This instructional guide contains 16 activities designed to help teachers familiarize their students with the forest resources of Illinois. Each activity is ready to be copied and given to students. Topics of the activities, which vary in format, include: an overview of past and present Illinois forests; organization and mechanics of a forest ecosystem; food webs; plant reproduction; forest shelters; mammal tracks; nutrient element cycling; ecological principles; life cycle of the flying squirrel; forest management; working as a forester; preparing a timber stand improvement plan; and land use planning. Although the materials are probably best suited for students in grades 4-8, most of the activities can easily be adjusted to match the skill level of nearly every primary and secondary grade. (JN)
SPECIAL
THEME
FOREST
ECOLOGY
AND
MANAGEMENT

ILLINOIS NATURAL HERITAGE
CONSERVATION EDUCATION
KIT II

ILLINOIS DEPARTMENT OF CONSERVATION • ILLINOIS STATE BOARD OF EDUCATION

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Illinois State Board of Education
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."
Illinois Natural Heritage Conservation/Education Kit II

ABOUT THIS EDUCATIONAL KIT: The special theme of this kit is FOREST ECOLOGY AND MANAGEMENT. The 16 exercises and activities included in this instructional guide are designed to help teachers familiarize their students with the forest resources of Illinois. Although the materials are probably best suited for students in grades 4-8, most of the exercises can easily be adjusted to match the skill level of nearly every primary and secondary grade.

NATURAL HERITAGE MONTH: As Natural Heritage Month in Illinois, April presents itself as a good time for teachers to use the contents of this kit. Natural Heritage Month includes the observances of Earth Day, (usually the third Wednesday), Arbor and Bird Day (the last Friday) and Bird Appreciation Week (the last week). Though the activities and exercises in this kit can certainly be used in relation to these special days in April, the materials are always topical and can be used at any time of the year.

GIANT HABITAT COLORING PAGE: A special feature of this kit is the inclusion of a forest coloring page which features 25 native Illinois plants and animals. The coloring page serves as an important visual reference for students as they complete exercises in the instructional guide.

STEP INTO THE WILD: Students who complete the "ILLINOIS' FOREST RESOURCES AND YOU — A Planning Questionnaire" on page 3 of the instructional guide are asked to mail their completed questionnaires to the ILLINOIS DEPARTMENT OF CONSERVATION at the address shown below. Students who mail in a questionnaire will receive the conservation button entitled "STEP INTO THE WILD" for their own keeping. To speed mailing teachers are asked to gather questionnaires and send them in together as classroom sets.

LET US HEAR FROM YOU: Teachers and resource interpreters who use this kit are asked to please complete the TEACHER QUESTIONNAIRE included in this kit. Since this kit is only the second in a five part series of conservation/education kits, the comments and suggestions we receive from the teacher questionnaires will be very helpful as we prepare the remaining three kits. Please help us make these educational materials useful and interesting by completing the questionnaire and mailing it to the address below. To show our appreciation, we will send a classroom set of GIANT HABITAT COLORING PAGES to each teacher or resource interpreter who sends in a questionnaire.

Illinois Department of Conservation
Communications Program
Division of Forest Resources and Natural Heritage
524 South Second Street
Springfield, Illinois 62706
This Illinois Natural Heritage Conservation Education Kit is jointly sponsored by the Illinois Department of Conservation and the Illinois State Board of Education and is approved by the Illinois Advisory Board of Conservation Education. Materials in the kit were prepared by Sally F. Stone, Communications Coordinator, Division of Forest Resources and Natural Heritage, Illinois Department of Conservation. Illustrations were provided by Robert F. Eschenfeldt, Squires Ad Agency and Art Studio. Technical editors for the project included the following Illinois Department of Conservation staff persons, William E. McClain, Natural Heritage Biologist; Richard H. Thom, Staff Forester; Carol J. Mahan, Mammal Ecologist; Dennis Tucker, Resource Planner; James S. Allen, Fisheries Biologist; Grant Haley, District Forester; Melissa Scanlon, Natural Heritage Assistant; Vernon Kleen, Avian Ecologist; and Carl N. Becker, Natural Heritage Section Manager. Special appreciation is extended to Victoria Little for typing the manuscript.

This kit is fully endorsed by the Environmental Education Association of Illinois "as a sound conservation education kit that will increase awareness of the value of forests and other renewable resources and contribute to a strong environmental ethic on the part of the future citizens of Illinois."

Environmental Education Association of Illinois

Environmental Education Association of Illinois
L.T.F.C., Box 299
Oregon, Illinois 61061

Illinois State Board of Education
100 N. First St.
Springfield, IL 62777
Phone: (217) 782-2826

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A note to teachers and resource interpreters: This Natural Heritage Conservation/Education Kit is the second in a five part series of conservation education kits being produced by the Illinois Department of Conservation. You can help us continue to prepare quality materials for the remaining three kits by filling out the following questionnaire. You can also use this questionnaire to request classroom sets of the GIANT HABITAT COLORING PAGE featured in this kit. Mail your completed questionnaire to the address shown below.

Communications Program
Division of Forest Resources & Natural Heritage
Illinois Department of Conservation
Lincoln Tower Plaza
4 South Second Street
Springfield, IL 62706

Teacher's Name ___________________ Grade level ________
Name of School ___________________
Address ____________________________

Did you use the first Natural Heritage Conservation/Education Kit featuring "These Precious Few", Illinois' Endangered and Threatened Plants and Animals? If yes, did you find the materials in that kit to be useful? _____

All of the exercises in the kit are ready to be copied and given to students. Do you like or dislike this "ready-made" format and please explain your answer. _________________________

Please rate the exercises in this kit in terms of how useful they are to you as a teacher. In the space to the right of each exercise, rate the usefulness of each exercise by placing a 1 if you consider the exercise to be VERY USEFUL, a 2 for MODERATELY USEFUL, a 3 if you used the exercise and found it to be POORLY USEFUL and a 4 if you did not use the exercise at all.

Journal of Jim ________ The Family Tree ________
The Way of the Woods ________ A Flying Squirrels Life to Live Game ________
Spinning a Food Web ________ Forest Sleuthwork ________
Plant Reproduction in the Forest ________ Forest Management-Making the Most of our Forests ________
Fitting Together Plant Reproduction Cycles ________ Working As A Forester ________
How Seeds Move in the Forest ________ Preparing a Timber Stand Improvement Plan ________
Forest Shelters ________ Land Use Planning ________
Tracking the Mammals of the Forest ________ GIANT HABITAT COLORING PAGE ________
Nutrient Element Cycling ________

Please use this space to express any comments or suggestions you have about the kit as a whole or about any of its individual exercises. (If additional space is needed, please write on the back of this sheet)

Please use this space to order classroom sets of the GIANT HABITAT COLORING PAGE. The maximum we can send as a classroom set is 25.

Yes, I would like to order a classroom set of COLORING PAGES. Please send me ________ coloring pages.
Dear Student:

For several years, the Illinois Department of Conservation has been asking citizens from all over the state to tell us how they feel about Illinois' forests. And we have been taking the ideas of those citizens and using them to prepare the ILLINOIS FOREST AND RELATED RESOURCES PLAN. Once this plan is finished, it will provide a blueprint for everyone in Illinois to follow if we are to make the wisest use of our forests. Now it is your turn to take part in developing this special plan. Please tell us how you feel about the forests in Illinois by filling out the questionnaire below. We will gather up your ideas and put them with the ideas of other students. Together, your thoughts and those of your fellow students in the state will be very helpful to us as the final draft of the FOREST AND RELATED RESOURCES PLAN is prepared. To show our appreciation for your help, we will send you a "STEP INTO THE WILD" conservation button for your own keeping when we receive your completed questionnaire.

Sincerely,

[signature]
Allan G. Mickelson
Chief
DIVISION OF FOREST RESOURCES AND NATURAL HERITAGE

PLANNING QUESTIONNAIRE

To complete this questionnaire, please put an A in the space beside each statement if you agree with the statement and put a D beside each statement if you disagree.

1. The forests of Illinois are beautiful and important._______
2. The trees in school yards, neighborhoods, and in cities are just as beautiful and important as the trees in forests._______
3. Forests are valuable because they provide a natural habitat for plants and animals._______
4. Forests are also valuable because of the benefits they provide for people like wood products and opportunities to study nature, camp, hike and hunt._______
5. The amount of forest land in Illinois that can be cleared to make room for cropland, houses, shopping centers, industries and roads should be limited._______
6. Some forests, especially those that have not been disturbed by civilization, should be set aside and preserved as Nature Preserves and Natural Areas._______
7. All forests, whether owned privately or included in a Nature Preserve, public park, or forest preserve, should be protected against vandalism, carelessly set fires, illegal off-the-road vehicle traffic and littering._______
8. Forest animals should be protected against illegal hunting or poaching._______
9. It is important to protect endangered and threatened plants and animals living in forests._______
10. Some of the forests in Illinois should be harvested on a regular basis to produce wood for products such as paper, furniture, and building lumber._______
11. When harvesting a forest, it is better to harvest some of the mature trees but leave behind a good supply of trees as growing stock and wildlife habitat than to harvest all of the trees at once._______
12. Since the supply of forest in Illinois is limited and since the demand for forest is great, it is important to carefully plan the wise use of our forests._______
13. The responsibility of taking care of Illinois' forests will some day be passed on to young persons such as yourself._______

Your Statement about Illinois' forests: (Please write in this space how you feel about the forests of Illinois. Tell us what you like best about forests and what you hope the future will hold for Illinois' forests.) ____________________________

______________________________

Step into the wild
(cut out)
Each exercise in this instructional guide is ready to be copied and given to students. In addition, the instructions for each exercise speak directly to the student. The following includes support information teachers may find helpful when working with the exercises.

**JOURNAL OF JIM** (pages 6-10) This exercise is a fictional account taken from the journal of a young boy living and writing in modern day Illinois. The objective of “Journal of Jim” is to give students a broad overview of Illinois’ forest resources by contrasting the ecological nature of Illinois forests with the past and present use of those forests. The “Journal” was chosen as the lead-off exercise in the kit because it introduces students through the eyes, spirit, and enthusiasm of someone their own age, to each of the themes explored more thoroughly in later exercises. A good follow-up activity would be to have students prepare their own journals by writing about a forest resource they are familiar with. That forest resource need not be as immense as the one Jim writes about, it could be a park, the trees in the school yard or even the tree(s) in a student’s yard.

**“THE WAY OF THE WOODS”** (pages 11-12) The objective of this exercise is to familiarize students with the organization and mechanics of a forest ecosystem. The “Important Words” defined in this exercise are very important as they are used repeatedly in later exercises. Before students progress from “The Way Of The Woods” to further exercises, they should have a good understanding of all of the terms used in the exercise and should be able to explain and discuss what makes a forest ecosystem “tick”. This exercise must be used in conjunction with the Giant Habitat Coloring Page contained in each kit.

**SPINNING A FOOD WEB** (pages 13-15) The objective of this exercise is to acquaint students with the flow of energy through the forest ecosystem. Steps 1-3 of the exercise build upon the concepts of energy flow discussed in “The Way Of The Woods”. Before the exercise is attempted, teachers may wish to review important terms such as photosynthesis, respiration, herbivore, omnivore, carnivore, predator, prey, forage, food chain and food web. This exercise can be completed as an individual project by one student, or as a class project by groups of students. For example, one group of students could handle the small mammals and another could handle the large birds of prey and so forth. A recommended extension to this exercise is to ask students to create circumstances that could possibly break strands of the food web. Students should then be asked to list the species that would be affected by possible disturbances of the food web. For example, students could list the species that would have less food to eat if one animal such as the rufous-sided towhee was illegally shot and thereby taken out of the food web.

**PLANT REPRODUCTION IN THE FOREST AND FITTING TOGETHER PLANT REPRODUCTION CYCLES** (pages 16-17) The objective of these exercises is to simplify for students the complicated process of plant reproduction. The drawing of a flower on page 16 can be used as a helpful reference when students attempt page 32 of the “FOREST SLEUTHWORK.”
HOW SEEDS MOVE IN THE FOREST: (page 18) This exercise is directly related to the two preceding plant-reproduction exercises. The objective of this exercise is to acquaint students with the different ways fruits and seeds travel from their parent plants to the soil. This exercise also attempts to show the interrelationship between plants and animals and the natural elements of wind, and water as it relates to seed dispersal. This exercise can easily be expanded to any other plant species by examining the structure of fruits and seeds to determine the way they are dispersed.

FOREST SHELTERS: (page 19) This exercise demonstrates the use of all parts of the forest by various forest animals. This exercise can be expanded by studying the life histories of additional forest animals to ascertain which part of the forest ecosystem they depend upon for shelter.

TRACKING THE MAMMALS OF THE FOREST: (page 20) This exercise has both a field and classroom application. The entire exercise can be done in the classroom and the completed exercise can be used as a field guide by students as they work on page 31 of FOREST SLEUTH WORK.

NUTRIENT ELEMENT CYCLING: (pages 21-23) This is one of the more difficult exercises of the kit. The broad objective of this three-part exercise is to demonstrate the absolute link between forest ecosystems and the recycling of nutrient elements on earth. The difficulty level of this exercise can be adjusted by teachers to match the skill level of their students by filling in parts of the cycles (water, oxygen and carbon) prior to giving the exercise to students.

THE FAMILY TREE: (pages 24-27) This play reinforces all of the ecological principles that have been presented in previous exercises of the kit. The play can simply be read aloud by students assigned to the different characters, or it can be acted out by students.

A SOUTHERN FLYING SQUIRREL’S LIFE TO LIFE GAME (pages 28-30) This game provides an in-depth study of the southern flying squirrel. In the game, the details of the flying squirrel’s life history are divided into categories. Being able to recognize the different categories is the most important ability students will need as they progress through the game. Therefore, it is recommended that teachers familiarize their students with the type of information each category contains.

