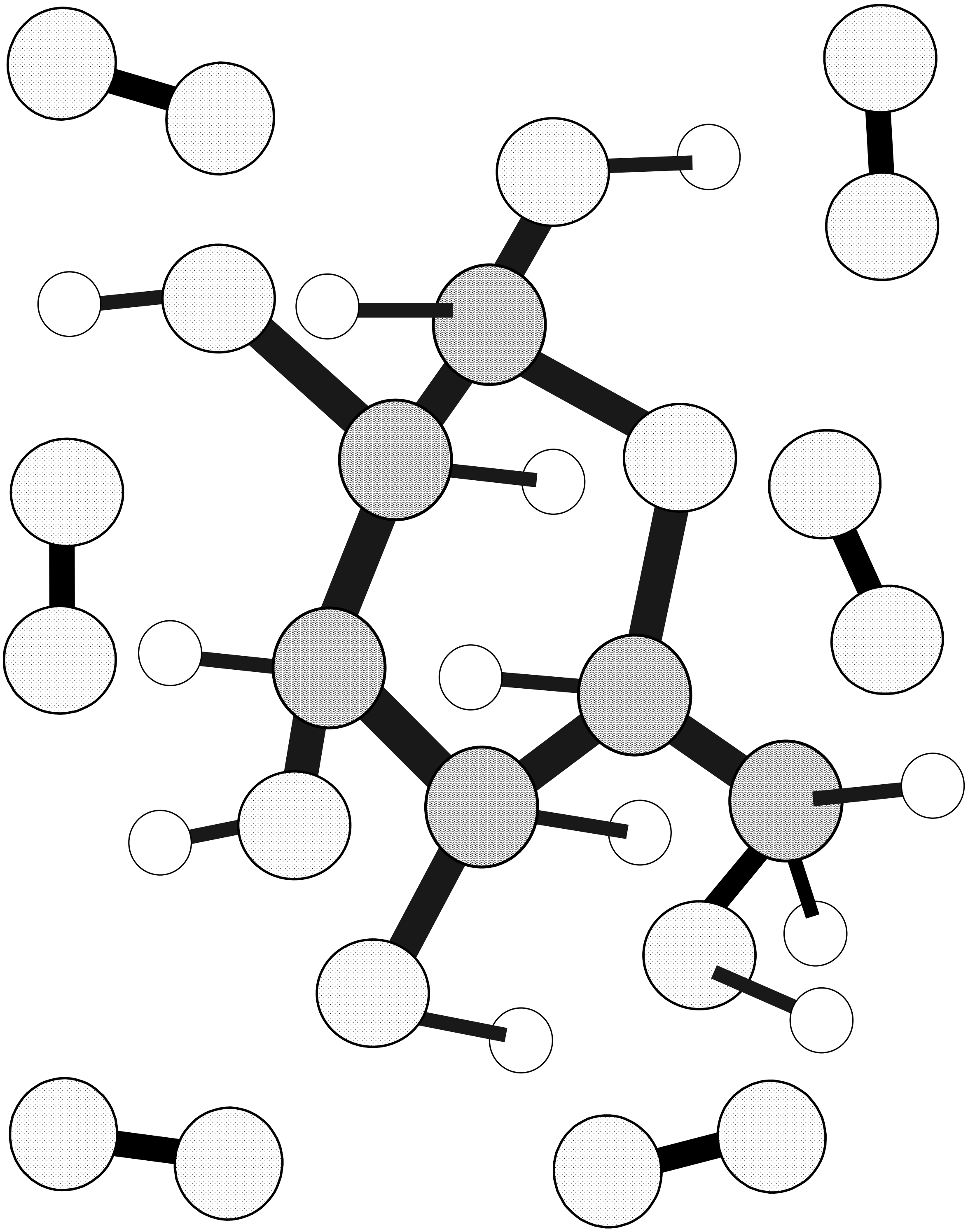
Answer Key



Worksheet 1



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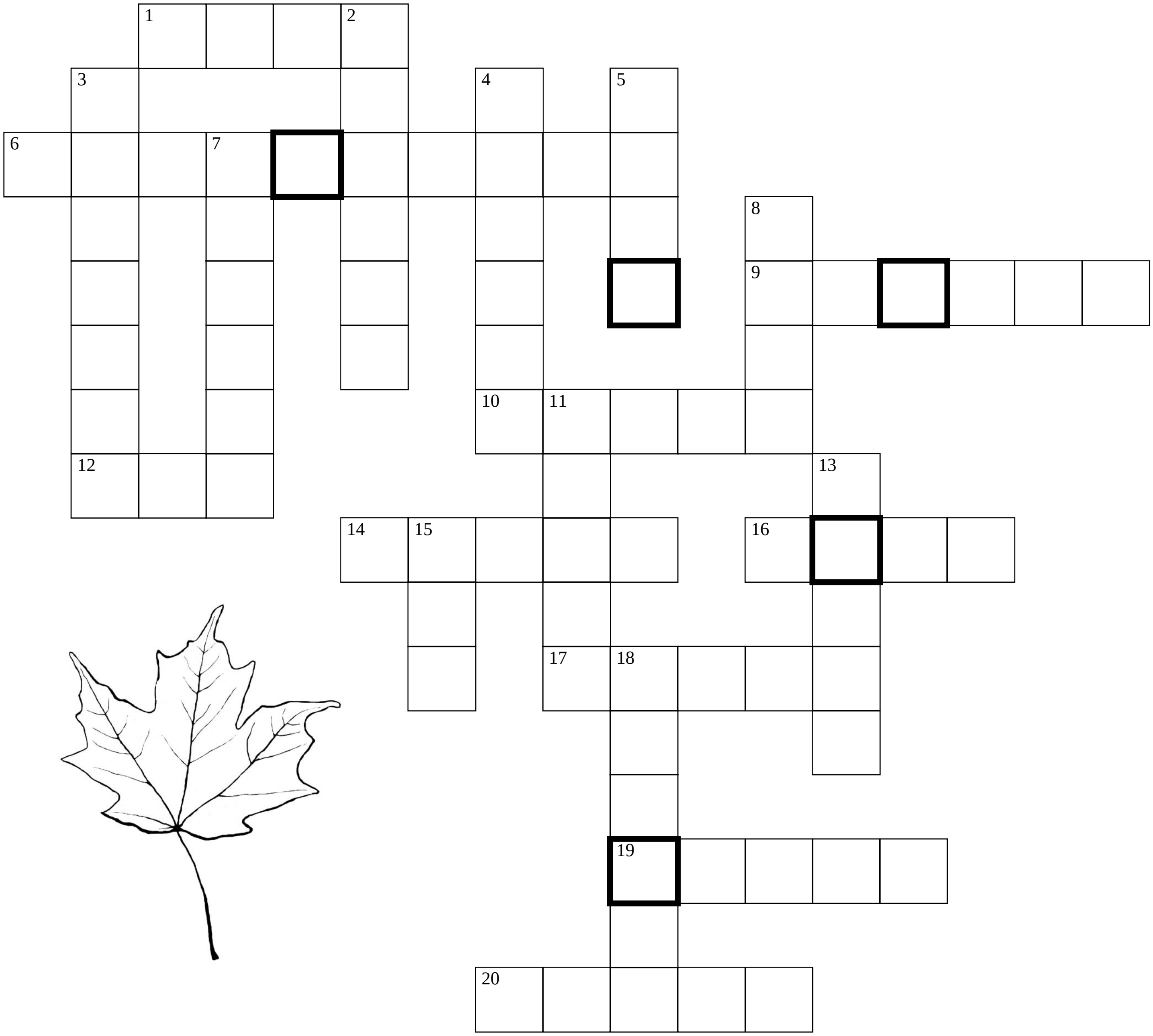


ACROSS

1. Squirrels bite the ____ off of twigs to get sap.
6. Syrup comes from a ____ ____ tree.
9. Plants put ______ into the air during photosynthesis.

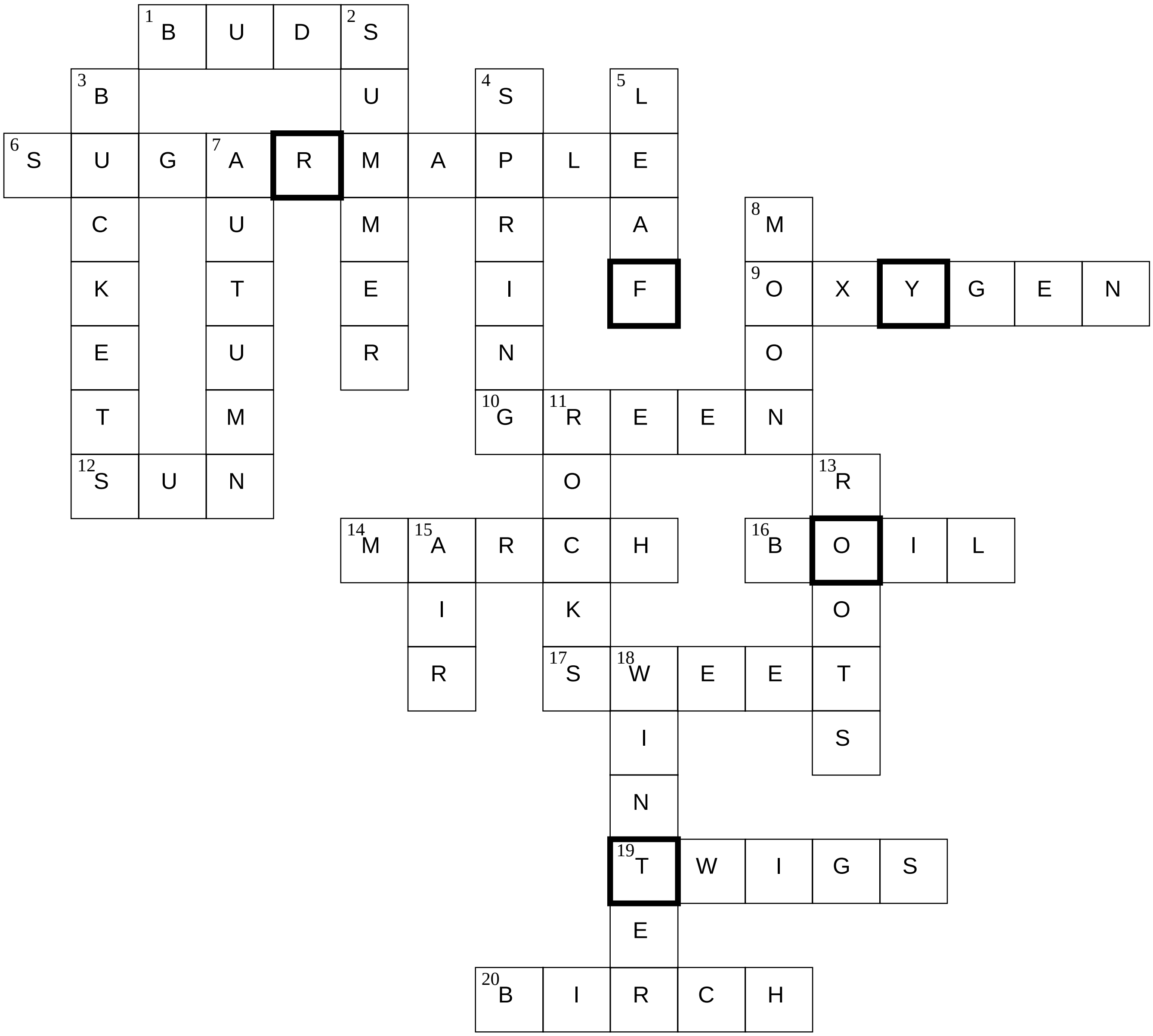
   Hint: We need this to breathe.
10. Chlorophyll gives leaves their _____ color.
12. Plants use energy from the ___ to make sugar.
14. People collect sap during February and _____.
16. To turn sap into syrup you must ____ it.
17. Syrup tastes _____.
19. Colonists made spiles out of sumac _____.
20. Native Americans made mokuks (boxes) out of _____ bark to carry their maple sugar in.

