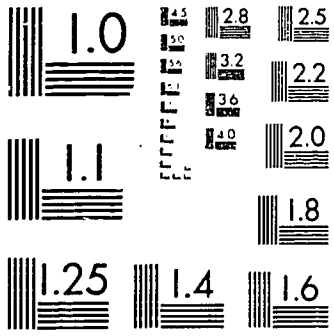

DOCUMENT RESUME

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IDENTIFIERS	*OBIS Program; Outdoor Biology Instructional Strategies

ABSTRACT

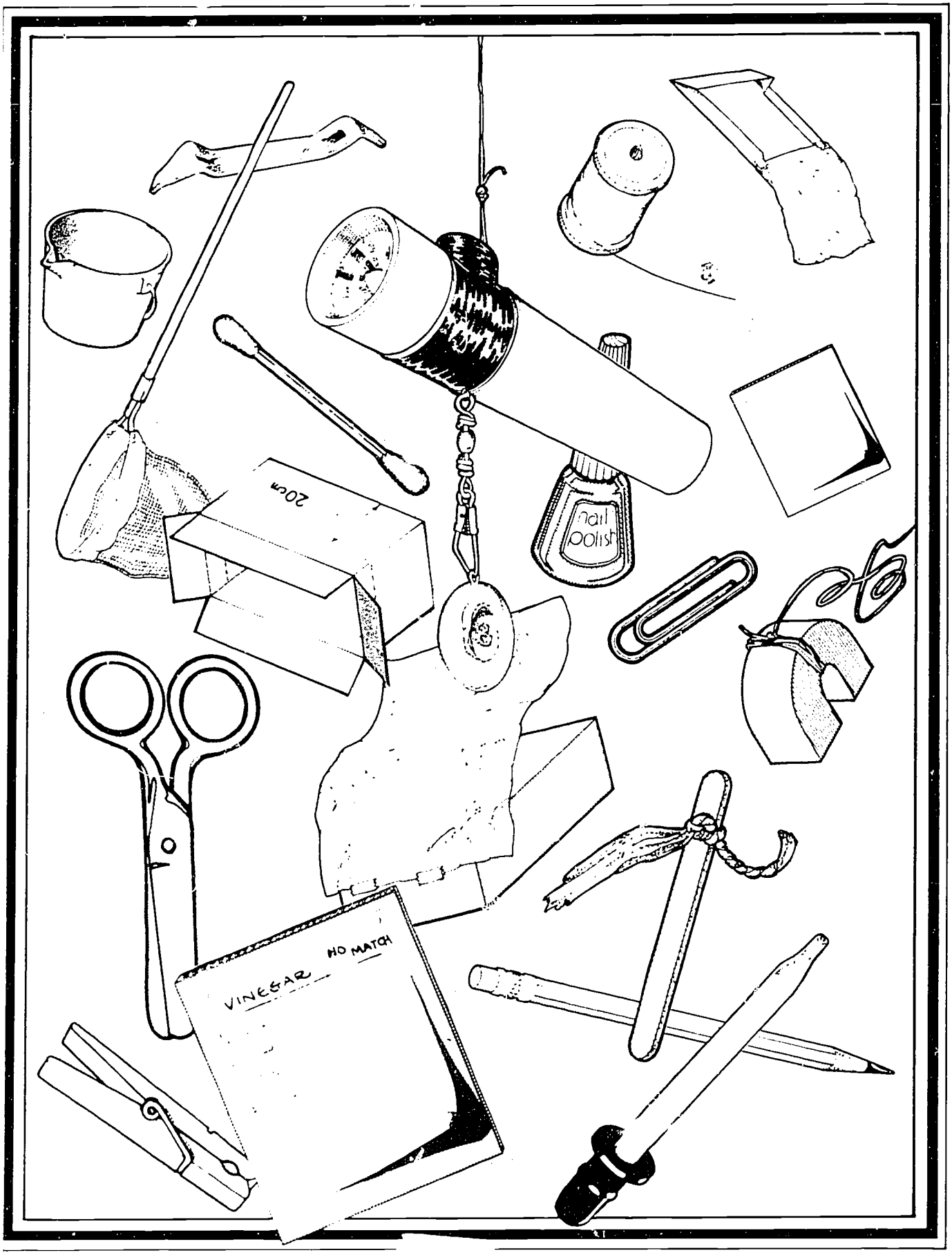
Eight games are included in the 24 activities in the Outdoor Biology Instructional Strategies (OBIS) Trial Edition Set IV. There are also simulations, crafts, biological techniques, and organism investigations focusing on animal and plant life in the forest, desert, and snow. Designed for small groups of children ages 10 to 15 from schools and community youth organizations, the activities include the study of squirrel food-storage strategies, desert plants, vines, damselfly and dragonfly populations, hopping animals, tree growth, soil differences, and plants that can live in the snow. These strategies for outdoor learning experiences are individually packed in folios that include pertinent biological concepts, materials lists, preparation, action, follow up and a list of related activities. Also included in the Set are a guide to OBIS; a "Leader's Survival Kit" with ideas for safety, conservation, and site selection, as well as suggestions for combining activities from Sets I, II, III, and IV into concept and skill modules; and a "Leader's Tool Box" describing certain biological techniques and detailing the building and use of home-made equipment such as thermometer dip-sticks, pollen boards, and desert leaf models. (SB)