FOREST SLEUTHWORK (pages 31-35) This is the primary outdoor activity of the kit. The four locations the students visit in the exercise are first introduced in “The Way of the Woods” on pages 11-12. Teachers may wish to review that exercise and specifically the four locations or layers of the forest before sending their students out into the field for “Forest Sleuthwork.”

FOREST MANAGEMENT – MAKING THE MOST OF OUR FORESTS: (page 36) This is the introductory exercise to the forest management component of the kit (pages 36-41). Students should have a good understanding of why forest management is important and of the principles of forest management before moving on to the next exercise.

WORKING AS A FORESTER: (pages 37-38) This exercise further investigates the principles of forest management and allows students to practice those principles by working as a Forester. In this exercise the student (as a Forester) will recommend a forest management plan for the five landowners featured on page 38. This exercise can be expanded by creating and describing additional landowners. Students can then recommend a management plan to meet the needs of those landowners.

PREPARING A TIMBER STAND IMPROVEMENT PLAN (pages 39-41) In this exercise, students decide which trees to leave and which trees to remove as part of a Timber Stand Improvement Plan for the sample plot of forest on pages 40-41. There are no absolute right or wrong decisions the students can make in regard to which trees they recommend removing and leaving. Just as actual plans drawn up by different FORESTERS may vary to some degree, so might the plans prepared by various students. However, students should be encouraged to follow the RULES OF THUMB FOR A TSI PLAN as closely as possible even though the final decisions are up to them.

LAND-USE PLANNING (pages 42-44) This exercise is a class project that is carried out in an oral format. Although most of the instructions for the exercise are read aloud to the class by students, the italicized portions in parentheses provide special instructions for the teacher to monitor to make sure the class is following the intended course of the exercise. In the final step of this exercise, the students vote to choose the final location for the airport. An excellent way to extend this exercise would be to invite another class to hear the presentation of Steps 1-6. That class could then also vote for the location of the airport.
April 18, 1981

Dear Journal:

You are never going to believe it! I finally got to see one and it was FANTASTIC. Well, you know how all last month, I heard them yowling, meowing and squalling through the night. I read up on them at the library and figured a pair must be mating, and not far away, probably right here, in our woods.

For weeks now, I've been searching for signs of them. The claw marks on the big oak that stands on the edge of the clearing were my first real clues. I guess they scratch on trees sorta like Fluffy scratches on the sofa (Mother hates that so). Anyway, the last three days in March, it rained buckets, night and day without stopping. The first night of April was the first clear night and I went to bed pretty early. Deep in the night, unbelievable shrill screams raced into my ears and sent me running from my bed to the front porch. It sounded like the biggest cat fight in the world. Standing there, listening to the screams, hissing and low-mad-sounding moans, I came up with the theory that a strange female had wandered into the territory of the female who was making a home in our woods.

The heavy rains must have washed away the urine our female had left as scent posts all around her territory, posts that meant to all strangers, especially other females, THIS IS MY PLACE—LEAVE ME ALONE. It was cold on the porch and I was shivering. As I jumped back under the covers, I thought about our female. I knew she was probably pregnant and I fell asleep hoping she would not be hurt or killed that night.

It was four days later that I found the tracks down by the creek. I knew Fluffy's little feet couldn't have made those big powerful-looking tracks, and besides, right by the tracks, were some fresh droppings. I bent down and picked apart the remains of what the big animal must have eaten the day before. I found what I figured to be the teeth of several mice, some bits of rabbit fur and part of the foot of a bird. Ever since the day I found those tracks, I have thought of nothing except getting a glimpse of the animal that left them.
And journal, it happened like this. I had been in the forest ever since I got home from school and the sun was starting to fall. I have always been afraid of the forest at night. To beat the darkness, I decided to take a short cut across the clearing. At the edge of the clearing I stopped for a second to look at the old oak. There were new claw marks but no time to spare studying them. As I turned from the woods to strike out across the clearing I saw a dark heap beneath a bush no more than twenty yards from me. It couldn't be, I thought and kept on. Then it moved and I dropped flat on my belly. It was! It was! It was standing up and stretching like a sleepy child. What happened next was spectacular.

Unaware of me and the sleepy heap beneath the bush, a long-tailed weasel came loping across the clearing. The bobcat crouched and froze. The weasel paused for a second and lifted its head to search the area. No motion detected — it continued with a slow gait but when it was about ten feet from the bush, it saw the big cat. Quicker than a flash, it turned tail and ran. But the bobcat was faster. With just three leaps the bobcat had the weasel by the neck. In a few seconds the squirming weasel was still and the bobcat proceeded to eat it, hind quarters first. For a split second, I felt sorry for the weasel but then I remembered the time I watched a weasel devour a rabbit. It's just the way the animals get their food and there's no waste or cruelty about it. When the big cat was through, it sat quietly and washed itself. Then a loud motherly call pierced the woods, "Jim, Jim, where are you?" Instinctively, I lifted my head to answer and the bobcat saw me. Before I could help myself, I stood up and thought about running, but it was too late — the bobcat beat me to it.

First trotting, and then leaping 7-10 feet at a time, it crossed the clearing and disappeared into the woods in nothing flat. It was dark by then and you know what, journal, I wasn't even scared of the night woods for the first time in my life. Yes, I was trembling but not from fear, from excitement, and as I raced along, I laughed and imitated the bobcat by taking great leaps all the way home.

So you see, journal, the forest proves time and time again to be the best friend I have. Mom and Dad say we are lucky to own so much forest land, just over 300 acres. On our land we have most of the trees that are the most common in Illinois like the different species of oak, ash, hickory, and maple. Down along the river you can find some pretty large trees like sycamore, sweet gum, cottonwood, black willow, slippery and American elm and one of my favorites, pecan. River birch,
silver maple and box elder are also some wet soil trees that manage to hit the 75-100 foot mark. Medium to small-sized trees like red mulberry, blue beech and sandbar willow also grow pretty good down in the bottomland. Once you leave the bottomland, the forest turns upland and you can find trees like sugar maple, basswood, red bud and paw paw, a tree that grows in thickets. Along the ravines, honey locust is pretty common and on the slopes white ash, white oak, pignut hickory, and red maple seem to take over the forest. On our northern-most property, we have some pretty steep slopes and ridges where you can find bur oak, hop horn beam and shadbush. Quite a bit of our land borders onto farmland, and along the fences that separate the forest from the fields, osage orange, wild black cherry, persimmon and Iowa crabapple are common. Every once in awhile, especially around an opening in the forest, you can find red cedar. Red cedar is one of the few native coniferous species of Illinois. A coniferous tree does not shed all of its leaves every fall like the deciduous trees. Coniferous trees usually have leaves that look more like needles. The great majority of Illinois' trees are deciduous but you can find coniferous trees such as tamarack in northeastern Illinois and bald cypress in southern Illinois.

I almost forgot to mention my mother's pride and joy, the forty acres of white oak just south of the house. Back in 1821, my mother's great-great-grandfather was one of the first settlers from the East to stake a claim in the Illinois Country. The story is that when he saw that forty acres of white oak he fell in love with the big trees and decided to build his cabin right beside them. Do you know journal that when my great-great-great-grandpa first laid eyes on those oaks, some of the trees were already 200 years old. Well, his cabin is gone now, our house stands in its place, but many of those old trees are still standing alive and well, even though they are over 350 years old.

Illinois was very different when my great-great-grandpa settled here. Back in his day, there was a great deal of forest in Illinois, just over 14 million acres. But when my grandfather was born in 1901, just 4 million acres of forest were left. When our district-forester came around last fall to inventory our forest, he told me there was only about 3.2 million acres of forest left in Illinois.

Sometimes when I'm out in the woods spying on a brown thrasher nest or collecting seeds to take to the nursery, I wonder how more than 10 million acres of forest could have disappeared from our state. I know better really. I know all that forest didn't really disappear. The land it stood on is simply used for different things now. I figure most of it is used for farmland. When the settlers moved into Illinois, they saw how the soil beneath the forest grew big, healthy trees and they decided the same soil would grow good crops of corn and soybeans. And since they had to make a living they started clearing forest to make cropland and the clearing has never stopped. Why, just this last fall, they cleared 60 acres of good forest just a few miles from here. Even the fencerows of timber running between the fields are being taken out. The new highway they laid north of here took a bunch of timber and so did the new shopping mall on the outskirts of town. Even at the school, forest was lost when they put in the new playing field. So you see, journal, every time something new needs to get built, there's a chance for losing more forest. I just hope there's always enough forest for wildlife to have a home and for people to enjoy.

We get a lot of enjoyment out of our forest. During the winter, my sister and I cross-country ski and during the warmer weather, we hike and go on picnics. My pa says I'll be patient enough to hunt for turkey in a few years (I'm glad he didn't see me jump in front of that bobcat). I already hunt for rabbit and squirrel and my pa traps for foxes and raccoons. Last year, he shot a 85 lb. buck with a bow and arrow.

Some of my favorite hunting is done with a pair of binoculars and I write down and draw my trophies in your journal. Remember this entry for May 15, 1980.
Yeah, you better believe it. Watching those hawks made me feel like a real forest sleuth. I've spied on so many of the forest creatures. I've watched a male eastern gray tree frog singing with its vocal pouch puffed out big like a trumpet. One early June morning, I watched a snapping turtle crawl from the water into the forest where she dug a hole and laid her soft-shelled eggs. Once, I saw a viceroy caterpillar loop along the limb of a cottonwood and when I touched it, it stopped dead in its tracks and imitated a twig. I've gotten to see a monarch butterfly bust loose of its green jewel-like chrysalis. I guess one of the neatest times was when I spied a cicada nymph scrambling up the trunk of a dogwood. It positioned itself on a branch and laid still until its shell cracked open and a winged adult crawled out and flew away. Do you realize journal, that cicada nymph had been in the soil growing and changing for seventeen years before it climbed that dogwood and flew off as an adult.

Trees and animals aren't the only things in the forest. There are lots of fungi like true morel, ear fungus and hen of the woods. You can find different varieties of moss like silky fork moss that grows on hillside and ostrich plume moss which grows on old logs. Down in the bottomland especially, you can find ferns like common adder's tongue and rattlesnake fern. But I guess the prettiest part of the forest are the wildflowers. My mother is a wildflower expert and every year, sometimes as early as February, she has me out in the woods to catch the blooming of harbinger of spring, usually the first wildflower to bloom. In March we look for the blossoms of yellow dog's tooth violet and blue cohosh. And then from April to June you can spy all kind of blooming flowers like sweet cicely, white violet, jack in the pulpit, fire pink, wild columbine, and one of Mother's favorites, green dragon.

We have one wildflower called goldenseal in our forest that is fast becoming rare and is classified by the State of Illinois as "threatened", which means it is in danger of becoming "endangered". If a plant is "endangered," it means it is in danger of becoming extinct. If a plant becomes extinct, no one will ever get to see it again. All together there are 72 animals and 364 plants listed as threatened or endangered in Illinois. The main reason why many animals and plants are "endangered" or "threatened" is because so much of their natural habitats, including forests, have been destroyed or changed. The bobcat I saw this morning is a "threatened" animal.

We also care for our forest by not grazing it with cows. If you let cows out on a forest, they eat off the young trees trying to grow. Plus, the cows beat down the wildflowers, fungi, mosses and even the soil. As a result, the packed down soil can't hold water very well and pretty soon, the soil of the forest is running down and filling up some nice stream or river. Of course, we have cows but we keep them in a pasture where they belong. Some insects can also harm a forest and we work with our forester to keep those insects under control.

Probably the most important way we protect our forest is by not overcutting it. Sure we select some of the mature trees to harvest every year but we leave back a good supply of trees as growing stock. The type of harvesting we practice is called selective harvesting. We harvest our forest in this way to guarantee that there will be more trees to harvest later and so that there will always be plenty of trees to provide food and shelter for the forest animals. Some of the wood we harvest we use ourselves to build the things we need like the new porch on our house. The rest of the wood we sell to the mill. Our wood is eventually used all over the country to build homes, schools, and furniture.

Another way we manage our forest is by practicing timber stand improvement. We improve the quality of our timber by removing some of the trees that our taking up too much space or are crooked, diseased or damaged. By taking out those trees it leaves more sunlight, soil, water and nutrient elements for the healthy, well-formed trees. Pa says that timber stand improvement produces a better crop of trees in the forest just like hoeing produces a better crop of vegetables in the garden. And besides, it sure provides plenty of firewood.
THE WAY OF THE WOODS

The way of the woods is a home for the forest in its entirety. The forest is a complex ecosystem, home to a wide variety of plants and animals. The forest is divided into various layers, each with its own unique environment and inhabitants.

The CANOPY forms a protective umbrella over the forest, providing shade and shelter for plants and animals from harsh weather. Much of the rain falling upon the forest is caught by the leaves of the canopy trees. When the leaves decay, they nourish the forest floor. When a producer plant such as the golden mouse feeds upon the grass, it takes the stored energy of the sun to make the plant grow. The green plants, called PRODUCERS, make their own food. When an animal or insect feeds upon a plant, it takes the stored energy in the form of food. When an animal or insect is eaten by another organism, that process is called PRODUCER PLANTS.

When a producer plant such as the golden mouse feeds upon the grass, it takes the stored energy of the sun to make the plant grow. The green plants, called PRODUCERS, make their own food. When an animal or insect feeds upon a plant, it takes the stored energy in the form of food. When an animal or insect is eaten by another organism, that process is called PRODUCER PLANTS.

The branches of the tallest trees such as the tree form the CANOPY LAYER of the forest. The CANOPY forms a protective umbrella over the forest, providing shade and shelter for plants and animals from harsh weather. Much of the rain falling upon the forest is caught by the leaves of the trees. When the leaves decay, they nourish the forest floor. When a producer plant such as the golden mouse feeds upon the grass, it takes the stored energy of the sun to make the plant grow. The green plants, called PRODUCERS, make their own food. When an animal or insect feeds upon a plant, it takes the stored energy in the form of food. When an animal or insect is eaten by another organism, that process is called PRODUCER PLANTS.