DOWN

2. Maple trees make sugar and grow during the___.
3. Colonists collected sap in wooden _____.
4. Maple trees grow new leaves in the _____.
5. In what part of the tree do plants make sugar?
7. Leaves fall from the trees in ____.
8. Native Americans called the time of cold nights and warmer days the "Season of the Maple___".
11. Native Americans put hot ____ in sap to boil it.
13. Plants get water from the ground using their ___.
15. Plants take carbon dioxide from the ___ to make sugar during photosynthesis.
18. Maple trees do not grow during ____.

BONUS: About how many gallons of sap does it take to make one gallon of syrup?

Hint: Unscramble the letters in the bold boxes.



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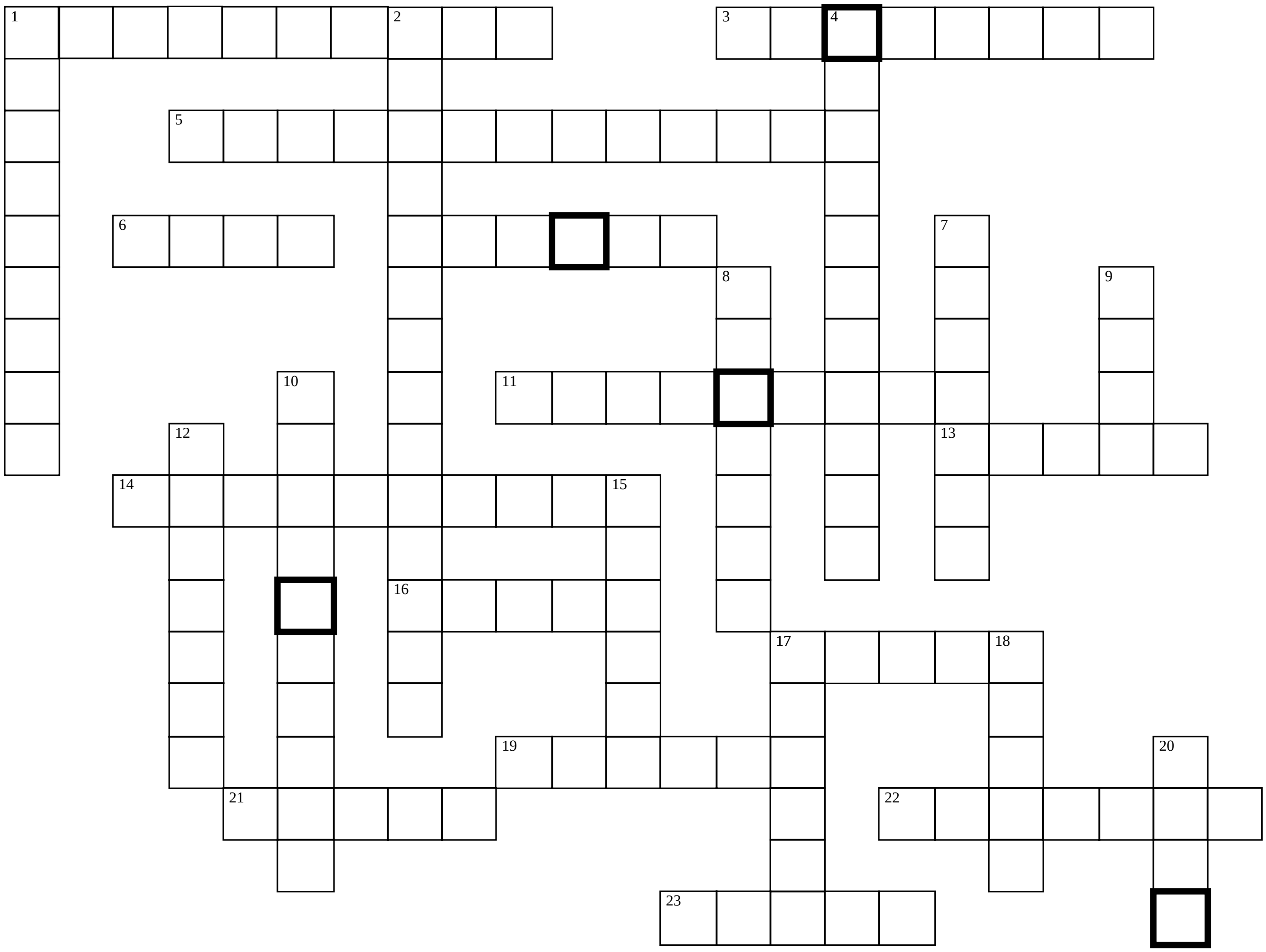
BONUS: About how many gallons of sap does it take to make one gallon of syrup? FORTY

Hint: Unscramble the letters in the bold boxes.

Name:____ Date:



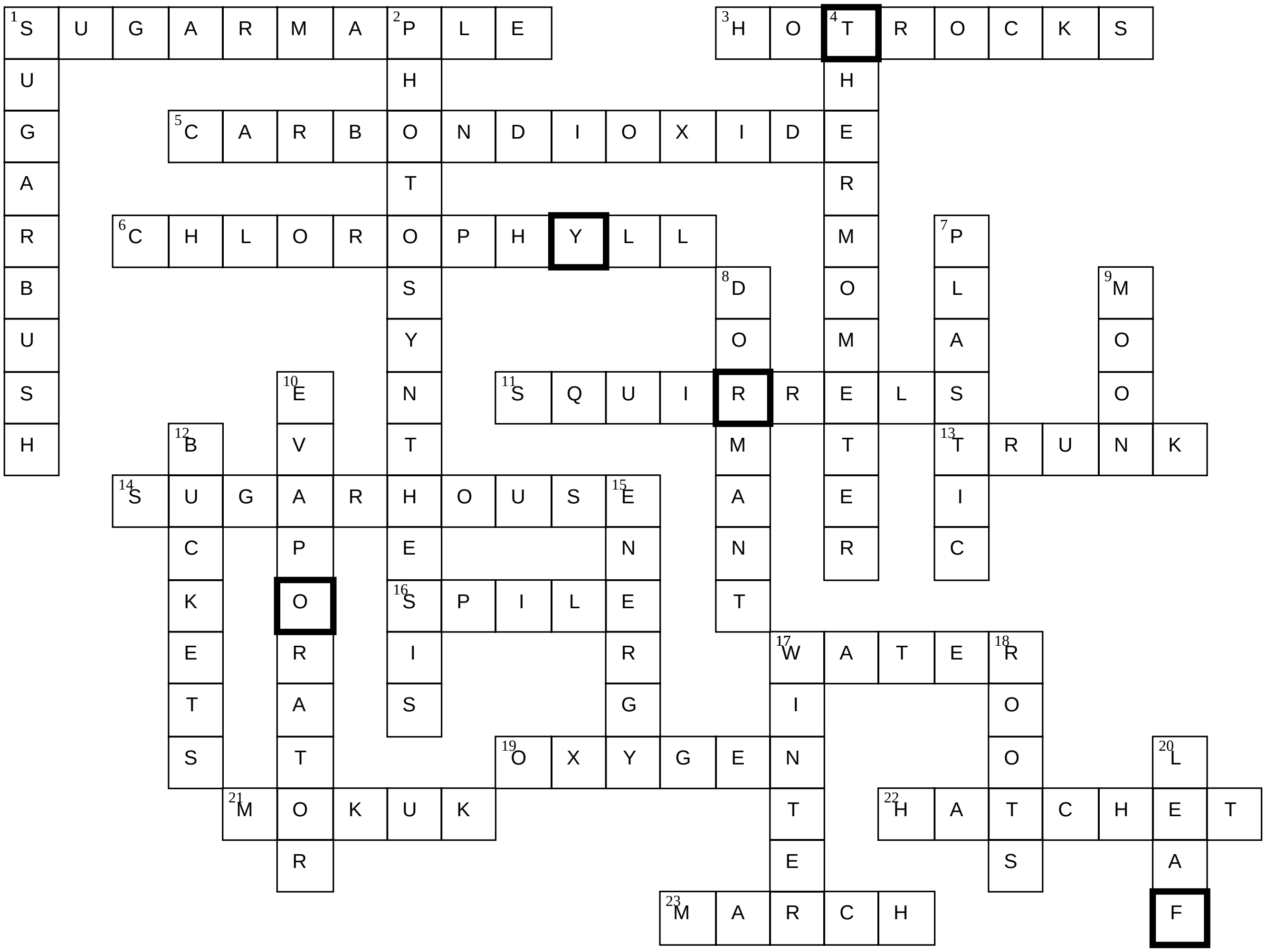
ACROSS

1. We get syrup from this tree. (2 Words)
3. Native Americans put these in sap to boil it. (2 Words)
5. Plants take this from the air to make food.
   Hint: We breathe this out. (2 Words)
6. The green pigment in leaves.
11. These nutty animals taught the Native Americans about the sweet sap.
13. The part of the tree you tap to get sap.
14. A place where sap is brought to be boiled.
16. The European colonists made this spout out of sumac twigs.
17. Sap is made mostly of this, which is boiled off to make syrup.
19. Plants put this into the air when they make food.
   Hint: We need this to breathe.
21. Native Americans made this out of birch bark to carry maple sugar in.
22. Native Americans used it to make notches in trees.
23. February and ____ are the best months to tap trees.