OBIS
TRIAL EDITION, SET IV

Outdoor
Biology
Instructional
Strategies

Lawrence Hall of Science
University of California
Berkeley, California
94720

No. 901 G.


nail polish
VINEGAR
NO MATCH

EQUIPMENT AND TECHNIQUE CARDS

There are an assortment of equipment and technique cards inserted in this folio. These cards give you instructions for building and using various pieces of equipment required for certain activities. This folio contains only one copy of each card. You may make additional copies without infringing on the copyright. The following activities require these equipment and technique cards:

Bird Nests
Bird-Nest Frame

Desert Water Keepers
Desert Leaf Models

Flower Powder
Pollen Collectors

Hopper Herding
Hopper Herding with a Plastic Corral

Sawing Away
Counting Growth Rings and How a Tree Grows

Wintergreen
Making a Light Reading
Thermometer Dip-Stick

BASIC EQUIPMENT, AIDS, GUIDES

DATA BOARD

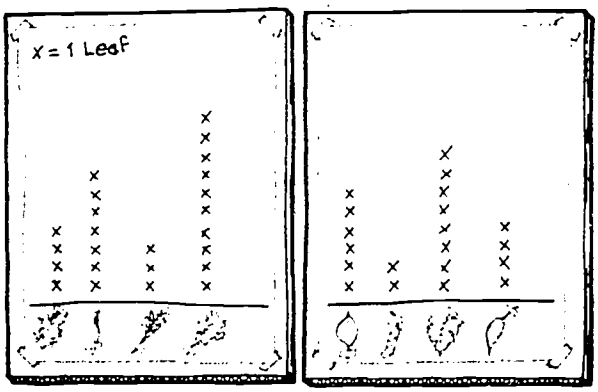
Many OBIS activities call for the use of a data board. This board serves as a portable chalkboard, record board, map, and all-purpose data organizer. Because your participants probably will not have a desk or locker for storage of records from one investigation to the next, a data board allows you to maintain a continuing record. The data board relieves youngsters of the burden of pencils and notebooks. Important terms can be viewed easily by all group members, and field observations are conveniently displayed in one place for group consideration.

Making a Data Board*

1. Find a piece of thick cardboard, masonite, or fiberboard about 80 cm x 60 cm.

2. Cut paper (butcher or other) to the size of the board. Attach the pieces of paper to the board with binder clips or masking tape.
3. Crayons or felt-tip markers are good for recording data because they leave broad marks and come in a variety of colors, allowing for easy color coding.

*As an alternative, you can use a large sketch pad or small chalkboard.



MATERIALS

Gathering materials and making equipment can be an interesting experience for your group before conducting an activity. When possible, let your group assist you with the gathering of materials. Often the youngsters can bring items such as empty milk cartons, plastic bags, egg cartons, juice cans and the like from home.

Bird Nests

Equipment Card
BIRD-NEST FRAME

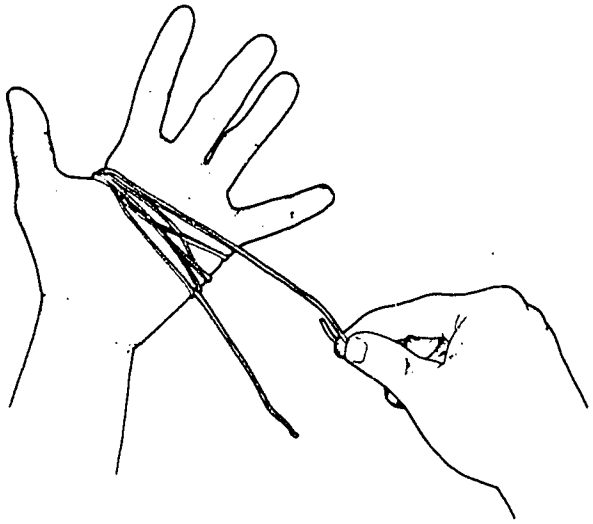
MATERIALS

1 two-meter length of thin wire for each participant (aluminum works best)
1 pair of scissors

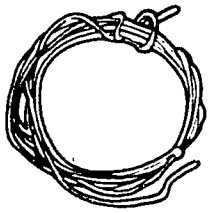
MAKING THE FRAMES FOR THE YOUNGSTERS:

1. Cut 1 two-meter length of wire for each participant.

2. Coil each wire into a circle approximately seven centimeters in diameter. One way to make the circle is to coil the wire around your hand.