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The branches of the tallest trees such as the tree form the CANOPY LAYER of the forest. The CANOPY forms a protective umbrella over the forest, providing shade and shelter for plants and animals from harsh weather. Much of the rain falling upon the forest is caught by the leaves of the trees. When the leaves decay, they nourish the forest floor. When a producer plant such as the golden mouse feeds upon the grass, it takes the stored energy of the sun to make the plant grow. The green plants, called PRODUCERS, make their own food. When an animal or insect feeds upon a plant, it takes the stored energy in the form of food. When an animal or insect is eaten by another organism, that process is called PRODUCER PLANTS.

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front wings. Insects carry pollen from pistillate to female flowers to staminate or male flowers. The pollen then fertilizes the seeds in the ovary of the pistillate flowers and the process of POLLINATION is complete. In some cases, pollen is transferred by wind.

Wildflowers such as ________ and ________ make up the most visible portion of the HERB LAYER of the forest. Fungi and mosses are also found growing at this low layer.

The FOREST FLOOR LAYER is a good place to find forest amphibians such as the ________, a 6"-7½" long, darkly colored animal marked with round, yellow-orange spots and forest reptiles such as the ________, a 8"-10" slender animal possessing a plain red belly and several dark spots about its neck. The FOREST FLOOR includes the soil that is rich with many hundreds of insects such as the ________, a dark green species about 1 inch long. But the forest floor is more than a home for animals and a place for plants to take root: The forest floor is like the garbage can of the forest catching the fallen branches, fruits, seeds and leaves of plants, and dead animal remains. All of the debris that collects on the forest floor is called FOREST LITTER. Since nearly two tons of forest litter is collected on one acre of forest in just one year, it is very important that the forest does not choke on this debris.

If the forest floor is like a garbage can for the forest, DECOMPOSERS are like garbage disposals. A fan-shaped white species that grows on dead wood is a DECOMPOSER. Decomposers are species which cause dead things and animal wastes products to decay. The most important decomposers are fungi, bacteria and some insects. In a small area of the forest floor, there are billions of decomposers, some you can see, but 100 times more that only can be seen only under a microscope. Decomposers break down the forest litter until mostly only nutrient elements such as carbon, nitrogen, sulphur, and phosphorus are left. These elements, necessary for the growth of all living things, are stored in the soil until they are taken in through the roots of plants. As a result, the decomposers have taken nutrient elements from dead materials and waste products and recycled them so that they can be used again by living organisms. This is what is meant by the NUTRIENT ELEMENT CYCLING of the forest.

The NICHES of the ________, a small mammal with thin folds of skins extending from its wrists to its hind feet, is foraging at night across the branches of trees for buds, seeds, nuts and fruits. This animal is preyed upon by larger animals and builds its nest in a hollow tree cavity. The niche of the ________, a small gray-colored mammal with a long bushy tail, is foraging across tree branches during the day for buds, seeds, acorns, nuts and fruits. This animal is also preyed upon by larger animals and builds either a leaf nest or settles into a hollow tree cavity. A NICHES is the particular function a species carries out within its ecosystem. To define a species' NICHES, one must consider where it travels, how and when, what it eats and what eats it, and what part of the ecosystem and what type of ecosystem it hunts and nests in. The niches of some animals may be similar but to make sure there is enough space and food for each animal, the niche of one animal is never exactly the same as the niche of another. For example, the niches of the two animals described above are very similar except for one thing. Even though the two animals may cover the same territory in search of food, one does so during the day and the other does so at night.

IMPORTANT WORDS IN THE WAY OF THE WOODS: Fill in the 24 blanks below with the 24 words appearing in bold face type in the previous exercise.

1. ________ the process whereby plants and animals break down food molecules in order to release energy to power their life func-

2. ________ this forms a protective umbrella over the forest, providing shade and protecting plants and animals from harsh weather.

3. ________ wildflowers make up the most visible portion of this layer.

4. ________ All of the materials that collect on the forest floor are known collectively as this.

5. ________ the verb that means one animal is killing and eating another.

6. ________ the home of a plant or animal...

7. ________ the science of studying the habits of a living organism within its habitat.

8. ________ green plants that manufacture food through the process of photosynthesis.

9. ________ this is formed by the undergrowth trees and shrubs in the forest.

10. ________ this is the process whereby either wind or insects carry pollen from the staminate or male flowers to the pistillate or female flowers. The pollen fertilizes the seeds inside the ovary of the pistillate flower and the process is complete.

11. ________ the lowest layer of the forest that includes the soil and serves as a collecting point for leaves, logs, fruits, seeds and dead animal remains.

12. ________ an animal that preys upon another.

13. ________ a verb which means to hunt.

14. ________ animals that eat only animal materials.

15. ________ a community of plants and animals living together and interacting with their habitat.

16. ________ the process whereby plants combine water and carbon dioxide in the presence of chlorophyll to make glucose or food molecules.

17. ________ animals that eat only plant materials.

18. ________ the total feeding scheme of an ecosystem.

19. ________ the evaporation of water from the leaves to the atmosphere.

20. ________ animals that eat both plant and animal materials.

21. ________ this is formed when a producer plant is eaten by a herbivore who is then either eaten by a carnivore or an omnivore. In turn, that last predator may be eaten by a larger, quicker or better equipped carnivore until the top of the food chain is reached.

22. ________ species that cause things to decay. They are very important because they break down the forest litter until almost nothing is left except for important nutrient elements.

23. ________ the process whereby decomposers of the forest break down dead plant and animal remains to release nutrient elements such as carbon, nitrogen, sulphur and phosphorous. These elements are stored in the soil and are taken in by the roots of plants. Thus, the nutrient elements have been taken from dead plants and animals and are now ready to be re-used by living plants and animals.

24. ________ This is the particular function a species carries out within its ecosystem.
In the previous exercise, "The Way of the Woods" you learned that plants are the PRODUCERS of food energy in the forest ecosystem. Animals known as HERBIVORES get food energy by eating the parts of plants, mainly the fruits, seeds, buds, leaves, bark and petals. Other animals known as OMNIVORES get food energy by eating plant parts and other animals. Still other animals obtain food energy by eating only animals. Those predator animals, are known as CARNIVORES.

If you were a spider and could spin a strand of silk from all of the animals in the forest to all of the plant parts and animals they eat, you would have a FOOD WEB. Of course, you are not a spider and you have no silk, but no matter, you have a pencil, and that's all you really need to spin a FOOD WEB. HERE'S HOW:

Step 1. A forest ecosystem is drawn for you on pages 14 and 15 of this booklet. Tape the two pages together so you have a one big forest complete with 17 plants and 57 animals. For the largest plants, the parts that animals most often eat such as the buds, seeds, fruits, bark and leaves are drawn large and highlighted by a circle. Most of the plants and animals are not drawn to scale.

Step 2. Study the DIET CHART below. The chart tells you what type of plant material and what animals each animal normally eats.

Step 3. Return your attention to the forest ecosystem and select one animal. Now reread the diet of that animal and draw a line to every plant or animal that animal might possibly eat. For example, the diet of the great horned owl includes all animals except the large mammals and birds of prey. By checking the DIET CHART, you can see which animals are not commonly in the great horned owl's diet. Therefore, the correct move is to draw a line from the great horned owl to all of the animals in the forest ecosystem except for the large mammals and the birds of prey. To complete the spinning of your food web, take each of the animals in the ecosystem and draw a line to each plant part or animal it might possibly eat.

**DIET CHART**

**SMALL MAMMALS**
1. eastern chipmunk—seeds and fruits
2. eastern gray squirrel—seeds, fruits, nuts and fungi
3. southern flying squirrel—seeds, fruits, buds and insects
4. white-footed mouse—seeds, buds, fruits and insects
5. pine vole—the roots of plants
6. short-tailed shrew—earthworms, snails and insects
7. silver-haired bat—insects

**MEDIUM-SIZED MAMMALS**
8. raccoon—fruits, seeds, insects, snails, earthworms, amphibians, reptiles, fish, and small mammals and birds

**LARGE MAMMALS**
9. gray fox—fruits, seeds, small mammals and birds and insects
10. bobcat—small mammals and birds
11. white-tailed deer—the flowers, bark, buds, fruits and seeds of plants

**SMALL BIRDS**
12. rufous-sided towhee—seeds, fruits and insects
13. acadian flycatcher—insects
14. yellow-billed cuckoo—insects, especially caterpillars, also fruits and seeds
15. black-capped chickadee—insects, fruits and seeds
16. red-headed woodpecker—insects, especially ants; also fruits and seeds
17. whip-poor-will—insects
18. hooded warbler—insects, especially beetles, ants and caterpillars
19. yellow-throated vireo—insects and spiders
20. orchard oriole—insects, especially caterpillars, also fruits
21. fox sparrow—insects, especially beetles, also fruits and seeds
22. barred owl—small birds and mammals, reptiles, amphibians and insects
23. eastern screech owl—small birds and mammals, reptiles, amphibians, and insects
24. great horned owl—all types of animals except the largest mammals and large birds of prey
25. red-shouldered hawk—small birds and mammals, reptiles, amphibians, and insects
26. Cooper's hawk—small birds and mammals, reptiles, amphibians, and insects

**LARGE BIRDS OF PREY**
27. marbled salamander—snails, worms, insects and spiders
28. eastern gray tree frog—insects
29. eastern wood frog—snails

**AMPHIBIANS**
30. eastern box turtle—fungi, fruits, seeds, insects, snails and spiders
31. northern fence lizard—insects, especially ants
32. ground skink—insect larvae
33. blue racer—small mammals and birds, amphibians, reptiles and insects
34. speckled kingsnake—small birds and mammals, small snakes and insects
35. eastern garter snake—amphibians, earthworms, and young birds

**REPTILES**
36. zebra swallowtail caterpillar—leaves of trees
37. tiger swallowtail caterpillar—leaves of trees
38. viceroy caterpillar—leaves of trees
39. red admiral butterfly—the nectar of flowers
40. tiger swallowtail butterfly—the nectar of flowers
41. aphis caterpillar—leaves of trees
42. underwing moth—leaves of trees
43. searcher beetle—insects
44. hermit flower beetle—the pollen held in flowers
45. hemipterus beetle larvae—decaying wood
46. horned passalus beetle (adult and larvae)—decaying wood
47. honey bee—pollen and nectar from flowers
48. bumble bee—pollen held in flowers
49. small carpenter bee—pollen held in flowers
50. black carpenter ant—insects
51. elm sawfly—the leaves of trees
52. flowerfly—pollen held in flowers
53. carrion beetle—dead plant and animal matter
54. triangle spider—small insects

**SPIDERS**
55. earthworm—dead plant and animal materials in the soil

**SNAILS (MOLLUSKS)**
56. white-lipped land snail—dead plant material
57. land snail—leaves of plants
Plant Reproduction in the Forest

To understand how trees and other plants pass on life from one generation to another, study the five stages of the reproduction cycle of plants and complete the Thinking Further section.

1. FLOWERING

Usually in the spring of the year, plants bear flowers. A complete flower is composed of four main parts, sepals, petals, pistil and stamen. The sepals are the outermost circle of leaves which protect the inner parts of the flower. The petals, stationed inside the sepals, may be brightly colored. The pistil is found in the center and is the female part of the flower. A stigma, shaped like a small bulb is at the top of the pistil. A slender stalk called the style runs from the stigma to the base of the pistil where the ovary is stationed. The ovary contains the undeveloped ovules (or seeds) of the flower. The stamen is the male part of the flower. At the top of the stamen is the anther. The anther is packed with pollen.

It is important to understand that flowers of different species are not alike. Some flowers have both a stamen and a pistil. Some flowers have just one or the other. A flower that has only a stamen is called a staminate or male flower. A flower that has only a pistil is called a pistillate or female flower. Not only are flowers different, so are plants. Some species of plants have both pistillate and staminate flowers on the same plant. Some species have pistillate flowers on certain plants and staminate flowers on others. Of course, flowers differ greatly in size, shape, color and how they are displayed.

2. POLLINATION AND FERTILIZATION

Pollination is defined as the transfer of pollen from the stamen to the pistil. Pollen can be carried in this way by wind or by insects. Flowers that depend on insects to carry their pollen have bright, showy flowers and/or nectar to entice the insects to them. When an insect visits such a flower, chances are good that sticky, moist pollen put out by the anther of the stamen will rub off onto the insect. When that same insect visits the pistil of the same or different flower, the pollen is rubbed off onto the insect onto the sticky, rough surface of the stigma, which functions sort of like a catcher's mitt for the pistil. Wind pollination is somewhat less complicated. The stamen and anthers of wind-pollinated plants are large and send out sizable amounts of dry, light pollen which catches the breeze and rides to the awaiting stigma on pistillate flowers. But what does pollination accomplish in the reproductive cycle?

Once pollen is caught by the stigma, it travels down the style to the ovary where it causes the ovules (seeds) to become fertilized. That is defined as the process of fertilization. Stop for a moment and study the illustration below to make sure you understand stages 1 and 2.

3. FRUITS AND SEEDS:

Following fertilization, the ovary and the ovules (seeds) begin to grow. The ovary grows into a fruit and the ovules develop into mature seeds. The fruit (which varies in shape, size, color and texture in different plants) will serve as a carrying case or vessel for the journey of the seeds to the soil.

4. SEED MOVEMENT:

How do seeds travel from parent plants to the soil where they can eventually grow as a new plant? Some seeds fall to the ground inside their fruits and are either eaten by animals, left to rot, or carried away by water. Other seeds are carried by the wind while still others stick to the fur of animals and the clothing of man. For a more detailed investigation into how seeds travel, complete the exercise on page 18 of this booklet.