DOWN

1. A grove of sugar maple trees.
2. How plants make their food (sugar).
4. A __________ is used to measure when syrup is ready.
7. The modern method of the pipeline system for carrying sap uses this material.
8. Not growing.
9. The "Season of the Maple ____" is a time of cold nights and warmer days.
10. Today, this machine is used to boil sap into syrup. It is fueled by wood, gas, or oil.
12. These were made out of wood but are now made of metal. They are used to catch sap from the tree.
15. Plants use this from the sun to make food.
17. Maple trees are not growing this time of year.
18. Plants take up water from the ground with these.
20. The part of the plant where food is made.

BONUS: About how many gallons of sap does it take to make one gallon of syrup?
Hint: Unscramble the letters in the bold boxes.



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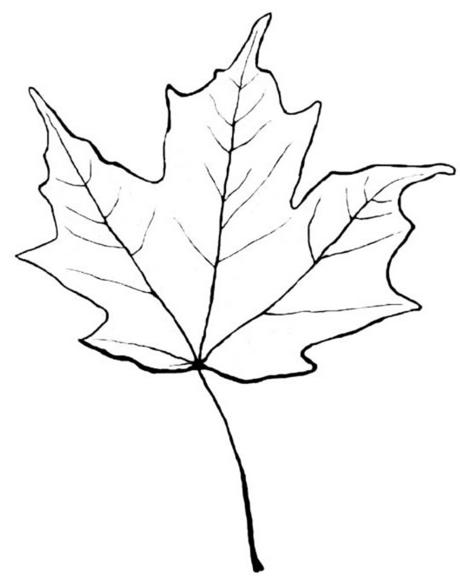
THE FOUR SEASONS OF THE SUGAR MAPLE TREE

Winter

The sugar maple tree is dormant (not growing) during the cold months of this season. At the end of winter, the nights are still cold but the days begin to get warmer. This is the time when the sap starts flowing. The sap is made of mostly water and a little sugar that was made the summer before. The water helps move the sugar to all parts of the tree.

Spring

The sap gives the tree a "sugar energy boost". The sugar gives the tree energy that helps it grow new leaves.



Summer

The newly grown leaves begin making food for the tree by photosynthesis. The chlorophyll (green pigment in the leaves) takes in the sun's light energy. Carbon dioxide comes from the air and water comes in through the roots. The leaves combine carbon dioxide and water to make sugar and oxygen. The sugar is food that can be used for the tree's new growth such as the roots, twigs, and flowers. The leftover food will be stored in the roots for next spring.

Autumn

The days and nights begin to get colder. The leaves of the sugar maple tree turn into bright red and orange colors. The leaves fall to the ground, and in time will become nutrients in the soil.

Bioaccumulation

Grades:

3rd - 7th

Objective:

Students learn how toxins are accumulated at the higher levels in a *food chain*.

Method:

Students represent mayflies, trout, and bald eagles in a physically interactive game.

Materials:

Picture of eagle, trout, and mayflies (enclosed, copy for each student), whistle, paper lunch bags, box of tri-colored pasta, construction paper cut into strips, adhesive tape.

Time:

Preparation time: 10 minutes
Class time: 40 minutes

Procedure:

DDT was a pesticide sprayed on crops to kill insects. It does not readily break down in nature. When it rained, runoff carried some of the toxin into streams. Algae in the streams took in these toxins and accumulated them. DDT is stored in the fatty tissues of animals, so it is not excreted. Mayflies in the streams eat the algae and accumulate the toxins too. In its lifetime, a trout eats many times its own weight in mayflies. Most of the mayfly is either digested or passed through. The toxins, however, remain in the fish. If the trout consumes 10 times its weight in mayflies, it may accumulate up to 10 times the concentration of DDT that was in the mayflies. Organisms near the top of the food chain such as eagles have more toxins than those at the bottom. This is called *bioaccumulation*. DDT affected many wildlife species. Probably thousands of people died because of health problems related to DDT and other pesticides. The US banned DDT from being sprayed in this country. It is still sprayed in some other countries, though. Other toxins that can bioaccumulate include PCBs, or polychlorinated biphenyls (found in the Hudson River as a result of their use in making electrical equipment) and mercury (from industrial air pollution, found in some of the reservoirs).

1. Bring students to an open area, outside if possible. Assign students as mayflies, trout, and eagles. There should be a large number of mayflies, less than half as many trout, and a very low

number of eagles. For example, a classroom of twenty would have 14 mayflies, 5 trout, and 1 eagle. Ask them why there are so many mayflies and only a few eagles. Predators need a large number of prey animals to survive. Use colored arm bands made of construction paper to identify each species. Set boundaries for the playing field.

2. Show the tri-color pasta to the students. Ask them to estimate the percentage of the pasta that is each of the three colors. It should be about 33% each color. Spread the pasta across the playing field. Give each mayfly a paper bag. The bags represent their stomachs. At your signal, they are to gather as much food (represented by pasta) as they can, regardless of color. Let them collect food until about half of the food is gone. Use the whistle to stop them from collecting food.

3. Tell students to discard half of the green and white pasta and scatter it across the field. This represents excretion. They do not discard any of the red pasta. Don't tell them what the red pasta represents yet, only that it is stored in the body instead of being passed on. If you tell them it represents something harmful, they will avoid collecting it in the next round.

4. Next, let the trout onto the playing field. Tell them they must try to catch the mayflies. When a trout tags a mayfly, the mayfly must give the trout the bag of food and then go to the sideline. The other mayflies can continue to collect food but must look out for the trout at the same time. Stop the trout from eating when almost all of the mayflies are gone. Tell the trout and remaining mayflies to look in their bags and discard half of the white and green pasta to represent excretion.

5. Let the eagles onto the playing field. They must try to catch the trout. When you say go, the trout can still try to catch any remaining mayflies. The mayflies may continue to collect food. Both trout and mayflies should watch out for predators. If an eagle catches a trout, he takes all of the trout's bags and the trout goes to the sideline. Stop eagles from eating trout when all or most of the trout are gone. Tell the eagles to discard half of the white and green pasta in each bag.

6. Return to the classroom to study the results. Students should keep their bags. Back at the classroom, first have any remaining mayflies empty their bags for everyone to see. Have the students count or estimate the percentage of their pasta that is red. Write this information on the board. Then do the same for trout, and then eagles. You should see that the animals that are highest in the food chain also have the highest levels of red pasta. Explain that the red objects represent food containing toxins. Certain pesticides, lead, mercury, aluminum, and many other toxins are stored in the body instead of being passed on.

7. Explain that even if the eagle survives, there may be other harmful effects. A pesticide, such as DDT, might cause their eggshells to be too thin. Ask students: What will happen if the eggshells are too thin? How will it affect the eagle population? A few decades ago, there were no eagles in the Catskills. DDT and other pesticides, which kept their young from hatching, had nearly wiped them out. Eggs were infertile or broke on the nest. Eagles were put on the US endangered species list. Finally, after the use of certain pesticides was banned in this country, eagles still surviving in more remote areas repopulated the Catskills. To help them get reestablished, scientists released

young eagles into our area. Bald eagles are now often seen in the Catskills along streams and at the reservoirs. They have been removed from the endangered species list.

8. Hand out copies of the picture of the eagle, trout, and mayflies. Instruct students to color in the water a very light shade of the color of their choice, not necessarily blue. Tell them to color the mayflies a slightly darker shade of the same color, the trout even darker, and the eagle darkest of all. The levels of shading show a visual representation of toxins bioaccumulating in organisms higher up the food chain.

Extension:

1. Students can research what methods were used to help the bald eagle.

2. Students can research the population changes of eagles in the Catskills before DDT was used, while it was used, after it was banned, and today. Is the population of eagles in the Catskills the same as before DDT was used?

3. Students can research what other organisms in the Catskills are affected by bioaccumulation of toxins and what, if anything, is being done about it.

Assessment:

1. Grade students on the quiz provided. Quiz answers are as follows.
    1. Mayfly→Trout→Eagle or any other realistic food chain.
    2. DDT thins the eggshells of eagles. The eggshells are easily broken so fewer eggs hatch. This will eventually cause a decrease in the population.
    3. C. 50 parts per million.
    4. Fish that only come to the Hudson River to spawn are safer to eat because they haven't had as much time to accumulate toxins.
    5. It is safer to drink the water because the fish have accumulated mercury.