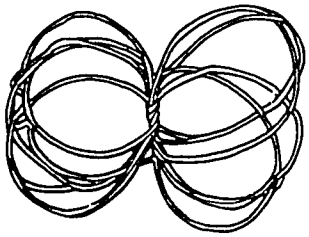


3. Take one loose end of the coiled wire and wrap it tightly around the coil three or four times.

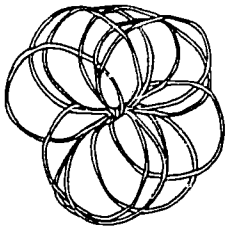


MOLDING THE FRAME (INSTRUCTIONS FOR THE PARTICIPANTS):

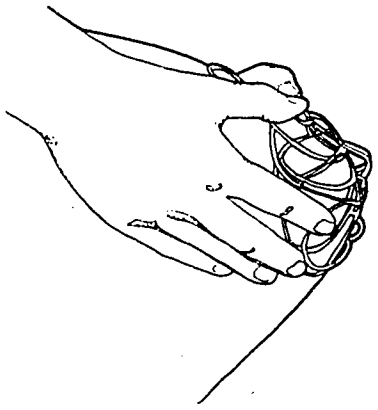
1. Separate the coil into two circles, forming a figure eight.



2. Spread the coils out into a flat flower shape.



3. The frame can then be molded into a nest shape by pressing it against a bent knee or the toe of a shoe.



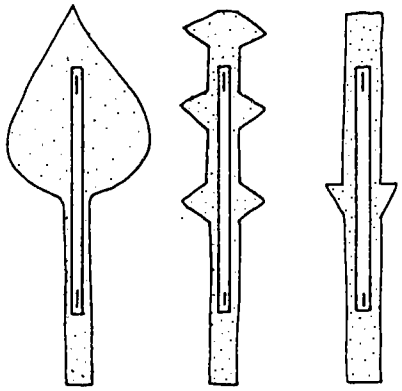
4. Materials can now be woven into or molded on the frame.

Desert Water Keepers
Technique Card
DESERT LEAF MODELS

MODEL LEAVES

Materials for each team:
2 paper towels
6 coffee stirrers
• stapler

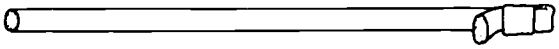
Making the Model Leaves (instructions for the leader):
1. Trace the leaf patterns onto a paper towel.
2. Cut out the paper-towel leaves.
3. Staple a plastic coffee stirrer along the center line of the paper leaf to provide support.



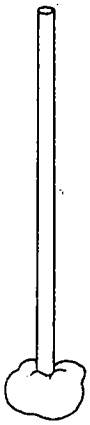
LEAF HOLDERS

Materials for each team:
1 drinking straw
1 ball of clay
• tape

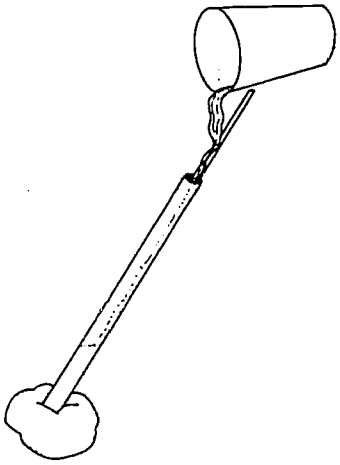
Making and Filling the Leaf Holders (instructions for the youngsters):
1. Crimp the drinking straw three centimeters from one end.
2. Squeeze the "V" parts together and tape tightly.