5. GERMINATION:

Most seeds do not immediately start to grow the minute they hit the soil. Instead, they lay in rest (dormancy) for a period of time. At the end of this rest period, the seed takes in water and starts to grow rapidly. The seed coat pops open and a root runs downward into the soil while a shoot pushes upward to catch the sunlight. This process is known as germination and completes the reproduction cycle.

THINKING FURTHER

1. Name and describe the four main parts of a flower.
2. Define the term pollination.
3. Pollen can be carried by two things. Name them.
4. Explain the process of fertilization.
5. Following fertilization, the ovary and the ovules (seeds) begin to grow. The ovary grows into a ________ and the ovules develop into mature _________.
6. Name two ways seeds move from their parent plants to the soil where they may someday grow as new plants.
7. Explain the process known as germination.
FITTING TOGETHER
PLANT REPRODUCTION CYCLES:
In the previous exercise, “Plant Reproduction in the Forest”, you studied the five stages in the reproduction cycle of plants. It is your assignment in this exercise to fit together the reproduction cycles of three forests plants, cottonwood, white ash and spring beauty. To do that, begin with the section on cottonwood. There are five sentences describing the reproduction cycle of cottonwood. Each of those sentences describes one of the stages in the reproduction of plants. To refresh your memory, those stages in the proper order are (1) Flowering (2) Pollination and Fertilization (3) Fruits and Seeds (4) Seed Movement (5) Germination. However, the five sentences in the cottonwood section are scrambled and not in the proper order. It is your job to unscramble the sentences and put them in the proper order. To help you out, one of the sentences has already been numbered as to its proper order. After you have placed the sentences in the proper order, you will have fit together the reproduction cycle of cottonwood. To fit together the reproduction cycles of white ash, and spring beauty, follow the same instructions.

COTTONWOOD Cottonwood is a large tree growing up to 100 feet tall.
The staminate and pistillate flowers of cottonwood are born separately on different trees; the staminate flowers are thick reddish catkins and the pistillate flowers are narrower, greenish yellow catkins.
3. By May, the pistillate flowers have matured into long strings of greenish brown capsule fruits which hold tiny seeds.
Wind carries pollen from the staminate flowers to the pistillate flowers where the seeds are fertilized.
The seeds of the cottonwood must arrive at moist soil along a river or stream bank within a few hours after leaving the tree or they lose their ability to germinate.
During spring and summer, the fruits split open and the seeds (which have a cottony, white sail attached to them) catch the wind and travel from the parent trees.

WHITE ASH White ash is also a large tree growing up to 100 feet tall.
The seed of white ash may lay dormant until the next spring and then germinate or the seed may lay dormant for several years before it germinates.
2. Shortly after the flowers appear, wind carries pollen from the staminate flowers to the pistillate flowers where the seeds are fertilized.
The staminate and pistillate flowers of white ash are born separately on different trees, appear in spring before the leaves unfold, and are small, purplish and grouped in clusters.
By midsummer, the pistillate flowers have ripened into light brown, paddle-shaped fruits which each hold a single seed.
The fruits of white ash have a narrow, light wind which travel by catching the wind when the fruits fall from the trees in late summer or fall.

SPRING BEAUTY Spring beauty is a very common woodland wildflower that grows to be about 6 inches tall.
The seeds of spring beauty lay dormant in the soil through the summer, fall and winter and germinate the following spring.
By May, each capsule fruit of spring beauty has matured and holds three to six flat seeds.
The white or pinkish flowers of spring beauty bloom by the first week in March; each flower has both a stamen and a pistil.
4. When the fruits are very ripe, they split open and the seeds fall to the soil.
Shortly after the flowers bloom, insects, especially bees, carry pollen from one flower to another where the seeds are fertilized.
How Seeds Move in the Forest

The forest never stands still. Even in the fall when the trees are losing their leaves and the birds have stopped singing, parts of the forest are on the move. Seeds, especially, are traveling from parent plants to new locations where they may someday grow into plants. On the previous page, you learned a seed ripens inside the fruit of a plant. In some cases, the fruit matures, splits open and releases its seed. When that happens, the seed has to do its own traveling. In other cases, the fruit leaves the plant by one way or another and it carries the seed with it. When that happens, the fruit is a carrying case for the seed. In either case, the structure of a fruit and its seed determines how the seed will travel through the forest. Below is a chart listing nine different types of fruits and seeds and the nine different ways each is moved through the forest. Study the list and then examine the nine fruits and seeds drawn below the chart. After you have carefully looked at the make-up of the fruits and seeds and studied the description belonging to each, write down how you think each of the nine fruits and seeds is moved from its parent plant to a new location in the forest.

1. Winged fruits—carried by wind.
2. Fruits with plumes (cottony, feathery, fibers attached to fruit)—carried by wind.
3. Fruits with spines or barbs (fruits that have spines or barbs that catch in the fur of animals or the clothes of people)—carried by animals, including humans.
4. Corky fruits (fruits that have air spaces enabling them to float)—carried by water.
5. Tiny seeds—carried by wind
6. Tiny seeds with arils (minute seeds that are so small they can be carried by insects. These seeds have arils, an extra bit of tissue which insects like to eat. For example, ants often carry seeds a long distance before they eat the aril and leave the seed.)—carried by insects.
7. Fleshy fruits (berries, pomes, drupes) eaten by animals and passed out in feces; or left to rot and seeds enter the soil.
8. Nuts—buried in ground by squirrels and other animals.
9. Explosive fruits—fruits burst open and the seeds shoot out.

The juicy red berries of smooth sumac each contain a single brown seed. The berries hang on the tree well into winter and are eaten by animals that can either climb or fly.

The narrow capsule fruits of quaking aspen are grouped in clusters. The many small seeds held in each fruit have cottony hairs attached to them.

The round, light, ball-like fruit of sycamore can float for quite a while. Each fruit contains many small seeds which need damp soil for germination.

The fruits of black maple each bear one seed, are borne in pairs and have thin, light wings.
Forest Shelters

Below are eight animals and eight shelters found in a forest ecosystem. A shelter is any place or thing that protects an animal or its young from harsh weather and/or attack from other animals. Study the shelter requirements of the eight animals below. Then match each animal to the shelter it needs by drawing a line from the animal to the shelter.

**Burying Beetle**
The burying beetle uses the soil of the forest as shelter and as a way of preserving its food. When a small mammal or bird dies, it buries the body by digging away at the soil from below. The female beetle then lays her eggs near the buried food and when the young grubs hatch, there is a ready supply of food.

**Luna Caterpillar**
The luna caterpillar makes its own shelter using silk produced by a gland near its upper lip. Hanging from a twig, the caterpillar spits out silk while shaking its head back and forth in a zig-zag motion. In a short time, the caterpillar spins a tough, water-proof, two-layered case of silk that is firmly tied to the twig. In this cocoon, the caterpillar (now known as a pupa) will undergo metamorphosis or changes in its physical make-up. The pupa spends the winter in the cocoon and in May or June, breaks out of the cocoon as a luna moth.

**Silver-haired Bat**
The silver-haired bat commonly takes shelter beneath the loose bark of trees. In such a shelter, the young bats (usually two) cling to the body of the female bat until they are about 3 weeks old and ready to fly by themselves.

**Gray Fox**
The gray fox commonly makes its den in the base of a hollow tree. During spring and summer, three to five naked and nearly blind kits are born in the den. During the rest of the year, the gray fox uses its den as a hidden resting place, usually during daylight hours.

**Hairy Woodpecker**
It takes 1-3 weeks for a pair of hairy woodpeckers to chisel out a nest cavity in the side of a tree. If the tree is dead or has rotten heartwood, the work takes less time. The opening of the cavity may be 1-1½ inches wide but the cavity itself may be as deep as 15 inches. Sometimes the male hairy digs a shallower hole near the nesting tree as a sleeping spot.

**Northern Oriole**
The female northern oriole builds a swinging nest high in a tree. First she hangs long strands of dried plant stalks, yarn or hair over the twigs of a tree. Next, she loops and weaves the strands together into a strong basket. Hanging on the nest, often with her head down, she chatters or sings a bit as she weaves.

**Northern Fence Lizard**
When not basking in the sun, the northern fence lizard commonly seeks shelter under fallen and decaying logs. Such a log is often used by the female lizard in summer as a place to deposit her long, soft-shelled eggs.

**Blue Racer**
The blue racer is often found under a rock, especially when it is time to shed its skin or when the weather is cold. In early summer, 19 to 15 white eggs are laid under a rock by the female racer.

**Thinking Further**
The tallest branches of the forest (the canopy) form a protective cover over the forest ecosystem. The canopy provides shade and shields plants and animals from strong winds and rain. The roots of trees and plants hold the soil steady, benefitting the plants that must grow from the soil and the animals that must take shelter in the soil. In your own words, explain how the forest ecosystem is one big shelter protecting many smaller shelters.
Tracking the Mammals of the Forest

Secretive and weary, the mammals of the forest are not easily seen. One of the best ways to tell if a mammal has been around is to find its tracks. Drawn for you below on the left are the feet of ten mammals. On the right, ten sets of tracks (some showing both running and walking gaits) are drawn just as they appear when they are imprinted on the forest floor. It is your assignment to carefully study the feet of each mammal and then match each mammal to the set of tracks you think its feet would make. After you are through, your work will be a guide to the mammal tracks of the forest. In fact, you can use your work to complete Strategy 6 at Location One of FOREST SLEUTH WORK. Special Note: The house cat and dog are not native mammals of the forest; however, they are included in this exercise so that you will be able to tell their tracks from native mammals as you go forest tracking.

MAMMALS

- Whitetail Deer
- Opossum
- Striped Skunk
- Gray Squirrel
- Raccoon
- Gray Fox
- Bobcat
- Dog
- House Cat

TRACKS

- Walking
- Running
- Trotting

You can use your work to identify the tracks of various mammals by matching the feet to the corresponding tracks. Each mammal has unique foot characteristics and track patterns that help in distinguishing them from one another.
Nutrient Element Cycling

"Time, to an atom locked in a rock, does not pass. The break came when a bur oak root nosed down a crack and began prying and sucking. In the flash of a century, the rock decayed, and X was pulled out and up into the world of living things. He helped to build a flower, which became an acorn, which fattened a deer, which fed an Indian, all in a single year."

Aldo Leopold, "Odyssey" of Atom X

Aldo Leopold, oftentimes called the grandfather of conservation, is describing the path of Atom X through a forest ecosystem. Although there are few Indians still living in Illinois, people continue to have a place in forest ecosystems. In Leopold's passage, Atom X travels from a rock to the soil, up the roots of a bur oak tree, and into its flower. Atom X is used to help ripen the flower into an acorn; the acorn is eaten by a deer who in turn is eaten by an Indian. What is Atom X and where will it go from the Indian?

Atom X is part of an element. Elements are the basic units of matter from which all things on earth are made. Living organisms need 30-40 elements for normal growth. The most important elements are carbon, hydrogen, oxygen, nitrogen, sulfur and phosphorus. Because these elements help plants and animals grow, they are known as nutrient elements and since there is a limited supply of nutrient elements they must be recycled so plants and animals can use them over and over again. Atom X will be recycled after it leaves the Indian. Fit together some of the nutrient cycles of the forest (oxygen, water, and carbon) and then you will be able to state how.

FITTING TOGETHER AN OXYGEN CYCLE

The forest scene above has all of the parts necessary to illustrate the oxygen cycle on land. It is your job to match the parts of the forest scene to the explanations of the oxygen cycle listed on the next page. Here is a strategy for doing just that. Step 1: Read the first explanation (A) and put the letter (A) beside the part of the forest scene explanation (A) is describing. For example, is explanation (A) describing the role of the tree, the mammal or the air mass of the forest? After you decide, read all of the explanations and place the letter of each explanation (A, B, or C) beside the part of the forest scene it describes. Step 2: Now you are ready to label the parts of the forest with common names. For example, what is the common name for the tree on the left? Step 3: It is now time to fit the whole cycle together. Start at the first explanation (the atmosphere) and reread all of the explanations. Notice that each time oxygen is transferred from one part of the forest scene to another, the sentence describing that movement is underlined. Each time you see an underlined sentence, draw an arrow from the part of the cycle oxygen is leaving to the part it is arriving at. Remember, every part of the forest that takes in oxygen also releases it back into the atmosphere. That is how oxygen is recycled.

(Oxygen is vital to the development of all living things. 21% of the atmosphere is composed of oxygen).
EXPLANATIONS

A. In the forest scene on the previous page, the air or atmosphere serves as the holding tank for oxygen.

B. Green plants, such as the paw paw, a small tree with a broad crown, and the mayapple, a large wildflower, take in oxygen from the atmosphere and use it in the process of respiration. Green plants such as the paw paw and mayapple release oxygen back into the atmosphere as they conduct photosynthesis. In fact, green plants are responsible for manufacturing most of the oxygen in the atmosphere.

C. Animals such as the silver-haired bat, a dark, small bat up to 4 1/2 inches long, and the white-footed mouse, a brown mouse with white undersides and feet, also take in oxygen from the atmosphere. Yet, as they respire, they release oxygen back into the atmosphere.

FITTING TOGETHER A WATER CYCLE

The forest scene drawn above has all the parts necessary to illustrate the water cycle of the forest. To fit together the water cycle, use the same directions you followed to put together the oxygen cycle. To help you out a bit, some of the work has been done for you. Remember, each time you see an underlined sentence, water is moving from one part of the water cycle to another. You should show that movement by drawing an arrow from the part water is leaving to the part it is arriving at.

EXPLANATIONS

A. Water is stored in clouds in the atmosphere. From those clouds, water falls as rain to the soil of the forest.

B. Water in the soil is absorbed through the roots of plants such as hop hornbeam, a small tree up to 35 feet tall, and bulbous cress, a wildflower up to 18 inches tall. The water carries into plants all of the nutrients they need for development. The plants use water during photosynthesis and release water back into the atmosphere during respiration.