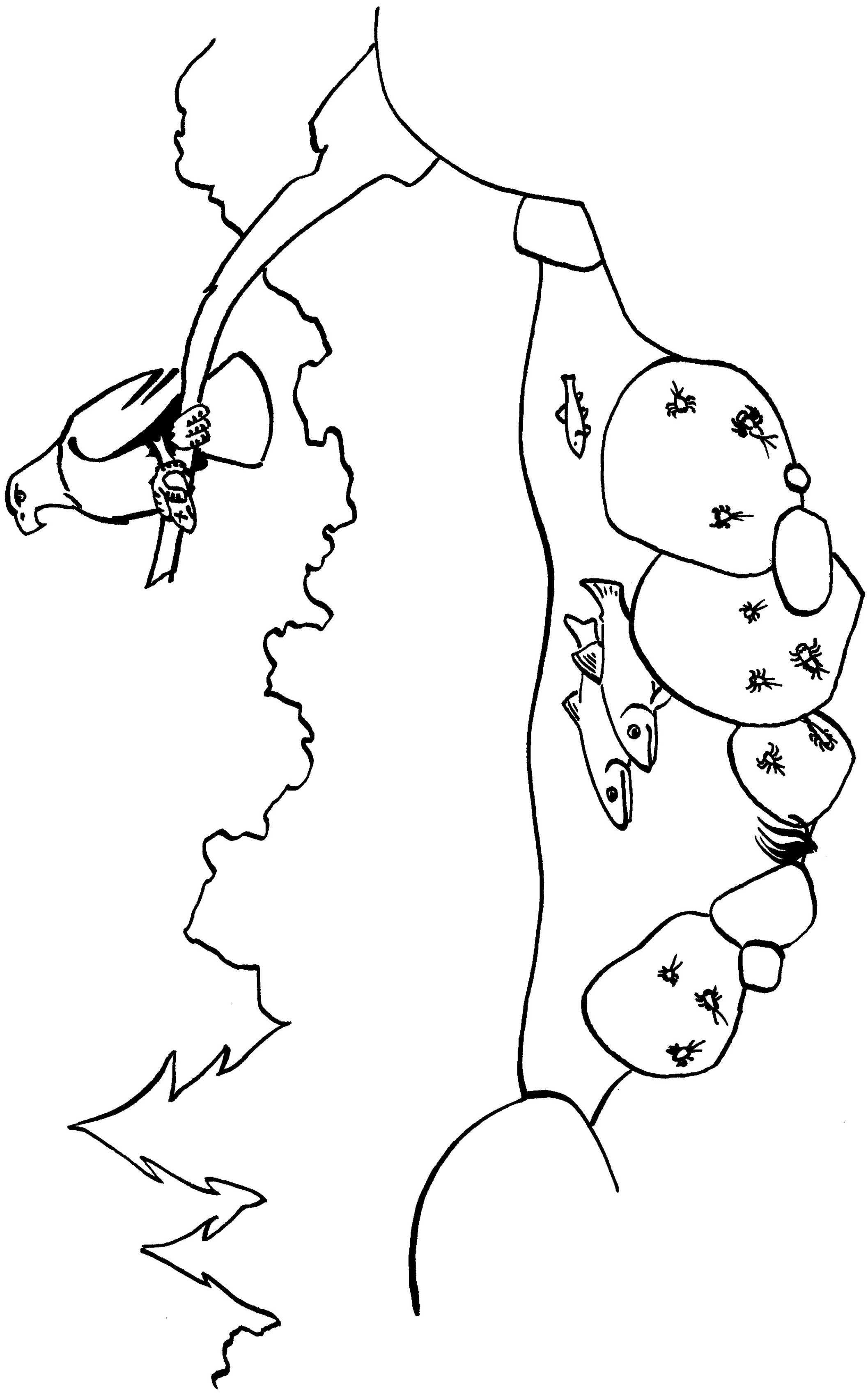
NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading

Health, Physical Education, and Home Economics
Standard 1 – Physical Health and Fitness: Physical Education

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 1, 6, 7

Source: Adapted from the Project Wild activity "Deadly Links".



Bioaccumulation Quiz

Name:_________________________ Teacher:_____________________ Date:_____________

1. Show an example of a food chain below.

2. How does DDT affect eagles?

3. If a fish grew up eating mayflies that had 5 parts per million of DDT, how much DDT do you think the fish might have in its body?

   A. 1 parts per million
   B. 5 parts per million
   C. 50 parts per million

4. Which would be safer to eat: a fish that grew up in the Hudson River, or one that went there only to spawn (lay eggs)?

5. If a reservoir has small amounts of the toxic metal mercury in it, which is safer: drinking the water or eating the fish?

Endangered Species

Grades:

6th - 9th

Objective:

Students develop communication skills and learn about Catskills wildlife listed as *endangered, threatened,* or *special concern*.

Method:

Students write a report about Catskills wildlife that is endangered, threatened, or special concern. They present their findings to classes at a younger grade level. The older students create a quiz to give to the younger students after their presentation.

Materials:

List of endangered, threatened, and special concern species (enclosed).

Time:

Preparation time: 15 minutes, scheduling presentations with teachers
Class time: five student presentations, each 5 to 10 minutes

Procedure:

1. Ask students if some species are more likely than others to become extinct. Explain that NYSDEC recognizes three levels of threat:

> **Endangered** - Any native species in imminent danger of extirpation or extinction in New York State.
>
> **Threatened** - Any native species likely to become an endangered species within the foreseeable future in New York State.
>
> **Special Concern** - Any native species for which a welfare concern or risk of endangerment has been documented in New York State.

Provide a list of Catskills wildlife considered endangered, threatened, or special concern.

2. Divide the class into five groups. Each group should choose a species they would like to do a report on. Their report should include the following information: drawing, description, behavior,

habitat, status (endangered, threatened, or special concern), management, restoration, and protection techniques for returning the species to natural habitats. Students will prepare a presentation to give to younger grade levels. Remind them that the information in their reports should be simplified for the younger students. Tell them what grade level they will be presenting to so they can adjust the information properly. They can be creative with their presentations as long as they include factual information. Such presentations could be done as a puppet show, short play, news brief, etc. Before students go to the younger grade levels, they should practice their presentation in their own classroom. If necessary, give students feedback on how they can better their presentations.

3. Students should prepare a short quiz on their presentations. This might include one question on each presentation, and will be given to the younger students once the presentations are finished.

4. Cooperate with the lower grade levels on scheduling the presentations. If you have to travel to another school, it is best to do all of the presentations in one day. If all grade levels are in one school, the presentations can be broken up over one week (one presentation per day). You may wish to bring only one group at a time to avoid intimidating the younger students. Try to schedule presentations in more than one classroom.

Extension:

1. The students can collect and grade the quizzes and return them to the teachers.

2. Younger students can write "thank you" notes to each group of students that gave presentations. These can include what they remember most about what each group taught them.

Assessment:

1. Grade students on their presentations. Younger students can be given grades for the quizzes.

2. Students should show improved communication skills. Students should understand some of the reasons species are endangered and what can be done to protect them.

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Speaking; Reading and Writing
Standard 4 – Language for Social Interaction: Listening and Speaking; Reading and Writing

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 1,6,7

Source: Activity developed by Marie Ellenbogen.

Selected New York State Endangered, Threatened, and Special Concern Species

Endangered	Common Name	Scientific Name
	Karner Blue Butterfly	*Lycaeides Melissa samuelis*
	Tiger Salamander	*Ambystoma tigrinum*
	Bog Turtle	*Clemmys muhlenbergii*
	Bald Eagle	*Haliaeetus leucocephalus*
	Indiana Bat	*Myotis sodalis*
	American Burying Beetle	*Nicrophorus americanus*
	Peregrine Falcon	*Falco peregrinus*

Threatened	Common Name	Scientific Name
	Eastern Mud Turtle	*Kinosternon subrubrum*
	Northern Cricket Frog	*Acris crepitans*
	Timber Rattlesnake	*Crotalus horridus*
	Osprey	*Pandion haliaetus*
	Red-Shouldered Hawk	*Buteo lineatus*
	Spruce Grouse	*Dendragapus canadensis*

Special Concern	Common Name	Scientific Name
	Jefferson Salamander	*Ambystoma jeffersonianum*
	Cooper's Hawk	*Accipeter cooperii*
	Common Raven	*Corvus corax*
	Eastern Bluebird	*Sialia sialis*
	Eastern Hognose Snake	*Heterodon platirhinos*
	Blue-Spotted Salamander	*Ambystoma laterale*

Plan a Preserve

Grades:

4th - 12th

Objective:

Students learn about forest preserve management.

Method:

Students mark off a small outdoor area for a miniature forest preserve. They create trails, design a brochure, and promote the preserve.

Materials:

For each group: string (cut to 4 meters long), yarn, magnifying glasses, markers, drawing paper, and toothpicks.

Time:

Preparation time: 15 minutes
Class time: Three 40-minute class periods

Procedure:

1. Explain that the Catskill Forest Preserve is state land within the Catskill Park that has been set aside for recreational use and conservation. The Catskill Park is a larger area that includes private land, villages, farms, homes, etc. in addition to the preserve land.

2. Bring students to an outdoor area that has a diversified terrain. Divide the class into groups of three. Tell the students they will be New York State Department of Environmental Conservation (NYSDEC) employees. They will use the string to mark off an area to represent a forest preserve. Tell them to use their magnifying glasses to find out interesting things about their preserve. Rocks can be mountains, cracks can be cloves, a puddle can be a lake, or an area of damp ground can be a wetland.

3. Instruct students to devise a plan for their preserve. They have to decide how much land will be wilderness, wild forest, and intensive use. If they have any areas of intensive use, they should decide what activities are permitted, such as hiking, biking, swimming, boating, nature trails, camping, fishing, hunting, cross-country skiing, etc. Revenue but also impact increase with the number of activities. Students draw a map of the preserve and design a brochure.

4. Give them enough time to complete their assignment before presenting it to the class on Day 2. Their presentations should include an interpretation of the map, why they rationed the land the way they did, and how the land will be managed for wildlife preservation and human activity.

5. Return to the preserve. Trails can be laid out with colored yarn, and toothpicks can be signposts. Students can create in miniature any necessary facilities such as beaches or parking lots. The back of a metal spoon can be rubbed on soil to produce a paved road effect.

6. Day 3. One person in each group should visit two other preserves while the other two students try to attract visitors to their preserve. Once the first student has visited two parks, he or she should return to his or her own preserve and let another student visit two parks. Each preserve should have a guest book that visitors sign.

7. Go back to the classroom. Each group should tell how many visitors they had and ask the students that visited why they came. What did they like or dislike? Would they come again? Why or why not? Which preserve had the most visitors? Is it possible to have too many visitors?

Extension:

1. Each group chooses a department of the NYSDEC. They give a presentation about the department and how it is involved in managing the Catskill Forest Preserve. They can research this information using the NYSDEC web site, http://www.dec.state.ny.us.

2. Contact Richard Parisio, NYSDEC environmental educator, for a slide show presentation on the Catskill Forest Preserve. Contact information is in the resource section of this module.

Assessment:

1. Did students understand the important factors to consider in managing their preserve?

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading
Standard 4 – Language for Social Interaction: Listening and Speaking; Reading and Writing

Mathematics, Science, and Technology
Standard 6 – Interconnectedness: Models
Standard 5 – Technology 3

Social Studies
Standard 3- Geography 1

Source: Adapted from Everglade National Park activity. www.nps.gov/ever/ed/eecreate.htm

The Visual Environment

Grades:

6th - 12th

Objective:

Students will be able to recognize ways in which the visual environment can affect quality of life. They will be able to critique aspects of the visual environment constructively.