3. Place the taped end of the straw into the clay ball so that the straw stands upright.

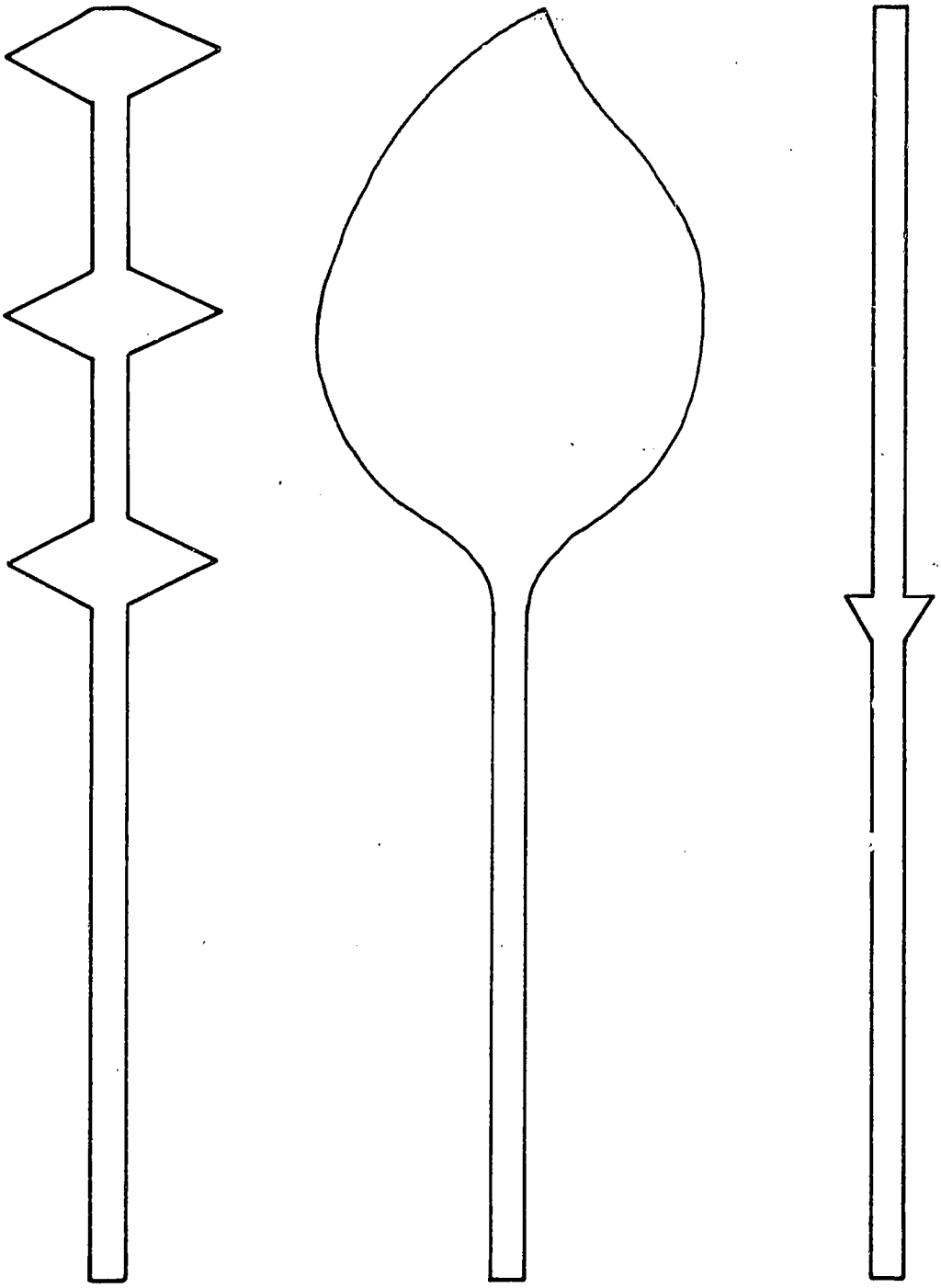


4. To fill the holder, place the extra coffee stirrer part way into the straw and carefully pour the blue water into the straw. The coffee stirrer prevents air bubbles from blocking the straw.



Desert Water Keepers

DESERT LEAF PATTERNS



Flower Powder
Equipment Card
POLLEN COLLECTORS

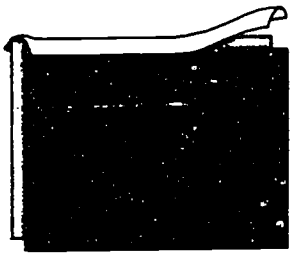
POLLEN BOARD

MATERIALS FOR ONE BOARD:

1 piece of cardboard, 10 cm x 15 cm
1 piece of black velveteen or corduroy, 10 cm x 15 cm
- masking tape

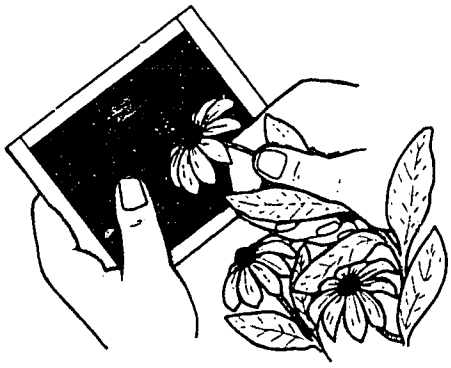
TO MAKE THE POLLEN BOARD:

1. Place the black material on top of the cardboard.
2. Cover the edges of the cardboard and material with masking tape.



TO USE THE POLLEN BOARD:

1. Grasp a flower gently by its stem.
2. Hold the pollen board in your other hand, and gently rub or press the flower against the board. Do not smash or pick the flower.