C. Some of the rainfall from the atmosphere runs into streams which feed lakes, rivers and eventually the ocean. During the process of evaporation, water in the form of water vapor returns to the atmosphere from those bodies of water.

THINKING FURTHER:

1. A great deal of oxygen is taken out of the atmosphere when fossil fuels such as coal, oil and gas are burned to energize homes and industries. We depend on green plants conducting photosynthesis to restore the oxygen supply in the atmosphere. Can the removal of large areas of trees and other plants affect the production of oxygen? If yes, explain how? What does your answer mean for people, for plants, for animals?

2. Trees and other plants are very important in the water cycle. They return water vapor to the atmosphere as they undergo respiration. The roots of trees and other plants hold the soil and prevent the soil from washing away into streams, lakes and rivers. Explain how the water cycle is affected when forests are entirely stripped of trees and other plants.
FITTING TOGETHER A CARBON CYCLE

The forest scene drawn above has all of the parts necessary to illustrate the carbon cycle on land. To get together the carbon cycle, use the same instructions you followed to fit together the oxygen and water cycles.

EXPLANATIONS

A. The atmosphere of the earth stores carbon in the form of carbon dioxide (CO₂).

B. The pecan, a large tree up to 150 feet tall, is taking in carbon dioxide from the atmosphere through its leaves. In those leaves, carbon dioxide is used in the process of photosynthesis. When the pecan respires, carbon dioxide and water vapor are released as waste products into the atmosphere through its leaves and into the soil through its roots.

C. The leaves of Red Mulberry, a medium tree up to 50 ft. tall, also take in carbon dioxide from the atmosphere to use in photosynthesis. And like the pecan, the red mulberry releases carbon dioxide to the atmosphere when it respires. The red, juicy berries of red mulberry are eaten by many animals. In this scene, an opposum is feeding on the berries. This means carbon compounds are being transferred from the red mulberry to the opposum.

D. The opposum, like all animals, also respires in order to release energy inside the cells of its body. As it respires, carbon dioxide is released to the atmosphere. The opposum is eaten by foxes, coyotes, large owls and maybe minks. In this scene, the opposum is about to be killed and eaten by a great horned owl. After that occurs, carbon compounds will transfer from the opposum to the great horned owl.

E. Just like the pecan, the red mulberry and the opposum, the great horned owl respires to gain the use of energy stored in its body. As it does so, carbon dioxide is sent out into the atmosphere.

F. In this forest scene, there are three decomposers. The protococcus is a bacteria growing on the bark of the pecan tree. The protococcus is feeding on the tissues of the tree and carbon compounds are moving from the pecan to the protococcus. The puffballs, small pear-shaped fungi, are feeding on the fallen leaves and limbs of the pecan and red mulberry and carbon compounds are moving from the leaves and limbs to the puffballs. The burying beetle is an insect living in the soil. When the great horned owl dies, the burying beetle will feed on its body, and carbon compounds will be transferred from the owl's body to the beetle. As one can see, the decomposers play a very important role in the carbon cycle of the forest because they receive carbon from every organism by one way or another. Furthermore, when the decomposers undergo respiration, they release more carbon dioxide back into the atmosphere than do larger plants and animals.

G. When the decomposers die and decay into the soil, carbon compounds will be transferred to the soil. Remember that the roots of the pecan and red mulberry are already releasing carbon dioxide into the soil. Some of the carbon dioxide is released from the soil to the atmosphere but most of it goes in the opposite direction, downward.

H. After many thousands of years, bits of animals and plants in the soil form reserves of peat, coal, oil and carbonate rocks deep below the ground surface. These reserves store the majority of the earth's total carbon.

THINKING FURTHER:

1. The forests of the world take in more carbon dioxide from the atmosphere than any other ecosystem. Approximately 15 billion tons of carbon dioxide are taken out of the atmosphere by trees which use the carbon to build their woody tissues. This transformation of carbon dioxide to wood is very important because it helps prevent a build-up of carbon dioxide in the atmosphere.

Such a build-up is a real danger as we continue to burn larger and larger amounts of coal, oil and natural gas (fossil fuels which release carbon dioxide into the atmosphere). In the past century, the amount of carbon dioxide put into the atmosphere by the burning of fossil fuels has increased by 2.3 parts per million each year. In your own words, explain how forests help control the amount of carbon dioxide in the atmosphere?
The Family Tree

(a Play)

List of Characters

Sarah

Transportation

Math

Physical Fitness

Aaron

Actor

Photo

A Multiphase Digestion of Past

27
A. The Heartwood was the oldest portion of the oak. It was originally xylem but with age matured into heartwood. The heartwood became filled with waste products and eventually succumbed to heart rot. The heartwood continued to help support the tree.

B. Xylem tissues, not yet matured into heartwood, piped water and minerals from the oak's roots to its leaves.

C. The thin (one-cell-thick) vascular cambium was always growing, except during the winter. The cambium produced xylem to the inside and phloem on the outside. Due to the production of the cambium, a new ring of wood was added each year.

D. The phloem tissues carried dissolved sugars to both ends of the tree and later aged to become part of the bark.

E. The opposite of the heartwood, the sapwood was the youngest wood of the tree.

F. The bark of the oak protected the tree from harsh weather and animal attack.
season. As the scorching hot summer dragged on without even a drop of rain, some of my oldest branches died from lack of moisture. Late one night, a fire, probably started in the forest by campers, spread to the meadow where I stood. Feeding furiously on the dead, sun-baked grasses, the flames leaped up my trunk, ripped open my bark and scorched my inner wood. Luckily, that same night, the long awaited rains came and saved me from both the drought and the fire.

**Fungi:** Quickly we made our way into the tree through its damaged bark. Eager for food, we quietly and slowly attacked the tender tissues of its wood.

**75 Year Old Tree:** My seventy-fifth growing season was good and bad. During a violent rain storm one April afternoon, the wind tore off several of my dead branches, leaving gaping holes in my trunk. Yet, the rest of the spring was a gentle one and the summer was good for growing with plenty of sunshine and just the right amount of rainfall. Because of those favorable conditions, my cambium added a wide, healthy ring to my girth.

**Cambium Tissues:** I was the thin layer of tissue beneath the phloem and next to the xylem tissues. To my outside, I produced phloem and to my inside I made xylem. Together, my production added a new ring of wood to the tree each year.

**Xylem Tissues:** Yes, and by that time, the innermost rings of me were turning dark brown and they were losing their ability to pipe water and minerals through the tree. My oldest rings had become heartwood.

**Heartwood:** Indeed, I was the oldest part of the tree. With the passing of each year, another ring of xylem matured into me.

**Cambium Tissues:** But for every ring that turned to heartwood, I added a new ring. These new rings gradually took over the job of piping water and minerals through the tree. So you see, I built new plumbing for the tree each year.

**75 Year Old Tree:** Even though the wood in my core was three-quarters of a century old, my outermost wood was never more than one year old. I was, at the same time, both old and young.

**Sapwood:** I guess it’s time to introduce myself. As you have already heard, the oldest wood of the tree had stopped functioning and was called heartwood. The rest of the wood, the younger xylem, cambium and phloem, was still alive and active. That wood was me.

**Heartwood:** During the oak’s one-hundredth year, I began to soften with rot. Remember the fungi that had trespassed into the tree’s inner wood after its bark had been damaged by fire. Well, they were still at work on me. I had a disease known as fungal decay or heart rot.

**100 Year Old Tree:** But never fear, I still stood strong. Unlike animal creatures, we trees can live without a heart.

**Cavities:** Yes, but you seldom live alone. We were first formed when the branches of the oak fell off, leaving holes unprotected by bark. It was through us that animals came to share life with the oak. The insects arrived first.

**Insects (Beetles, Caterpillars, Ants) A Chorus**

Cuticle.

(Thin, waxy, waterproof layer covered epidermis)

Upper epidermis (protected delicate mesophyll tissue from injury, loss of water, infection)

Mesophyll (Thin-walled, soft tissues containing small round bodies known as chloroplasts which hold the green pigment chlorophyll.)

Stomata (minute openings in lower epidermis of leaf)

The main job of the oak’s leaves was to make food. Carbon dioxide entered the underside of the leaves through the stomata. Chlorophyll in these cells changed the sunshine, carbon dioxide and water to glucose or food molecules. This was the process of photosynthesis.
RED-HEADED WOODPECKER: Yes I know you did, my ancestors found the oak to be a most happy hunting ground for tasty tid-bits such as yourself.

GRAY SQUIRREL: And we owe a great debt to the woodpeckers.

SCREECH OWL: Yes, and my ancestors found a big hollow deep in the trunk of the tree a most fitting place to raise their young.

125 YEAR OLD TREE: You are all correct. I was a good thing for the little wood around the pond and the forest. Not only did I provide shelter and food to countless animals, I gave life to new generations of oaks with my acorns. My roots held the earth firm when the spring rains came. My body gave cool shade during the summer, and cut the harsh winds of winter. During the summer my leaves filtered impurities and renewed the air with oxygen.

AUTUMN: But it was during my time that the oak showed its greatness to the world. Since my daylight hours are shorter, the tree slowed its production of chlorophyll. When the green pigment of the chlorophyll began to fade, yellow pigments known as carotenoids appeared.

155 YEAR OLD TREE: Yes, I remember the autumn of my 155th year. I had grown to be a giant of a tree. My trunk was a full 8 feet in circumference and my mighty branches stretched 100 feet toward the sun. When the pond reflected the color of my autumn leaves, not a square inch of the water did not glow yellow, maize, gold, lemon saffron or mustard.

WINTER: The old oak never could keep its leaves for long. As I took over the season, the leaves would always turn brown, curl up and fall to the ground. Never once in my season did I see the tree when it did not stand naked.

SPRING: Each year I awoke the sleeping oak and it showed its renewed life by sprouting open the hundreds of green buds on its twig.

POLLEN: Not every spring, but every other, the oak used the wind to send me into the air. It was my job to travel from the staminate or male flower to the pistillate or female flower. Sometimes it was a short trip because both flowers were on the same tree. The pistillate flowers were tiny, red and without petals. The staminate flowers also had no petals but they looked like drooping yellow catkins. By going from the male flowers to the female flowers, I made sure the seeds in the female flowers became fertile. These female flowers grew and ripened into acorns.

SUMMER: During the 225th year of the oak's life, I gave it a supreme test. I brought heat that baked the land and a drought that turned the pond into a crater of hard cracked dirt. The stream of water flowing through the tissues of the tree came to a halt. Its root system, which branched out as widely as its crown, searched desperately for a source of water in the earth, but even the most efficient root system cannot find water where there is none. In desperation, thousands of the oak's leaves curled inward in an effort to conserve moisture. But it was too late. With my drought I had strangled the giant oak.

THUNDERSTORM: It was I who finally brought an end to the drought. With a slight wind from the west, I issued a warning that I was about to let my fury fly. I flashed heat lightning across the sky and brought in a giant front of cool moist air. To back it up, I filled the air with heavy, threatening cumulonimbus clouds. A few drops fell and then I unleashed my wrath without mercy.

225 YEAR OLD TREE: Yes, I had survived storms before but I was no longer young. Fungal decay had gutted my insides, tapping much of my strength. Yet, with everything I could muster, I braced my body and roots against the onslaught of the rain and the wild, raging wind. As if it were a traitor to me, my wide crown caught the wind and threatened to pop me out of the earth.

With each slam of wind, my giant body moaned in agony. As if to herald my passing, the storm sent forth a massive crack of lightning and a tremendous blast of wind that smashed me broadside. Slowly, without hurry, my body leaned to one side. And as I groaned so loud to outshout the thunder, my trunk Splintered in two. When the storm had passed and the little meadow was green and refreshed from the rain, the greater part of my trunk lay out at right angle to my stump. My crown was laying in the pond. Since my trunk was cracked open, It was easy, to see what had been my achilles heel in the storm — my rotten heartwood.

DEATH: My time is the only season the old oak knows now. Yet, the old tree continues to serve life. Fungi, insects, birds, mammals, reptiles and amphibians feed and live amongst the branches and the trunk of the tree. Its rotting wood adds to the rich humus of the earth just as its fallen leaves did for two centuries. Some of its wood has been sawed and carted away by people who will use the oak to warm their homes in winter.

GRAY SQUIRREL: So here I stand on the stump of the old oak. You might say that the oak was my family tree, one oak for 225 generations of squirrels.

BOBCAT: Yeah, and you better get moving along there buddy, or that little acorn in your paw will be your next family tree.

REVIEW QUESTIONS:
1. Explain what happened to the acorn when it germinated?
2. What was the function performed by the xylem tissues of the tree? Where were the xylem tissues stationed in the tree? What did the older xylem tissues mature into?
3. What was the main function carried out by the phloem tissues? Where were the phloem tissues stationed in the tree? What did the older phloem tissues mature into?
4. Explain how the oak got its food and how it released ox-ygen to the environment.
5. Where were the cambium tissues stationed in the oak. What was their purpose?
6. The sapwood was the youngest, still active part of the oak's wood. The __________ part was the dead, no longer functioning part of the wood.
7. Did the oak depend on wind or insects to carry its pollen?
8. Name ten animals that depended on the oak for at least part of their survival?
9. Explain how the oak served life even in death.
A Southern Flying Squirrel's Life To Live Game

Life History

The southern flying squirrel, Glaucomys volans (Linnaeus), may be common in much of Illinois' mature forests. Since the flying squirrel is active only at night, an accurate count of its numbers in Illinois has been impossible to make. The flying squirrel is protected by Illinois law and it is illegal to harm or capture individual squirrels.