Method:

After a classroom discussion, students take a walking tour to assess the visual environment in their community. Through writing or artwork, they generate options for improving the visual environment.

Materials:

Catskill journal (see appendix), Kingston photo overheads (see appendix), art materials.

Time:

Preparation time: 20 minutes
Class time: 2 hours

Procedure:

Preparation: Plan a walking tour route that will allow students to see the main street and adjoining *commercial* areas in the hamlet or village where the school is located. Plan on a 40-minute tour, allowing ample time for students to stop and make observations. Also copy the Kingston photos in the appendix onto overhead transparency material. If you have a color printer, you can print the photos in color from our web site onto transparency material.

1. In the classroom, lead a discussion about the visual environment. Why would you care how your house looks? What are some things that can be done to improve how a house looks? Why would a shop owner care how their store looks? Be sure to discuss the fact that more tourists will come and support local businesses if the village looks nice. By show of hands, how many of your students have parents whose livelihood depends directly on tourism? What about indirectly?

2. Show the photos of different sections of Kingston. Which areas would be more appealing to tourists, and why? Which place would you most like to live in? Have students write their answers in their journals and then discuss.

3. Discuss whose responsibility it is to ensure a healthy visual environment. Local government agencies such as the town planning board can regulate development and shape the visual environment to some extent. There may be laws that affect the visual environment, for example laws against having junk cars or large signs on a property. In this region, much is left to the owner of the property.

4. Explain that students will take a field trip to see what visual environment improvements could be made in the village or hamlet where the school is located. Establish ground rules for this investigation: As you discuss the appearance of properties in the village, students should respect the property owners by not calling out comments about the property. When discussing among themselves or writing in their journals, students should avoid describing properties in ways that could offend other students who might know the owners of the property. Give an example such as: "Instead of saying 'that store is a dump', say, 'that store could be improved by painting it and trimming the shrubs'." Even the nicest looking property can be improved, so wording it this way avoids rating properties against each other. Our interest is in how things could be improved rather than how good particular properties look.

5. Have students bring their Catskill Journal on the field trip. Walk along the planned route, stopping frequently for students to write down observations. What are some things they like about the visual environment? What are some things they would change? Their comments should not be limited to the buildings themselves. They should include comments on vegetation, signs, landscaping, sidewalks, the layout of the village, etc., all components of the visual environment. Make a longer stop in the downtown area and ask each student to draw a street scene, selecting one portion of the main street. (A worksheet is provided.) They will use this later, so the drawing must be detailed. It should show any features of the environment that the student likes or feels could be improved.

6. Return to the classroom. Working individually or in small groups, students create a written work or an art project based on the street scene they chose to draw. Students might draw or build a model of the building as it appears today and create a second representation of how the building might look if certain improvements were made. Ask students to choose modifications that wouldn't cost too much and that would help the building fit in with the rural character of the village. (Kingston photos are relevant here.) Each student or group should write a paragraph explaining the recommendations.

7. Students should hand in their before-and-after projects for a grade.

Extension:

1. Have your students carry out a visual environment awareness campaign. As a class, students can make a list of major opportunities for improvement they saw and distill their list of specific improvement ideas to make a list of general recommendations for property owners. Then students vote on which of the recommendations are most important, ranking them according to number of votes and chose the best ones. It is not appropriate to tell a particular landowner how

he or she can improve his or her property. However, *general* suggestions for landowners can be sent to the newspaper or posted on community bulletin boards. Students should be sure to explain why the visual environment is important. They should explain how business owners and residents can benefit by taking steps to improve the appearance of their properties.

Recommendations that seem to single out a particular business should be reworded. For example, instead of saying “big plastic signs don’t fit in with the rural character of the village”, say instead “the design and construction of signs should be suited to the rural character of the village”. Similarly, if students feel a particular store should have flowers in front of it, they are not free to identify the particular store. They might instead say “buildings without landscaping can be improved by planting flowers”.

2. Students can write to the local government to offer their opinions on how the sidewalk and park areas in the village should be maintained. Students can also propose changes to local laws.

Assessment:

1. Did students present their recommendations in a constructive, tactful way?

2. Did students become aware of how the visual environment affects the local economy?

NYS Learning Standards:

English Language Arts
Standard 1 – Language for Information and Understanding: Listening and Reading
Standard 4 – Language for Social Interaction: Listening and Speaking; Reading and Writing

Mathematics, Science, and Technology
Standard 4 – Science: The Living Environment 7
Standard 5 – Technology 2, 6
Standard 6 – Interconnectedness: Common Themes 1, 2, 6

Social Studies
Standard 3 – Geography 1
Standard 4 – Economics 1, 2
Standard 5 – Civics, Citizenship, and Government 2, 3, 4

Source: Activity developed by Nathan Chronister.

Your Visual Environment

Name:____________________________ Teacher:__________________ Date:_____________

Choose one section of the village and answer the following questions.

1. Draw the street scene below.

2. How do you feel about the buildings here?

3. Do the buildings seem to fit in with the other buildings in town?

4. Choose one building you drew. How is it different from other buildings in town?

5. How is it similar?

6. If you were the owner, what could you do to make the property look nicer?

7. What do you like about the building?

Glossary

Note: Words in italics are defined separately within this glossary.

Adaptation - An inherited feature of an *organism* that helps it to survive and reproduce.

Alternate branching - A branching pattern of plant stems in which new branches begin on alternating sides of the main stem, not directly across from each other.

Autotroph - An *organism* that produces its own food, usually through *photosynthesis*.

Benthic - Living on the bottom of a stream, lake, or other body of water.

Bioaccumulation - The process by which pollutants become concentrated in the bodies of animals that are high on the *food chain*. Also called biological magnification.

Biodiversity - The number of *species* in an area, or the amount of biological variety present, considering the number of species, uniqueness of species, genetic variation within species, etc.

Carbohydrate - Compounds such as sugar and starch that are composed of carbon, hydrogen, and oxygen.

Carbon - An important chemical element that forms the backbone of biological molecules such as *carbohydrates*, proteins, fats, and nucleic acids. Complex molecules based on carbon are called organic molecules.

Carbon cycle - The process by which *carbon* is converted from one form to another and back again by living *organisms*. Carbon dioxide from the atmosphere is used in *photosynthesis* to make sugar used by plants. Carbon in plant tissues can be eaten by animals or used by decomposers. Carbon compounds can be used for energy through the process of *respiration*, which releases carbon dioxide back to the atmosphere, or they can be used as part of the organism.

Carnivore - A meat eater.

Chlorophyll - The light-absorbing pigment in plants that captures the sun's energy, allowing *photosynthesis*.

Climax - The point in *succession* at which, in the absence of additional disturbance, the species that are *dominant* will not be displaced by other species.

Commensalism - An ecological relationship in which two species closely associate with each other and one benefits but there is no substantial harm or benefit to the other.

Community - The collection of *organisms* living in a place.

Consumer - An *organism* that uses a particular resource.

Deciduous - Dropping its leaves for the winter.

Denitrifying bacteria - Bacteria that convert organic *nitrogen* to nitrogen gas.

Department of Environmental Conservation (DEC) - The New York State agency responsible for the environment, wildlife, and managing the state forest *preserve* land.

Detrivore - An *organism* that feeds on *detritus*.

Detritus - Decomposing organic matter such as fallen leaves, dead *organisms*, etc.

Development - The process through which an *organism* matures.

Diurnal - Active by day.

Dominant - Abundant or important in a particular *ecosystem*.

Ecology - The study of the how *organisms* interact with each other and the environment.

Economics - The study of the production, distribution, and consumption of goods and services.

Ecosystem - The system formed by the interaction of living things with each other and the non-living environment.

Ecotone - An intersection of ecological *communities*, such as the place where field and forest meet. Edge habitat.

Endangered - Any native *species* in imminent danger of extirpation or extinction in New York State.

Energy - The capacity to do work. In *organisms*, most of the available energy is stored in the chemical bonds of molecules. Energy allows the organism to carry out the many chemical reactions that allow it to function. *Carbohydrates* and fat are often used for energy storage.

Environment - Surroundings, including natural and built components.

Eukaryote - An *organism* whose cells have a membrane-bound nucleus.

Eutrophication - The process by which excessive nutrient levels in a water body can damage the aquatic ecosystem. Fertilizer can lead to excessive algal growth. Sewage or large populations of algae lead to a high rate of decomposition. The increased decomposition depletes the water of dissolved oxygen, leading to the death of many aquatic species.

Evaporator - Equipment for boiling most of the water out of maple sap to produce syrup.

Evolution - Genetic change in a *population* of *organisms* over time.

Flora and Fauna - Plants and animals. These terms no longer embrace all of living things, because fungi, bacteria, algae, and protists, once considered plants and animals, have been reclassified. See *kingdom*.

Food chain - A sequence of *organisms*, each of which provides food for those later in the sequence. The food begins with producers (plants), followed by primary consumers, secondary consumers, and so on, to decomposers.

Food web - Like a *food chain*, but allowing for the fact that consumers don't always eat the same thing. More complex pathways from producers to consumers to decomposers are allowed.

Forest management - A plan of action taken by humans to influence the life in a forest for certain goals, such as timber or wildlife production. Management techniques include selective cutting or planting of trees, hunting, and others.

Gene - Part of a DNA molecule that carries hereditary information.

Habitat - The type of environment where an *organism* normally lives, such as stream, field, or hardwood forest.

Herbivore - An animal that eats plants.

Heterotroph - An *organism* that gets its energy from other organisms, for example by eating them or through parasitism.

Invasive - Tending to move into a *habitat* previously not occupied by the *species*.

Invertebrate - Animal without a backbone.

Kingdom - One of the five major groups of living things: plantae (plants), animalia (animals), fungi, monera (bacteria), and protista (algae and single-celled *eukaryotes*). The kingdom is the largest *taxonomic level.*

Macroinvertebrate - Animal with no backbone that is large enough to study with the naked eye.

Mutualism - A relationship between two *species* that both benefit from. In many cases, the two depend on each other for survival or reproduction.

Natural selection - The process by which *genes* that have an advantage in survival and reproduction tend to increase in the *population*.

Niche - An *organism's* role in the environment, such as what it eats, where it lives, etc.

Nitrifying bacteria - Bacteria that convert ammonia in soil to nitrate used by higher plants.