The flying squirrel is told from all other squirrels by the presence of a "gliding" membrane on each side of its body. The squirrel uses these thin folds of skin to glide from limb to limb. Contrary to what its name implies, the flying squirrel glides and does not fly. Though the flying squirrel may glide downward 150 feet or more, most of its glides are between 20 and 30 feet in length.

The female flying squirrel gives birth to 1-6 young during March to early April. She may produce a second litter in late summer. At birth the young are naked, pink, and have their eyes and ears shut. The female flying squirrel has complete responsibility for taking care of the young and she defends them and the territory around her nest tree quite courageously. The male flying squirrel, on the other hand, does not defend his home territory.

Though nuts, seeds, fruits, berries and mushrooms make up most of the flying squirrel's diet, it also feeds on animal foods such as moths, beetles, insects, insect larvae, bird eggs and nestlings, and meat from the carcasses of dead animals. In turn the flying squirrel is preyed upon by native animals such as weasels, raccoons, owls, hawks, bobcats and tree-climbing snakes. A non-native predator of the flying squirrel is the domestic cat.

The flying squirrel is active all year but it may stay in its nest for several days to avoid bad weather during the winter. Also during the winter, several flying squirrels may get together in one nest, presumably for warmth.

The flying squirrel is a beautiful and valuable member of the forest community. By feeding upon the buds of trees, the flying squirrel probably stimulates better tree growth and by eating wood-burrowing insects, it aids in controlling these sometimes harmful forms. The flying squirrel helps the forest continue by planting nuts and seeds. By serving as food for other forest dwellers, it is an important link in the food chain. Even in death, the flying squirrel serves life by adding its body waste to the soil as rich organic material.

Correct Scorecard Answers

1. Category: Natural Predator
2. Category: Food Gathering
3. Question: "NO"
4. Situation: False
5. Category: Young
6. Category: Travel
7. Question: "The presence of a gliding membrane on each side of its body"
8. VALUE BONUS: By feeding on tree buds, probably stimulates better tree growth; is beautiful and harmless.
9. Category: Habitat
10. Category: Unnatural Disturbance/Predator
11. Question: "NO"
12. Category: Nest
13. Situation: False
14. Question: "True"
15. Question: "20 to 30 feet"
16. Situation: False
17. Category: Travel
18. Category: Physical Appearance
19. Category: Natural Predator
20. Question: "Moths, beetles, insects, insect larvae, bird eggs, and nestlings."
21. Category: Habitat
22. Category: Unnatural Disturbance/Predator
23. Question: "weasel, raccoon, hawks, bobcat"
24. Situation: "True"
25. Category: Nest
26. Question: "naked, pink, and with eyes and ears shut"
27. Category: Young
28. Category: Territory
29. Question: "True"
30. VALUE BONUS: "part of the food chain; eats harmful insects; plants nuts and seeds; returns body waste to the soil"
31. Category: Food Gathering
32. Category: Physical Appearance
Instructions for Playing

1. This game can be played by 1-10 players.
2. Each player should begin the game with a player token, a nine-lives pass, a glide pass and a scoresheet.
3. Before beginning the game, one player should read aloud the life history of the southern flying squirrel (see opposite page). Players should listen carefully as the information may come in handy during the course of the game.
4. To begin the game, each player should spin the spinner and the person with the lowest number is entitled to go first. The rest of the players should take their turns in clockwise order after the first player.
5. After a player spins the spinner, she should move the designated number of spaces. If for any reason, the player does not want to land on a certain space, she can use the glide pass to land on any other space on the board. However, once a player uses the glide pass, it is no longer valid. A GLIDE PASS CAN BE USED BY ONE PLAYER ONLY ONE TIME DURING A GAME. If at the end of the game, a player still has her or his unused Glide Pass, she may turn it in for 20 points.
6. If a player lands on a CATEGORY space, the space will be marked with a number and a capital C. The player should read what is written on the space and decide which category the space refers to. The following are the categories to choose from:
   - Natural Predator
   - Territory/Home Range
   - Unnatural Disturbances/Predator Travel
   - Food gathering
   - Physical Appearance
   - Nest
   - Habitat
Each of the categories represent important parts of the flying squirrel's life history.
If a space seems to refer to more than one category, the player should decide what the main theme of the space is.
After a player decides which category the space refers to, she should write down the category on her or his scoresheet opposite the number of the space. A correct answer for a CATEGORY space is worth 5 points.
7. If a player lands on a QUESTION space, the space will be marked with a number and a capital Q. The player should write the answer to the question by the number of the space on her or his scoresheet. A correct answer for a QUESTION space is worth 10 points.
8. If a player lands on a VALUE BONUS space, he or she must write down one value of the southern flying squirrel on the scoresheet next to the space with the same number. A correct answer for a VALUE BONUS space is worth 10 points.
9. If a player lands on a SITUATION space, the space will be marked with a number and a capital S. The player must decide if the drawn situation represents a true or false situation in the flying squirrel's life. The player should write true or false next to the space with the same number on her or his scorecard. A correct answer is worth 5 points.
10. If a player lands on a space where her or his squirrel is killed, she may avoid the death by playing her or his nine-lives pass. If the nine-lives pass is played, the player may stay in the game but is still responsible for playing that space in the appropriate manner. If a player lands on a space where her or his squirrel is killed and she has already played the nine-lives pass, the player must drop out of the game. However, that player can tally her or his scorecard at the end of the game and is eligible to win. Remember, like the GLIDE pass, THE NINE-LIVES PASS CAN BE USED BY ONE PLAYER ONLY ONCE DURING THE GAME. If at the end of the game a player still has her or his unused NINE-LIVES PASS, she may turn it in for 10 points.
11. After each player has crossed the finish line, a judge or a panel of the players must review the score sheets for the correct answers. The player with the highest points wins the game. Ties are permissible but run-offs in the case of a tie are advised.

Scorecard

1. C.
2. C.
3. Q.
4. S.
5. C.
6. C.
7. Q.
8. V.B.
9. C.
10. C.
11. Q.
12. C.
13. S.
14. Q.
15. Q.
16. S.
17. C.
18. C.
19. C.
20. Q.
21. C.
22. C.
23. Q.
24. S.
25. C.
26. Q.
27. C.
28. C.
29. Q.
30. V.B.
31. C.
32. C.

GAME BOARD PLAN

SPINNER

Spin Using Pencil
Forest Sleuthwork

This exercise requires you to become a spy of the forest and will take you to the four locations or layers of the forest. Good luck!

Location One: The Forest Floor

Briefing: It is your mission at Location One to scour the forest floor for signs of plant and animal life.

Strategy: A. Get down on your knees and pick up a handful of forest litter.

List three items you see and feel in the litter. 1. 2. 3.

Dig with your fingers into the litter on the forest floor. What is the grainy, dark-colored substance beneath the litter? 4. Do you see any plant roots running through the soil beneath the rocks? 5. Are there any insects or other animals? 6. If so, can you name them? If you do not know their names, write down a description of them.

B. Look under three rocks for signs of plant and animal life. Is the soil beneath the rocks cool and moist or hot and dry? 7. Do you see any plant roots sunning through the soil beneath the rocks? 8. Are there any insects or other animals? 9. If so, can you name them? If you do not know their names, write down a description of them.

C. Locate a fallen and decaying log. Check out the bark first. Are there any types of fungi such as artist's fungus growing on the bark? 10. Is there moss such as star moss growing on the bark?

D. Peel off a small section of bark and examine the wood of the log. Do you see any tunnels, 11. cocoons, 12. or spider webs 13. ? Is the wood decayed (filled with open spaces) enough so that animals could place their nests, young and eggs in it? 14. If so, is the wood of your log big enough to hold the nest of the masked shrew 15. , or the eggs of the black rat snake? 16.

The female masked shrew (about 3½ inches long) gives birth to five young each April in a ball-shaped nest about 4 to 5 inches in diameter.

The stout-bodied black rat snake (about 48 inches long) lays one dozen large eggs in decaying wood.

E. Now if you can, roll the log over. Can you spy any clue of plant or animal life in the area where the log was laying? If so, write down your observations.

Each of the animals drawn below lives at least part of its life under a decaying log. Which of the following animals would be about the right size to live beneath the log you have overturned. The hermit flower beetle 17. , the white-footed mouse 18. , the eastern gray tree frog 19. ? Be sure to carefully roll the log back over into its original position.

The 3¼ inch long hermit flower beetle is one of Illinois' larger beetles.

The white-footed mouse is about 5-7 inches from head to tail.

The eastern gray tree frog is only 1¼ to 2 inches long.

F. Crisscross the forest until you find a mound of dirt that opens into an underground tunnel. Do you know which animal the tunnel is used by? 20. Is the tunnel the right size for the mole 21. or the pine vole 22. ?

The 3¼ to 5 inch long pine vole makes a small opening in ground surface and blaze a branching network of underground tunnels.

The chunky mole measures 5½ to 8 inches long. Using its spadelike hands, the mole moves with a "swimming" or "breaststroke" motion through its tunnels near the ground surface. When the mole is home, it plugs all openings to its tunnels so mice and shrews cannot move in and use its runways.

G. Sneak around with your head down and your eyes targeted on the forest floor. Look for mammal tracks. The forest floor is like a roadway for animals, especially mammals. Can you find any of the tracks illustrated on page 20 of this booklet? If so, which ones.
Location Two: The Herb Layer

Briefing: As you walk through the forest, the small plants growing at your feet are the herbs. Herbs are green plants with soft, non-woody tissues. Most of the herbs in the forest are called wildflowers. It is your mission at Location Two to study the wildflowers and to uncover any insect activity.

Strategy:

A. Locate a wildflower. How tall is the plant you have found? _______________ What colors are on the plant? _______________. Smell the plant, especially the flower or blossom if it has one. Does the plant have a scent? _______________. If so, describe the scent.

B. Now it is time to study the construction of the wildflower. Below is a drawing of a complete plant. Though the plant you have found may be different in some ways, you can use the drawing as a guide as you answer the following questions about your plant. (The exercise on the parts of a flower on page 16 of this booklet will also help you.) Does the plant you have chosen have a stem? _______________. Touch the stem gently, is it smooth or covered with small hairs? _______________. Is the stem fatter or thinner than a pencil? _______________. Does your plant have leaves? _______________. Can you see any buds on your plant? _______________. Do you see any seeds or fruits? _______________. If so, draw and describe them.

C. If your plant has a flower, you should investigate it thoroughly. How many flowers are there on the plant? _______________. Does your flower have petals, sepals, pistil, or a stamen? _______________. Describe the flower of your plant in great detail and then draw your flower in the box provided above in the next column.

D. Your wildflower is a good place to look for insects. Location Two in the forest is busy with insects who carry out the very important task of pollination. Do you see any insects on the plant you are studying? _______________. If so, name, describe and/or draw the insect(s).

E. In order to search for more insects, move on from your plant and inspect as many different herbs in the forest as you can. Be on the lookout for any of the insects drawn below. If you find insects other than those drawn below, be sure to describe, name and/or draw them.

The bumble bee and honey bee visit showy and sweet-smelling flowers in search of nectar and pollen. When a bee visits a flower, pollen from the anther brushes off onto the bee's body hairs. Sometime later, the bee combs its hairs with its hind leg and the pollen is rubbed onto a small area of the leg that is equipped with a ring of hairs to catch and hold the pollen. In this "pollen basket" the bee carries pollen from one plant to another.

The pretty-colored flower fly visits flowers, especially those that contain aphids (tiny insects) to feed on pollen. The flower fly lays its eggs in the flower and when the larvae hatch they feed on the aphids.

Though less than ½ inch long, the ambush bug lays in wait in flowers and can catch an insect as large as a bumblebee.
Location Three: Shrub and Understory

Briefing: It is your mission at Location Three to investigate the sizes of the shrubs and understory trees and to discover any bird activity.

Strategy:

A. Locate a shrub. A shrub is a small woody plant that has several stems arising from the ground at the same spot. Some shrubs are commonly called bushes. Some shrubs are small trees which eventually may grow into large trees. How tall is the shrub? Name or describe the shrub (include details on leaves, branches, buds, and fruits).

How wide is the shrub? 

B. Draw the shrub you have found in the right hand corner of the box below. When you are done, the box should look something like SAMPLE BOX A.

C. Shrubs are only one part of Location Three. The trees that are smaller than the largest trees are called the understory trees. Together, the understory trees and shrubs make up Location Three in the forest. Locate an understory tree. How tall is the understory tree?

D. Now go back to strategy B. Draw the understory tree in the same box that you drew the shrub in. Draw the tree in the space to the left of and above the dotted lines. When you are done, the box should look something like SAMPLE BOX B.

E. The branches of shrubs and understory trees in Location Three provide cover and nesting spots for many birds. One by one, investigate as many shrubs and understory trees as you can for signs of birds. These are some of the signs and birds you may find. If you spy any of these signs or birds, write it down and/or draw it in the box below. REMEMBER: Good Forest Sleuths DO NOT TOUCH OR HARM ANIMAL NESTS.

Signs of birds at Location 3.
**Location Four: Canopy Layer**

**Briefing:** It is your mission at Location Four to investigate the branches, leaves, and bark of the canopy trees.

**Strategy:**

A. Select a deciduous canopy tree that has leaves (either last year's old leaves or this year's new ones.) A canopy tree is one of the largest trees in the forest. Its leaves and branches form a protective umbrella over the lower layers of the forest. How tall is the canopy tree you have chosen? ________ How wide is its crown of branches? ________ In the box below, draw the wildflower you studied at LOCATION 2, the shrub and the understory tree you investigated at LOCATION 3 and finally, the canopy tree you have selected for study at this location. Be sure to draw at the base of those plants what you investigated at LOCATION 1. When you are through your box should look something like the sample box.

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**SAMPLE BOX**

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B. Find a twig (a small branch) on your canopy tree. Break it off as close to the main limb as possible. Use the illustration below to help you answer the following questions about your twig.