Nitrogen - An element used in important biomolecules such as amino acids, nucleic acids, and proteins. Nitrogen cycles from the atmosphere to living things and back again.

Nitrogen-fixing bacteria - Bacteria that convert atmospheric *nitrogen*, N_2, to ammonia, which can be used by other living things.

Nocturnal - Active at night.

Nutrient - Any substance used by *organisms* to grow and survive.

Omnivore - An animal that eats both plants and animals.

Opposite branching - A branching pattern of plant stems in which new branches grow in pairs from opposite sides of the main stem.

Organism - A living thing.

Parasitism - An association of two *organisms* in which one benefits at a cost to the other.

Photosynthesis - The process by which carbon dioxide, water, and energy from sunlight are used to produce sugar.

Phylogeny - The evolutionary origin of a *species* or group of species.

Phylogenetic tree - A diagram that shows the evolutionary relationships among *species*.

Population - Members of a *species* living in a particular area.

Prokaryote - An *organism* lacking a cell nucleus. Bacteria are prokaryotes.

Respiration - Breathing. Also, the reaction of oxygen with organic molecules to provide energy.

Scat - Animal droppings.

Sign - Evidence that an animal has been present, such as tracks, *scat*, nests, etc.

Special Concern - Any native *species* for which a welfare concern or risk of endangerment has been documented in New York State.

Species - A group of *organisms* that can interbreed and produce fertile offspring.

Spile - A hollow tap inserted into a bored hole in a tree that allows sap to be collected.

Succession - The process by which colonizing *species* move into a newly disturbed *habitat*, and are then replaced by other species that are better adapted to the environment as modified by the *community* then present.

Symbiosis - Living together in a close association. A symbiosis may be either *parasitic* or *mutualistic*.

Taxonomy - A system of classifying living things, or the act of classifying them.

Taxonomic level - One of the levels in the biological classification system. *Kingdom* is the broadest level, followed by phylum, class, order, family, genus, and *species*. For plants, the word "division" is sometimes used instead of "phylum". Here are the classifications for humans and sugar maple:

Kingdom: Animalia	Kingdom: Plantae
Phylum: Chordata	Division: Magnoliophyta
Class: Mammalia	Class: Magnoliopsida
Order: Primates	Order: Sapindales
Family: Hominidae	Family: Aceraceae
Genus: Homo	Genus: Acer
Species: sapiens	Species: saccharum

Threatened - Any native species likely to become an *endangered species* within the foreseeable future in New York State.

Transpiration - Evaporation of water from within the leaves of plants.

Vertebrate - Animal with a backbone.
Wilderness - An area with no obvious effect from human activities.

Wildlife management - Control of animal populations, for example through hunting regulations.

Books and Articles:

The Ashokan Catskills: A Natural History. Jack Bierhorst. 1995. Fleischmanns, NY: Purple Mountain Press and The Catskill Center for Conservation and Development. 116 pp. 7x10" $18.00 softcover. (845) 586-2611.

A detailed description of the Town of Olive, including its geology, plants, animals, communities, and prehistory. Contains species checklists.

Bare Trees: Zadock Pratt, Master Tanner, & the Story of What Happened to the Catskill Mountain Forests. Patricia Millen. 1995.

Describes the denuding of the catskill mountains by 19th-century tanners. Author is former director of Pratt Museum in Prattsville.

The Catskill Forest: A History. Michael Kudish. 2000. Fleischmanns, NY: Purple Mountain Press. 218 pp. $45 hardcover. (845) 254-4062 or (800) 325-2665.

The story of how Catskills forests have developed since the last ice age. The author's own investigations of evidence from bog samples, tree rings, and carbon dating give a sense of how science can be used to uncover mysteries of the past. The book includes a large, full-color map showing forest history and forest industries.

The Creation Controversy & The Science Classroom. National Science Teachers Association. 2000. 64 pp. $15.95, member price $14.36.

This book will help science teachers respond to inquiries and concerns about evolution. By providing religious grounding in favor of modern science and effective strategies for dealing with common creationism arguments, this book is a must read for administrators and teachers alike. Provides an understanding of the nature of science and the relationship between science and religion.

Creatures of the Woods. Toni Eugene. 1985. National Geographic Society. 34 pp. 8.5x11" hardcover.

This book with large color photographs is a good way to introduce forest creatures to young students. It focuses on large mammals, and most of the species are common in the Catskills.

Eastern North America's Wildflowers. Louis C. Linn. 1978. New York: E. P. Dutton. 277 pp. $9.95 softcover.

A good field guide for children because of its colorful, life-size illustrations. The descriptions are, unfortunately, on different pages than the illustrations, and are fairly technical, but teachers can help students with this information.

Environmental Education Program: Curriculum in Science Field Studies Grades K-6. 1997. New Paltz, NY: Mohonk Preserve, Inc. 268 pp. 8.5x11" $31.00 three-ring notebook.

Designed to supplement environmental education programs offered at Mohonk Preserve. Activities, based on NYSED science requirements, are grouped by fall and spring and cover a variety of topics, including plant and animal life in various habitats, water, Native Americans, and geology. (845) 255-0919.

A Field Guide to the Mammals. William Henry Burt. 1976. Boston: Houghton Mifflin. (Peterson Field Guide series) 289 pp. $17.95 hardcover.

This guide is very easy to use to identify mammals and to give students a sense of the many different kinds.

Golden Guide series. New York: Golden Press. 4x6" softcover.

The following books in this series may be helpful: Birds, Butterflies and Moths, Endangered Animals, Flowers, Insects, Mammals, Pond Life, Trees, Weeds. The guides can be used by children. They allow identification of common species and also contain other information.

Guide to Freshwater Animals Without Backbones. Arlene de Strulle and Tora Johnson. 1997. Arkville, NY: The Catskill Center for Conservation and Development. 108 pp. 6.5x8.5" $10.95 softcover.

Identification key and detailed information on each type of aquatic invertebrate including habitat, feeding, locomotion, etc. Available from The Catskill Center, (845) 586-2611.

Hidden World. Claude Delafosse and Gallimard Jeunesse. Scholastic, Inc. 1997.

Students use a simulated flashlight beam to explore hidden worlds. Titles in this series include Under the Ground and Under the Sea.

House Bats and Bat Houses: How Science Helps a Species Survive. Ellen Rathbone and D. Andrew Saunders. 1997. 38 pp. softcover. State University of New York Environmental Science and Forestry.

In the Catskill Mountains: A Personal Approach to Nature. Walter F. Meade. 1991. Fleischmanns, NY: Purple Mountain Press. 127 pp. 10x8" $25.00 hardcover. (845) 254-4062 or (800) 325-2665.

Wildlife stories and 63 photos of local plants and animals, most in color, with information about the animals in each picture.

Into the Field: A Guide to Locally Focused Teaching. Clare Walker Leslie, John Tallmadge, and Tom Wessels. The Orion Society, 195 Main St, Great Barrington, MA 01230. (413) 528-4422.

Suggests approaches to place-based environmental education that give students a stronger connection to their home as well as to the natural environment.

New York Wildlife Viewing Guide. Frank Knight. Falcon Publishing. 96 pp. $8.95 softcover. (800) 582-2665.

This book by a DEC educator describes 89 sites in New York State that provide good wildlife viewing opportunities. The state is divided into seven regions, each with its own map of sites.

Pond and Stream Safari: A Guide to the Ecology of Aquatic Invertebrates. Karen Edelstein. 1993. Ithaca, N.Y.: Cornell University. 57 pp. 8.5x11" softcover.

Written for elementary educators who want to teach their students about aquatic ecology. Comes in a folder with activity sheets and quick reference guide. Available through the Cornell Cooperative Extension office in your county.

PLT (Project Learning Tree) Pre-K-8 Environmental Education Activity Guide. 1993. American Forest Foundation. 1111 19th Street NW, Washington DC 20036.

A broad and progressive collection of environmental education activities. Contact Catskill Forest Association for information on workshops.

Project Seasons. 1995. Deborah Parrella. Shelburne Farms. Shelburne VT 05482. (802) 985-8686. 320 pp. softcover.

An activity guide on the natural world and traditional living, with activities for each season.

Project Wild Elementary Activity Guide. 1986. Western Regional Environmental Education Council, PO Box 18060, Boulder CO 80308-8060. (303) 444-2390.

This guide contains activities on wildlife. It is available by attending Project Wild workshops. Contact Richard Parisio (see Resource People) for information.

The Ways of the Watersheds. Kathleen M. Haskin. Claryville, N.Y.: Frost Valley YMCA. 248 pp. 8.5x11" $30.00 unbound.

Curriculum guide on the New York City watersheds, with a section on ecology, pages 58-86. (845) 985-2291.

Who Lives Here? A Coloring Guide to Animals and Their Homes. 1993. Minocqua, Wisconsin: NorthWord Press. 40 pp. 8.5x11" $4.95 softcover.

This is a series of coloring books with color photos of animals and a paragraph about how each species lives. Example: Book One: Rivers, Lakes, and Ponds contains many species that live in and around these habitats that are common in much of the country. (800) 356-4465.

Teaching Materials:

American Chestnut Foundations, Inc., Buffalo Museum of Science, 1020 Humboldt Parkway Buffalo, NY 14211. (716) 896-5200. These folks sell an education kit with which you can plant American Chestnut trees at your school. The species nearly became extinct because of a disease.

Catskills Native Nursery, 607 Samsonville Road, Kerhonkson, NY 12446. (845) 626-3502. www.ulster.net/~cnnursery. cnnursery@ulster.net. A nursery specializing in native plants.

Ironwood Pacific, 16176 SW 72nd Ave., Portland OR 97224. (800) 261-1330. They sell a “Backyard Bass”, which is used for teaching children how to cast a line. The casting weight catches on a notch on the plastic fish so it can be reeled in.

Trees for Life, 3006 W St Louis, Wichita KS 67203-5129, phone: (316) 945-6929 or (800) 873-3736. fax: (315) 945-0909. email@treesforlife.org. Trees for Life has a tree-planting kit for classrooms. It includes, among other things, seeds and a planting carton for each student and a teacher handbook with instructions, activities, fun facts, and a book list.

Web Sites:

The American Museum of Natural History www.amnh.org/explore/index.html
This website has a "just for kids" section with a variety of interesting activities. Kids can learn

about biodiversity, make observations about plants and animals, contact other students, and build dioramas. Some of the activities are designed to be printed out for use offline.