Start at the outermost end of your twig. Is there a bud? ________ If so, what is that bud called? ________ Is there a leaf or a flower growing out of the end of the twig? ________ Look on the side of the twig. Do you see any buds? ________ If so, what are those buds called? ________ Do you see any leaf scars on the twig? ________ If so, how many? ________ When the leaves fall off the twig in autumn, what mark will they leave behind on the twig? ________ Can you find a terminal bud scale scar on your twig? ________ If so, how many? ________

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For Strategies C & D, turn to the next page.

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C. Find a leaf. Listed and drawn below are three major types of SIMPLE LEAVES and three major types of COMPOUND LEAVES. Simple leaves such as those of pawpaw appear on the twig singly. Compound leaves are different from simple leaves because they are made up of many leaflets which are arranged in pairs opposite each other. Carefully study the leaf types below and then answer the following questions about the leaf you have found. After you answer the questions, draw your leaf in the box provided. Is your leaf a simple or compound leaf? If it is simple, is it a simple-smooth leaf, a simple-lobed leaf, or a simple-toothed leaf? If your leaf is a compound leaf, is it a pinnately compound leaf, a palmately compound leaf, or a doubly pinnately compound leaf?

**SIMPLE LEAF TYPE ONE**
Simple-smooth: the edges of these leaves are smooth.

**SIMPLE LEAF TYPE TWO**
Simple-lobed: the edges of these leaves are cut deeply to form lobes.

**SIMPLE LEAF TYPE THREE**
Simple-toothed: The edges of these simple leaves appear to have small teeth.

**COMPONENT LEAF TYPE ONE**
Pinnately Compound: These leaves are made up of many leaflets which appear opposite each other on the twig.

**COMPONENT LEAF TYPE TWO**
Doubly pinnately compound:

D. Take a separate piece of white paper and press it against the back of your canopy tree. While continuing to press the paper against the bark, rub a crayon over the paper so that the bark makes an impression on the paper. When you are through, attach the paper to this sheet. Congratulations! You have completed your study at LOCATION FOUR and you are now a certified FOREST SLEUTH.
Because of the shortage of forest habitat, many forest-dwelling plants and animals depend on forests for natural habitats and people use forests for recreation, hunting, nature study, and for the production of lumber. When Illinois was first settled by white pioneers in the early 1800’s, the state’s 14 million acres of forests provided a vast habitat for plants and animals and a wonderful abundance of forest resources for people to use. In modern day Illinois, however, the state’s supply of forest has shrunk by 10 million acres to just 3.2 million acres. Because of the shortage of forest as habitat, many forest plant and animal species are fighting for survival. And to make matters worse, the growing population of people in Illinois need more forest products than ever before. What it all boils down to is that the need for forests by plants, animals and humans is great, yet the supply of forests is shrinking.

THE NEED FOR FORESTS IS GREAT

Your completed list demonstrates what is called the MULTIPLE USE of forests. In Illinois, forests are used for multiple reasons. Plants and animals depend on forests for natural habitats and people use forests for recreation, hunting, nature study, and for the production of lumber. When Illinois was first settled by white pioneers in the early 1800’s, the state’s 14 million acres of forests provided a vast habitat for plants and animals and a wonderful abundance of forest resources for people to use. In modern day Illinois, however, the state’s supply of forest has shrunk by 10 million acres to just 3.2 million acres. Because of the shortage of forest as habitat, many forest plant and animal species are fighting for survival. And to make matters worse, the growing population of people in Illinois need more forest products than ever before. What it all boils down to is that the need for forests by plants, animals and humans is great, yet the supply of forests is shrinking.

FOREST MANAGEMENT CAN HELP MAKE THE MOST OF OUR FORESTS

Good forest management can help make the most of the forests we have. Forests have one great advantage; they are a renewable natural resource. That means that forests can renew themselves by growing new trees. With good forest management, we can help forests grow bigger and healthier trees and we can even replant trees in areas that have been cleared. Forest management is the job of foresters and biologists working for state, county, local, and private organizations. To help you understand how forest management can help close the gap between the need for forests by plants, animals and humans and the supply of forests, study the Principles of Forest Management and answer the questions in Thinking Further.

3P(s)principles of Forest Management

PRESERVE—Forest management often involves setting aside some of our forests as forest preserves. These areas provide a forest and animal habitat, as well as opportunities for people to study nature, hike, camp and participate in other outdoor recreation. Some of these areas provide an opportunity to hunt and fish. Since many of these areas have been preserved in the same condition they were in at the time when white settlers first came to Illinois, they are living museums of our natural heritage.

PROTECT—An important part of forest management is protection. Forest managers work to protect forests from the destruction that fire, harmful insects and grazing can cause. This also means protecting forests from being cleared when it is absolutely necessary. When protected from harm, forests can better provide all of the things they are needed for.

PRODUCE—Since we all need forest products ranging from firewood to building materials to paper, it is important to manage some forests to produce a good crop of timber. Even though a forest will grow trees without any assistance from people, a forest manager can help it grow straighter, healthier and better-formed trees by removing some of the trees that are taking up too much space and sunlight (known as “wolf” trees) and some of the trees that are diseased, crooked or damaged. This leaves more sunlight, soil, water-and nutrient elements for the healthy, straight and well-formed trees. Of course, not all of the “wolf” trees or damaged trees are removed, many are left to provide food & shelter for forest animals. The practice of removing some trees to help more valuable trees grow is called Timber Stand Improvement. Timber Stand Improvement is wise forest management because it helps produce better, faster-growing trees.

Another way to help a forest produce more timber is by not overcutting it. An overcut forest is one wherein all of the mature trees usable for lumber have been cut. An overcut forest provides poor habitat for plants and animals and it takes many, many years for an overcut forest to grow mature trees that can be harvested. The best way to manage a forest is to select some of the mature trees to harvest but leave many others behind as growing stock. The growing stock can then be harvested every few years as more trees mature. This type of harvesting is called Selection Harvesting. A forest that is harvested in this way can produce timber for all of the years it is a forest. Plus, it will continue to provide habitat for plants and animals.

THINKING FURTHER

1. What is meant by the “multiple use” of forests?
2. How many acres of forests have been lost from Illinois since the early 1800’s?
3. What is the one great natural advantage forests have?
4. What are the 3 P’s or Principles of forest management?
5. Why is Timber Stand Improvement wise forest management?
6. Why is it better to Selection Harvest a forest than to overcut it?
WORKING AS A FORESTER

Recommending FOREST MANAGEMENT PLANS for private forest landowners is a very important part of forest management and the chief job of a FORESTER. Since 95% of the land in Illinois is owned by private landowners, FORESTERS work very closely with landowners to help them manage their woodlands in the best way possible. To complete this exercise, you will need to wear the cap of a FORESTER and it will be your job to recommend a FOREST MANAGEMENT PLAN for five Illinois landowners. You will meet those landowners and look over their land when you read the next page. These are all people who have contacted you as a FORESTER because they need advice or assistance concerning their existing or potential woodland. You should recommend to each landowner one of the five FOREST MANAGEMENT PLANS featured on this page: The choices are SELECTION HARVEST PLAN, TIMBER STAND IMPROVEMENT PLAN, FOREST PROTECTION PLAN, FOREST PRESERVATION PLAN, and TREE FARM PLAN.

FOREST PRESERVATION PLAN: A forester recommends this plan when a landowner wants to preserve his or her forest as a natural area, nature preserve, state, county or local park, a forest preserve or a conservation district. Foresters usually consult with many other persons when preparing this plan. The forester usually consults a Natural Heritage Biologist about the plant and animal species living on the property. In addition, the forester talks to different state, county or local officials about registering the property as a protected area to prevent trespassing and any other form of damage.

TREE FARM PLANTING PLAN: A forester recommends this plan when a landowner would like to plant trees on an area that is not presently forested. The forester visits the location and reviews the soil type and drainage patterns. If the location is suitable for raising trees, the forester prepares a plan for the landowner that recommends which species to plant, how to plant and care for seedlings.

SELECTION HARVEST PLAN: A forester recommends this plan when a landowner has a forest with mature trees that are ready to be harvested. This plan calls for the cutting of some of the mature trees but recommends that a good supply of trees be left in the forest as reserve growing stock and to provide habitat for plants & animals. More trees in the forest can then be harvested every several years as the trees mature. This plan allows the landowner to market part of his or her trees on a regular basis while not upsetting the forest ecosystem of plants & animals.

FOREST PROTECTION PLAN: A forester recommends this plan when a landowner would like to protect his or her forest against fire, insects or grazing. For fire protection, foresters may recommend putting in fire breaks. Fire breaks are narrow strips of land that have been cleared of vegetation down to the soil. These breaks stop a spreading fire and also give firefighters access to the fire. Foresters always recommend that landowners be very careful with any type of burning they do near their forests. For insect control, foresters sometimes recommend the use of pesticides although this is unusual. For control against grazing, the advice of a forester is simple. DO NOT GRAZIE CATTLE ON WOODLANDS. Cattle kill wildflowers, fungi and young trees growing from the forest floor. Cattle also pack down the soil so that the soil can no longer hold water. This leads to serious problems of soil erosion.

TIMBER STAND IMPROVEMENT PLANS: A forester prepares this plan when a landowner would like to improve the quality of his or her woodland. The goal of this plan is to help the forest produce healthier, better-formed trees that could someday be harvested and sent to market. Timber Stand Improvement (TSI) calls for the girdling of trees that are taking up too much room (known as “wolf” trees) or diseased, crooked or damaged trees. Girdling is done by cutting a ring around the trunk of the tree. The girdled trees die and are left to decay naturally in the forest. The important thing is that the unwanted trees are no longer able to steal sunlight, water and nutrient elements from healthy well-formed trees. Of course, not all of the “wolf” trees or diseased, crooked or damaged trees are girdled. Many “wolf” trees are left because hawks and owls perch & nest in their highest branches. “Wolf” trees that are producing fruits and seeds are also left so animals can find food. Some of the diseased, crooked, or damaged trees are left because they have natural cavities where animals find shelter. Timber Stand Improvement is not a harvest but is more like a maintenance operation. TSI does for the forest what the same thing hoeing does for a garden. TSI is wise forest management because it helps trees produce more good timber per acre while not harming the natural habitat for plants & animals.
Mr. Jones owns a large forest that is filled with oak, ash, and maple species. When Mr. Jones sold his farm to Mr. Martin, Mr. Martin decided to preserve the forest. He wanted to create a wildlife sanctuary for various species to thrive in their natural habitat. The forest was dense with tall trees, providing ample shade and shelter for different animal species. Mr. Martin planned to create hiking trails and nature paths for visitors to enjoy the beauty of the forest. He also wanted to introduce educational programs about the importance of forest conservation.

Mr. Martin realized that some areas of the forest needed additional care and maintenance. He called Mr. Jones to discuss the current state of the forest and the need for some improvements. Mr. Jones was concerned about the forest's future and agreed to support Mr. Martin's efforts. They decided to work together to enhance the forest's condition and ensure its long-term sustainability. Mr. Martin proposed several projects, including planting new trees, managing the current tree species, and implementing water conservation techniques to maintain the forest's health.

Mr. Martin believed that the forest was a valuable asset and could provide significant benefits to the community. He was committed to preserving the forest as a natural resource and an area for peaceful recreation. Mr. Jones was impressed by Mr. Martin's dedication and agreed to contribute to the forest's improvement. They both envisioned a thriving, sustainable forest that would serve as a valuable resource for years to come.
PREPARING A TIMBER STAND IMPROVEMENT PLAN

INTRODUCTION: The following are the rules a FORESTER and landowner should observe when preparing a TSI Plan: On pages 37 and 38 of the sample plan, a complete set of instructions is provided. To complete the TSI Plan, study the sample trees in the sample plot and then prepare the TSI Plan for your own land. A blank TSI Plan is provided on page 39. Before you begin work, review the TSI Plan on page 37 and the situation of the landowner on page 38, and study carefully the RULES OF THUMB FOR A TIMBER STAND IMPROVEMENT PLAN listed below.

RULES OF THUMB FOR A TIMBER STAND IMPROVEMENT PLAN

1. Leave all healthy, understory trees and shrubs. They are not competing with the larger trees for sunlight and air, and are an important part of the forest ecosystem.

2. Leave the young, healthy and well formed canopy trees. These trees will continue to grow and are providing food and shelter for forest animals.

3. Leave the mature healthy and well formed canopy trees. These trees can be harvested later and in the meantime, are providing food and shelter for animals.

4. Leave the dead trees. These trees provide good natural cavities for animals and they are not taking sunlight, water or nutrient elements from live trees.

5. Remove crooked trees. They will never be useful as saw timber and they take up too much space and they tend to reproduce other crooked trees. Exception: Leave a poorly formed tree if it is a valuable species such as black walnut. Though the tree will not produce good timber it will put out seed for new generations of its species in the forest.

6. Remove trees that have been badly damaged by lightning, disease, insects or fire. These trees will never be valuable as saw timber and are taking sunlight, water and nutrient elements from well-formed trees. Exception: Leave some damaged trees if they are providing food or cavities for animals.

7. Remove trees that are gutted by fungi. Because these trees are usually rotten inside they are often said to have “heart rot”. Again, these trees are stealing valuable sunlight, water and nutrient elements from well-formed trees. Exception: Leave some trees with “heart rot” if they are providing cavities for animals.

8. Remove “wolf” trees. “Wolf” trees are trees with an exceptionally wide crown of branches. “Wolf” trees sometimes take up five times the space a well-formed tree requires. “Wolf” trees retard the growth of other trees by shading them too heavily. Exception: Leave some “wolf” trees to provide nuts and other fruits for wildlife. Also, leave some “wolf” trees since hawks and squirrels nest and perch in their highest branches and since owls, woodpeckers and chickadees use cavities in their trunks and lower branches.