Biodiversity Counts www.amnh.org/learn/biodiversity_counts/
A middle school science program maintained by American Museum of Natural History in which students study biodiversity at a site near their school.

Childrens Butterfly Site www.mesc.nbs.gov/butterfly.html
Designed for grades 4 to 6. Includes coloring page, photos, other information.

Classroom Feeder Watch **birdsource.org/cfw**
Cornell Lab of Ornithology project in which students report data from bird feeder sightings.

Cornell Cooperative Extension Catalog www.cce.cornell.edu/publications/catalog.html
Catalog lists CCE publications on many agricultural and environmental topics.

Dragonfly Hot Links www.muohio.edu/Dragonfly/links.htmlx
A collection of links related to science education. It has nothing to do with dragonflies and is named for the NSTA publication with that name.

Eisenhower National Clearinghouse www.enc.org/classroom/lessons/nf_index.htm
A listing of science and math teaching resources.

Enature.com www.enature.com
Online field guides for a wide variety of organisms.

Integrated Taxonomic Information System www.itis.usda.gov
Allows you to find out the full taxonomy of North American organisms.

Kodak's Peregrine Falcon Birdcam
www.kodak.com/country/US/en/corp/features/birdcam2000
Give your students a look at the nesting process of this amazing species. Formerly more abundant, this species is starting a gradual comeback and sometimes nests on buildings and bridges. They nest in spring.

National Science Teachers Association www.nsta.org
Various resources for science and elementary teachers: news, information, books, membership info, science equipment suppliers, and more.

New York State Department of Environmental Conservation www.dec.state.ny.us
A large web site with all kinds of information. Of particular interest are the sections on deer management, www.dec.state.ny.us/website/dfwmr/wildlife/nydeer.html, endangered species,

www.dec.state.ny.us/website/dfwmr/wildlife/endspec/index.html, and fish hatcheries, www.dec.state.ny.us/website/dfwmr/fish/foe4chat.html.

Plants and Animals of the Santa Barbara Backcountry
www.sbceo.k12.ca.us/~mcssb/sbpanda/plants_animals.html
This is a California website, but many of the animals it describes are also found here in the Catskills. Look for information on bobcats, mountain lions, and black bear.

Sustainability Education Center www.globaled.org/sustain/paper_trail/cover.html
The American Forum for Global Education offers teacher resources on ecological economics.

Tots to Teens www.ga-web.com/kidz/science.html
A collection of science links for children. The biology section is relevant here.

United States Department of Agriculture www.usda.gov/news/usdakids/index.htm
Activities and links for kids.

United States Geologic Survey USGS www.nbs.gov/features/education.html
Educational resources, including a list of interesting web sites related to biology.

Resource People:

Spider Barbour, 3000 Fish Creek Rd., Saugerties, NY 12477. Expert on local natural history.

Ursula Baush, 224 East 27th Street, Apt. 5B, New York, NY 10016. (212) 532-9322. Herbs and medicinal uses of herbs.

Catskill Outdoor Education Corps, Student Activities Office, Farrell Hall, Room 226, SUNY Delhi, Delhi, NY 13753. (607) 746-4051. This AmeriCorps program offers outdoor education programs to the public and can be reserved for school groups. Topics include map and compass skills, primitive living, mammology, nature crafts, nature stories, discovery nature walks, problem solving skills, new games, kayaking, fishing, and hiking.

Nathan Chronister, Director of Education, Catskill Center for Conservation and Development, Route 28. Arkville, NY 12406. (845) 586-2611. educat@catskill.net.

Cornell Cooperative Extension. Call the extension office for your county, as listed in the phone book. Cornell Extension offers a wide variety of education programs and publications.

Lorraine Herschkorn, PO Box 1272, Port Ewen, NY 12466. (845) 339-1690. acartoonforyou@yahoo.com. Teaches programs on animal tracking and using art as a way to increase sensory awareness of the environment.

Lori McKean, The Eagle Institute, PO Box 182, Barryville, NY 12719. (845) 557-6162. www.eagleinstitute.org. eagleinstitute@yahoo.com. Eagle Institute offers educational programs about bald eagles, which may include eagle watching field trips or classroom activities.

National Science Teachers Association, 1840 Wilson Boulevard, Arlington VA 22201-3000. (703) 243-7100. www.nsta.org. NSTA provides helpful information for science teachers and for elementary school teachers on teaching science.

Richard Parisio, DEC Environmental Educator, Belleayre Mountain Ski Center, PO Box 313, Highmount, NY 12441. (845) 254-5600 extension 225.

Rebecca Perry, Environmental Educator, Catskill Forest Association, Route 28, Arkville, NY 12406.

Bob and Kathy Powell, 226 Moonhaw Road, West Shokan, NY 12494. (845) 657-8665. Classroom programs on fly fishing and fly tying.

Sportfishing and Aquatic Resources Education Program (SAREP), Department of Natural Resources, Cornell University, Ithaca, NY 14853. (800) 261-1330. The SAREP program is aimed at introducing young people to fishing.

Gene Weinstein, 3 Belmont Drive, Monticello, NY 12701. Expert on bald eagles in Sullivan County.

John Yrizarry, 147 Benjamin Meadow Rd., Tuxedo NY 10987. (845) 783-4302. Expert on butterflies of the Catskills.

Places to Visit:

Ashokan Field Campus, 477 Beaverkill Road, Olivebridge, NY 12461. (845) 657-8333. An environmental and historical education center owned by SUNY New Paltz but located near the Ashokan Reservoir.

Balsam Lake Mountain, near Margaretville, NY. The summit of Balsam Lake Mountain contains one of our most accessible examples of balsam fir forest. Although the round trip hike is six miles, most of the trail is not steep. A fire tower is present at the summit. From Arkville, take Dry Brook Road about 6 miles. Turn right onto Millbrook Road and go 2 miles. Parking is on the right, across the road from the trailhead. Summit elevation is 3720 feet.

Beech Mountain Nature Preserve, Cathy Hinkley, Coordinator, HCR1, Box 71, Lew Beach, NY 12753. (845) 439-3545. An environmental studies facility with a high elevation lake and a cabin with 11 bunks. The preserve as an acid rain monitoring project.
Catskill Fly Fishing Center and Museum, 5447 Old Rt. 1, Livingston Manor, NY. (845) 439-4810.

Frost Valley YMCA, 2000 Frost Valley Rd., Claryville, NY 12725. (845) 985-2291. A large outdoor education facility in the southern Catskills.

Hudson Valley Materials Exchange, Jill Gruber, Director, 207 Milton Turnpike, Milton, NY. 12547. (845) 795-5507. Fax (845) 795-2892. hvme@warwick.net. www.hvmaterialsexchange.com. The materials exchange is an inexpensive source of materials such as wood, fabric, board, and many more items that you may find useful in your classroom. The web site lists materials and offers a curriculum guide on reuse of materials.

Minnewaska State Park Preserve, PO Box 893, New Paltz, NY 12561. (845) 255-2011. Preserve offers educational programs near Lake Minnewaska on the Shawangunk Ridge.

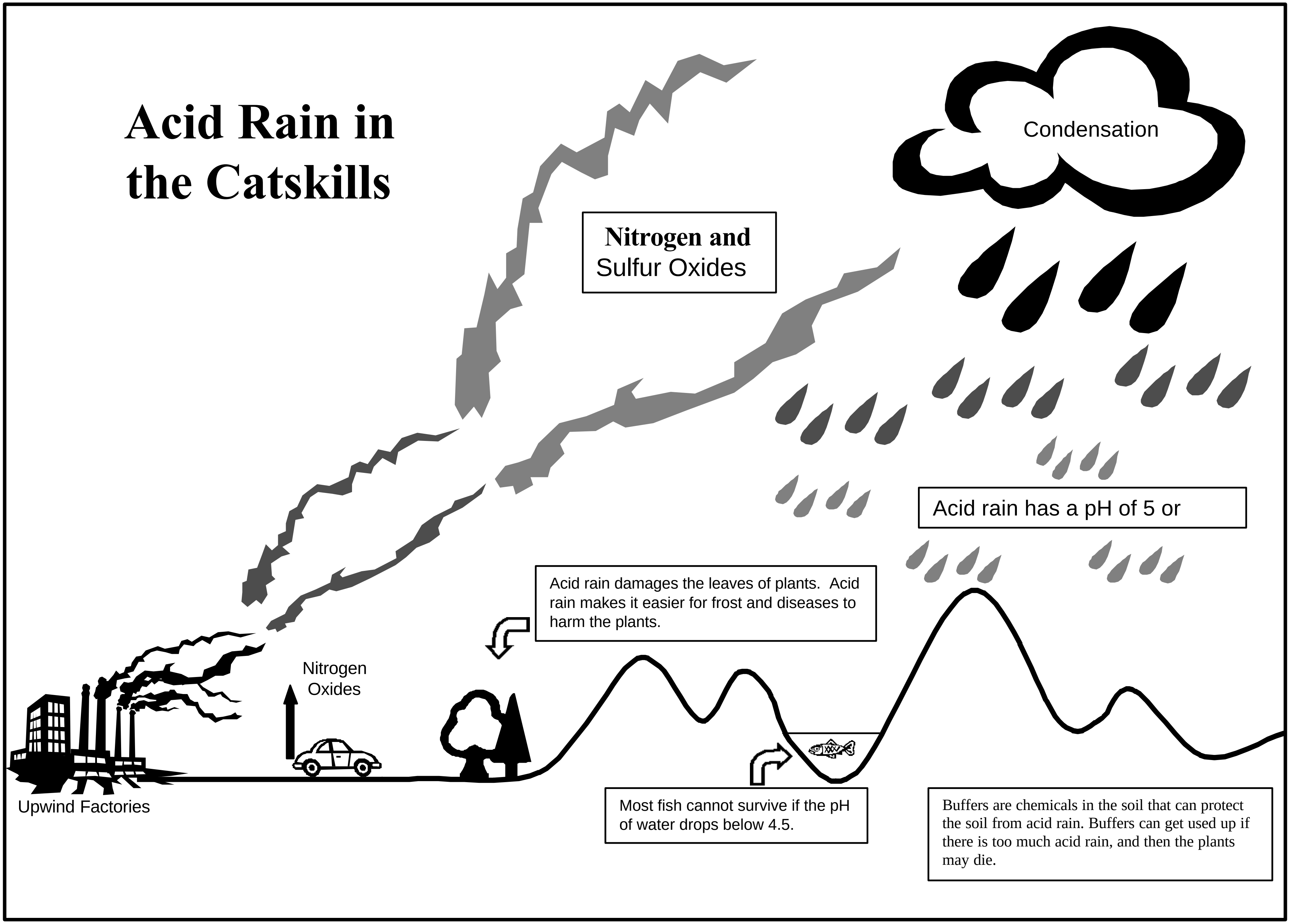
Mohonk Preserve, PO Box 715. New Paltz, NY 12561. (845) 255-0919. Preserve maintains a visitor's center at the base of the Shawangunk Ridge, located on Route 44/55 just north of Route 299. Educational programs are available.