9. Remove less desirable trees that do not produce quality timber if they are shading more valuable trees. For example, in some forests, black locust is a less desirable species. Exception: Leave a less desirable tree if it is a good wildlife food producer. Red mulberry is an example of a less desirable species in terms of poor timber quality but FORESTERS usually leave it since its berries provide good food for forest animals.

TIMBER STAND IMPROVEMENT PLAN

PREPARED BY

NAME OF LANDOWNER

GOAL OF PLAN (What this plan will do for the forest)

DETAILS OF PLAN

The 20 trees in the sample plot are listed below. In the space beside each tree, write the species of the tree, and either “MOVE” or “AVOID” Then use the rest of the space to explain your reasoning. Use this sample as a guide.

TREE #1 White Oak: Move: This tree is crooked, does not have cavities for animals and is stealing sunlight, water and nutrient elements from the well-formed trees.

TREE #2

TREE #3

TREE #4

TREE #5

TREE #6

TREE #7

TREE #8

TREE #9

TREE #10

TREE #11

TREE #12

TREE #13

TREE #14

TREE #15

TREE #16

TREE #17

TREE #18

TREE #19

TREE #20
Tree #13 white oak: This mature canopy tree is healthy and well formed.

Tree #14 red bud: This is a healthy shrub.

Tree #15 white oak: This wolf tree is a good producer of acorns and does not interfere with the growth of other trees.

Tree #16 shagbark hickory: This tree is damaged by fungi but has a natural den at its base and cavities in its trunk and branches.

Tree #17 black oak: This tree is gutted by heart rot and is heavily shading Tree #18. This tree does not have as many cavities as Tree #16.

Tree #18 wild black cherry: This is a healthy tree that would grow faster if not shaded by Tree #17.

Tree #19 wild plum: This is a healthy understory tree.

Tree #20 black locust: This is an undesirable species that has little value as a wildlife food producer. This tree is competing with Tree #18.
Tree #1 white oak: This tree was hit and badly damaged by lightning.

Tree #2 black walnut: Though this tree has poor form, it is the only black walnut tree in the forest.

Tree #3 red oak: This tree is diseased and has little value as a wildlife cavity tree.

Tree #4 blue beech: This is a healthy understory tree.

Tree #5 black oak: This is a wolf tree. Squirrels and hawks nest in its mast of branches. Other animals nest in its cavities.

Tree #6 hop hornbeam: This is a healthy understory tree.

Tree #7 red oak: This tree is crooked.

Tree #8 shagbark hickory: This mature canopy tree is healthy and well formed.

Tree #9 white oak: This dead tree is an excellent home for animals and does not interfere with living trees.

Tree #10 red oak: This young canopy tree would grow faster if it was not shaded by tree #11.

Tree #11 white oak: This is a wolf tree with few dens for animals.

Tree #12 white oak: This young canopy tree would grow faster if not shaded by tree #11.
Land Use Planning

Introduction: (Read aloud by one student to the class)

"Carefully planning the use of the land in Illinois is very important because there is only so much land to go around. Every time something new needs to be built, the question arises as to where to put it. For example, when the people of a town decide to build a new shopping center, should they build it on natural land such as forest, wetland, or prairie or on land that is used as cropland? The decision is never easy and a PLANNING COMMISSION is usually formed to settle the question. In making a decision, the COMMISSION considers the interests of everyone that may be affected by the decision. For example, if cropland is involved, the COMMISSION listens to farmers who are usually reluctant to lose cropland. And if natural land is involved, the COMMISSION listens to outdoor people (including hikers, campers, hunters, and naturalists) who usually do not wish to lose acres of forest, wetland or prairie. And even though, they cannot speak for themselves, the COMMISSION considers the needs of plants and animals who depend on natural lands as places to find shelter and food and to reproduce and raise their young. No matter what kind of land is being considered for use, the COMMISSION studies the position of businesspeople who usually want the new development to be built near roads and business areas.

"This exercise is a class project that involves land use planning. As a class, we are asked to act as a PLANNING COMMISSION for ILNI TOWN, ILLINOIS. And as a PLANNING COMMISSION, we will plan the location of a new airport for ILNI TOWN. Since the land use planning process involves many steps, our class should follow STEPS 1-7 before we recommend the placement of a new airport for ILNI TOWN."

STEP ONE: FORMING A PLANNING COMMISSION (This step should be read aloud to the class by another student)

"To form a PLANNING COMMISSION, we as a class, should elect one student to the position of PLANNING CHAIRPERSON. The PLANNING CHAIRPERSON is responsible for making sure STEPS 2-7 are followed correctly. Once a PLANNING CHAIRPERSON is chosen, the CHAIRPERSON should divide our class into 5 groups. The CHAIRPERSON should then assign students in each of those groups to represent the 5 special-interest groups that make up the PLANNING COMMISSION. Those groups are the following: FARMERS, TREE FARMERS, PLANTS/ANIMALS, BUSINESSPEOPLE, OUTDOORSPEOPLE. Each student in those 5 groups should make a name tag that says which group he or she belongs to. Each student should pin that name tag on his or her shirt or blouse." (After a CHAIRPERSON and the 5 special-interest groups have been formed the Planning Commission will be complete, and the class can move to STEP TWO.)

STEP TWO: APPOINTING SPECIAL-INTEREST GROUP SPOKESPERSONS (Read aloud by CHAIRPERSON)

"It is my first duty as PLANNING CHAIRPERSON to appoint a spokesperson for each of the special-interest groups." (Chairman should appoint 5 spokespersons and class should move to STEP THREE).

STEP THREE: LOOKING AT THE NEEDS OF THE SPECIAL-INTEREST GROUPS (Read aloud by PLANNING CHAIRPERSON)

"It is now time for our class as the PLANNING COMMISSION for ILNI TOWN, to look at the needs of the special-interest groups. I ask now that the spokesperson for each group present to the Commission the special interests of her or his group."

FARMERS: (Read aloud by Spokesperson for FARMERS)

"The FARMERS do not want the airport to be built on or near cropland. If it is built on cropland, we will lose more of the land that supplies us all with food. If it is built near cropland, there will be more traffic, noise and air pollution, vandalism and littering on boundaries of the cropland."

BUSINESSPEOPLE: (Read Spokesperson for BUSINESSPEOPLE)

"We want the airport to be built near a major road. We also want the airport to be near either the downtown area or the shopping mall. Since the townspeople will have to pay for the airport, we feel the airport should be built on land that can be purchased for the lowest price. The Businesspeople want what is best for the businesses and the overall economy of ILNI TOWN."

OUTDOORSPEOPLE: (Read Spokesperson for OUTDOORSPEOPLE)

"We are a group made up of everyone who enjoys natural land. We are hunters, fishermen, wildlife photographers, cross-country skiers, hikers, and campers. And we are naturalists who enjoy natural areas as places to simply watch and study nature. We do not want the airport to be built in or near a natural land area. We feel that the airport would take up too much natural land and we don't have much natural land to spare."

TREE FARMERS: (Read Spokesperson for TREE FARMERS)

"The TREE FARMERS do not want the airport to be built on forestland that is harvested to produce the wood we all depend upon. If the airport is built in a tree farm, there will be less trees for plants and animals and less trees to harvest to make lumber to build houses, schools and furniture."

PLANTS/ANIMALS: (Read Spokesperson for PLANTS/ANIMALS)

"We represent a group that cannot tell us what they want but we know that plants and animals need a natural place to live where they can find food and shelter. Therefore, we do not want the airport to be built in or near a natural habitat. The construction, traffic, air and noise pollution of an airport might destroy the habitat for plants and drive many animals from their natural homes."

(After the spokesperson for each group has presented the interests of his or her group, the class should move to STEP FOUR)

STEP FOUR: STUDYING THE LOCATION—OPTIONS (Read aloud by PLANNING CHAIRPERSON)

"Now that the Commission has heard the needs of the 5 special-interest groups, it is time to study the 4 Location Options for the new airport. I will read a description of each location as well as the advantages and disadvantages of placing the airport at that location. As I read the description of each location, each member of the Commission should look at the location on the map of ILNI TOWN."

LOCATION 1 is a 500 acre forest park. An acre of LOCATION 1 would sell for $2,500.00 an acre. The forest park is a natural habitat for many forest plants and animals, including several "endangered and threatened" species including goldenseal, ginseng, bobcat and Cooper's hawk. The forest park is open to many forms of outdoor recreation including camping, hiking and nature study. The forest preserve is also..."
This map of ILNI TOWN shows the 4 Location-Options for the new airport. The actual placement of the airport at each location is shown by this symbol. An estimated total of 80 acres is needed for the new airport.

LOCATION 1: LOCATION 1 is a 500 acre Forest Park. The airport would be close to a major road and the downtown area. ADVANTAGE: The land could be purchased for the lowest price. The airport would be near a major road and close to the shopping mall. DISADVANTAGE: The construction, increase in traffic, noise and air pollution, vandalism and littering could disturb the forest ecosystem within the Nature Preserve.

LOCATION 2: LOCATION 2 is a 2,000 acre tract of cropland. An acre of LOCATION 2 would sell for $4,000.00. LOCATION 2 is farmed by area farmers and produces part of the food supply for ILNI TOWN and the state of Illinois. ADVANTAGE: A new major road would have to be cleared if the airport is built in LOCATION 2. DISADVANTAGE: A new major road would have to be built to connect the new airport with the existing major road. Cropland would be lost and less food would be produced from LOCATION 2.

LOCATION 3: LOCATION 3 is an old field that borders directly onto a Forest Nature Preserve. The old field is abandoned and would sell at a rate of $1,500.00 an acre. The Forest Nature Preserve is a unique forest since it has oak, hickory and walnut trees that are several hundred years old. There is a unique abundance of wildflowers such as harbinger of spring, and dutchman’s breeches and animals such as piliated woodpecker, gray fox and eastern chipmunk. ADVANTAGE: The land could be purchased for a low price. The airport would be near a major road and close to the shopping mall. DISADVANTAGE: The construction, increase in traffic, noise and air pollution, vandalism and littering could disturb the forest ecosystem within the Nature Preserve.

LOCATION 4: LOCATION 4 is a 300 acre Tree Farm. An acre of the tree farm would sell for $4,000.00 an acre. The tree farm produces a large amount of oak and walnut lumber each year for use by the townspeople and by area farmers and produces part of the state of Illinois. ADVANTAGE: The airport would be close to a major road and the downtown area. DISADVANTAGE: Approximately half of the Tree Farm (150 acres) would have to be cleared to make room for the airport, a road, and proper runway clearance. The natural habitat for plants and animals would be harmed, and the opportunities provided for outdoorspeople would be cut in half. The Tree Farm would produce only half or less of the amount of lumber it produces now. 
(After the 4 Location-Options have been reviewed, the class should move to STEP FIVE)

STEP FIVE: PREPARING RECOMMENDATIONS (Read aloud by PLANNING CHAIRPERSON)

"As PLANNING CHAIRPERSON, I now ask that each special-interest group meet by themselves and prepare a RECOMMENDATION FORM for the placement of the airport. The Spokesperson of each group is in charge of making sure that the members of his or her group discuss the 4 location-options thoroughly before a RECOMMENDATION FORM is drawn up.

(The 5 special-interest groups should meet by themselves to discuss the location-options and prepare a RECOMMENDATION FORM. Once all of the RECOMMENDATION FORMS have been turned into the Chairperson, the class should move to STEP SIX).

STEP SIX: STUDYING THE RECOMMENDATION FORMS (Read aloud by CHAIRPERSON)

"It is time now for the PLANNING COMMISSION to study the RECOMMENDATION FORMS submitted by the five special-interest groups. To do that, I would like to ask the spokesperson for each group to present the RECOMMENDATION FORM of his or her group to the Commission.

(The Spokesperson for each group should stand before the class and orally present the RECOMMENDATION FORM of his or her group to the class. The spokesperson should explain how his or her own group feels about the placement of the airport at each of the location-options. At the end of the presentation, the spokesperson should explain to the class which location-option his or her group chose as the site for the new airport and why. After all of the RECOMMENDATION FORMS have been prepared, the class should move to STEP SEVEN.)

-STEP SEVEN: MAKING A FINAL DECISION. (Read aloud by CHAIRPERSON)

Now that the PLANNING COMMISSION has heard the Recommendations of the five special-interest groups, it is time for the COMMISSION to make a final recommendation. I ask now for all of the students to take off their name tags. They should no longer think of themselves as members of a special-interest group but rather as individual members of the Planning Commission. The members of the Commission will now vote on the five RECOMMENDATION FORMS submitted by the special-interest groups. Students should vote for their own preference and not necessarily for the choice of their special-interest group. The RECOMMENDATION FORM that receives the most votes will become the final recommendation of this Commission for the placement of a new airport for ILNI TOWN.

(After the vote has been taken and one RECOMMENDATION FORM has been chosen, the CHAIRPERSON should announce the choice to the class and circle the location on the map.)

RECOMMENDATION FORM

1. Name of Town:

2. Type of project being planned for:

3. Reasons why project should be built:

4. Total acreage project will require:

5. Name of Special Interest Group Preparing This Recommendation:

6. The special concerns of this group concerning the project. (List here what your group wants in relation to the placement of the new airport. You may wish to review your group's statement in STEP 3).

7. Evaluation of Location-Options. (Write a description of each location, including the type of land, total acres and what the land is currently used for. Then list the advantages and disadvantages of placing the airport at each location).

   LOCATION 1: Description:
   Advantage:
   Disadvantage:

   LOCATION 2: Description:
   Advantage:
   Disadvantage:

   LOCATION 3: Description:
   Advantage:
   Disadvantage:

   LOCATION 4: Description:
   Advantage:
   Disadvantage:

8. Final Recommendation (Write here the final recommendation of your group for the placement of the airport. Be sure to state why this location is the best choice.)