Mountain Top Arboretum, Tannersville, NY 12485. (518) 589-3903. mtarbor@mhonline.net. A living museum of trees and shrubs for the pleasure and education of the public, located in Tannersville.

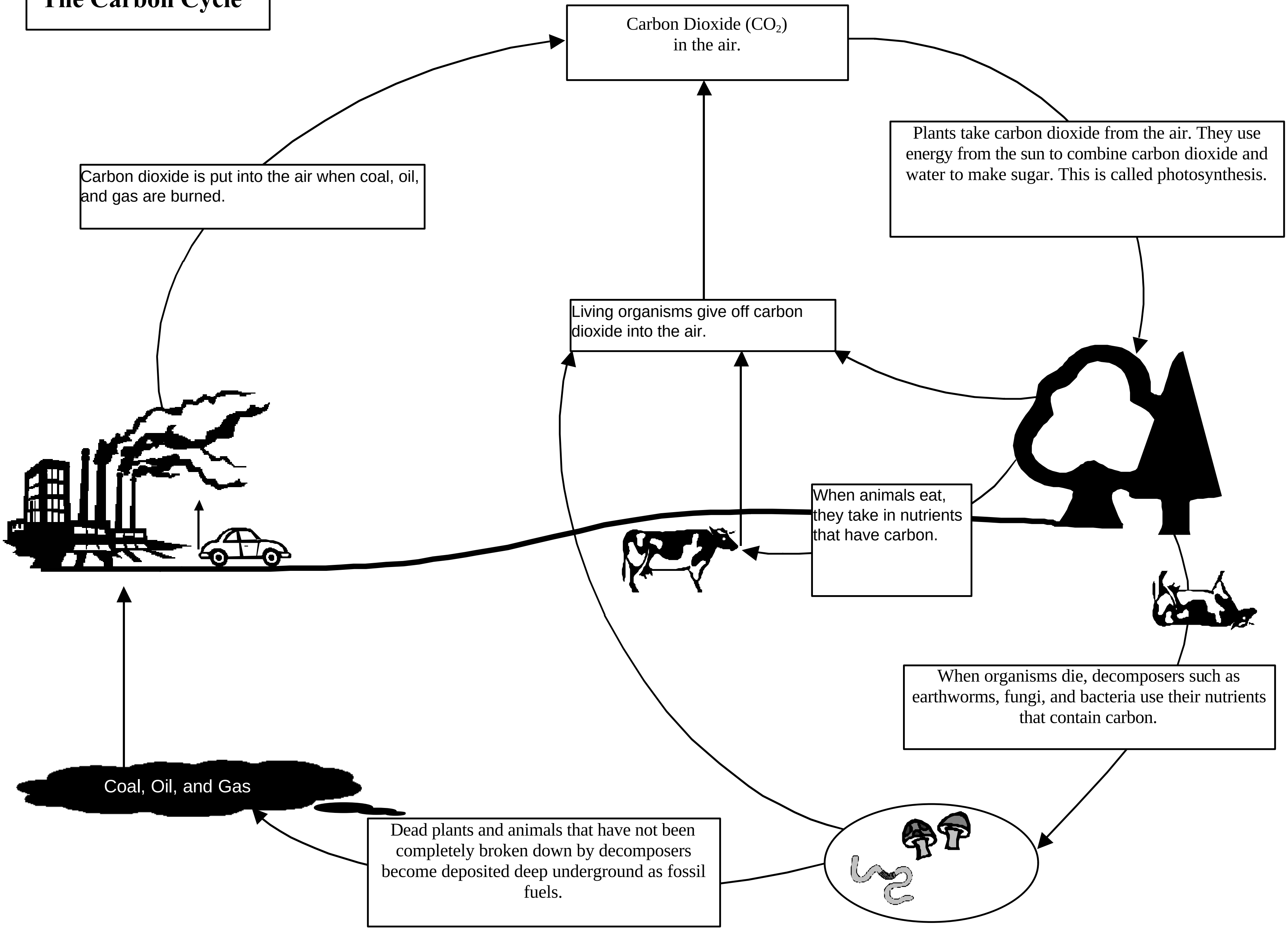
Overlook Mountain, Meads Mountain Road, Woodstock, NY. Contrast the oak-hardwood forest on this peak to the beech-maple forest on the slopes of Balsam Lake Mountain. The hike is the same distance but steeper. Take Rock City Road from Woodstock. At an intersection it becomes Meads Mountain Road, which leads to the trailhead, on the right, after a few miles. Parking lot is often full on good hiking days. Summit elevation is 3140 feet.

The Catskills Journal

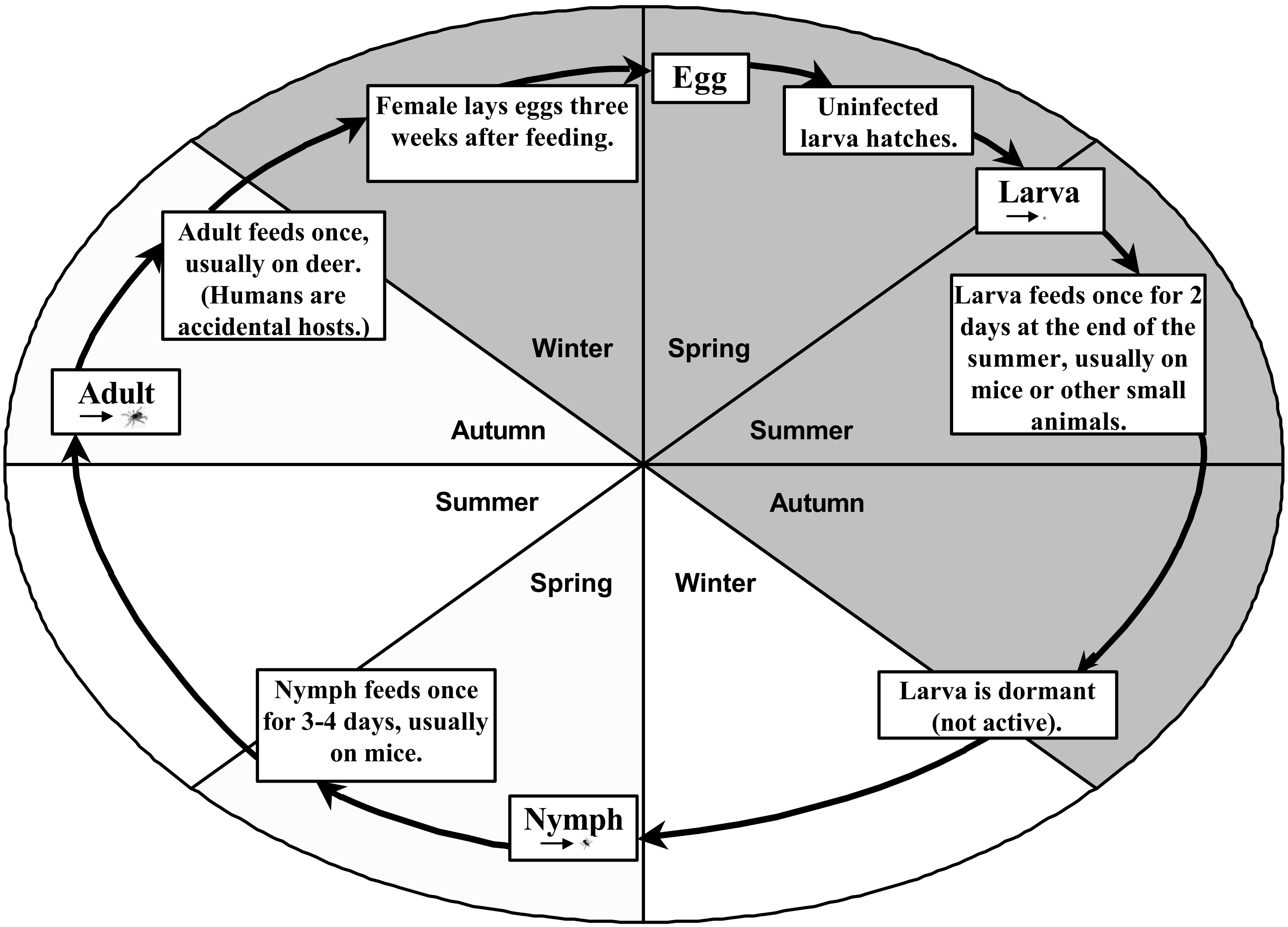
The Catskills journal should be a 3-ring notebook to which blank writing paper, handouts, worksheets, drawings, charts, and other items can be easily added. The journal will help students improve their observation skills and enhance their creativity while developing a sense of place. Students should use the journal for all activities that are Catskills-related. Each activity should begin on a new page. Students should write the title of the activity and the date. If the activity is science-based, they should write down specific information such as location, time, weather conditions, etc. Any descriptions of objects, locations, etc. should be accompanied by a drawing. Before doing the activity, they should pose questions that they would like to answer, such as “I want to know…”, “what would happen if…?”, “I predict that…”. They should follow up with “this is what happened”, “this is what I learned”.


Acid Rain in the Catskills
Nitrogen and Sulfur Oxides
Condensation
Acid rain has a pH of 5 or
Acid rain damages the leaves of plants. Acid rain makes it easier for frost and diseases to harm the plants.
Nitrogen Oxides
Upwind Factories
Most fish cannot survive if the pH of water drops below 4.5.
Buffers are chemicals in the soil that can protect the soil from acid rain. Buffers can get used up if there is too much acid rain, and then the plants may die.

The Carbon Cycle



2 Year Life Cycle of a Deer Tick

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