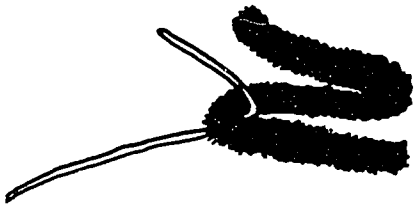
ARTIFICIAL BEE

MATERIALS FOR ONE BEE:

1 4-6 cm piece of black pipe cleaner (called "chenille" at craft and hobby stores)
1 20-cm length of thin wire
- white paper
- black felt pen
- rubber cement

TO MAKE THE BEE:

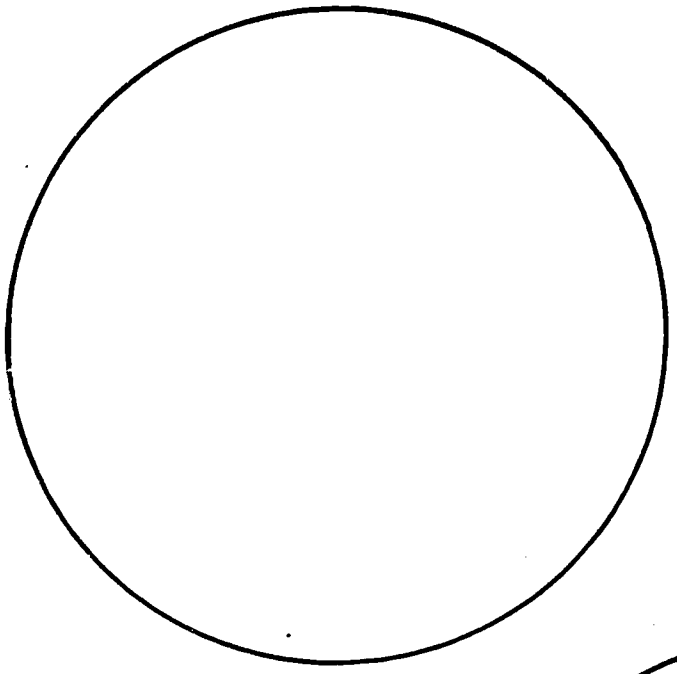
1. Bend the pipe cleaner into thirds to form a "Z" shape. Flatten the shape.

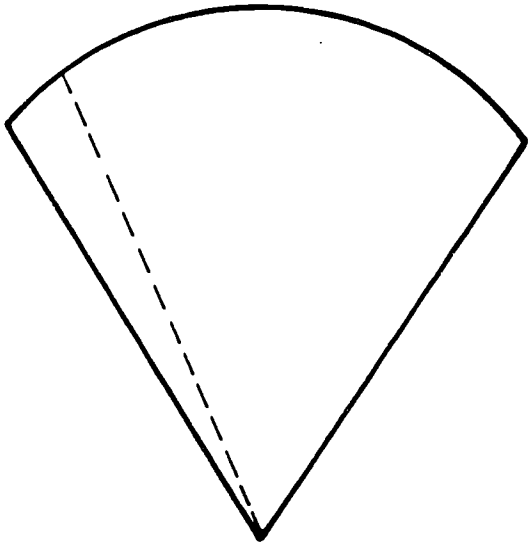


2. Take the thin wire and thread it through one of the loops formed in the flattened pipe cleaner. Twist the wire together and then wrap it around the end of the pipe cleaner.

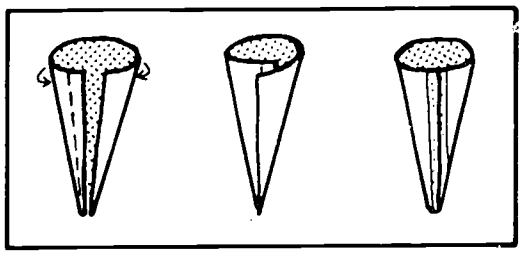
3. Cut out a tiny piece of paper this big □. Make two dots on it with the pen and glue the "eyes" to the end opposite the wire.

Flower Powder
SHAPES





OVERLAP EDGE
TO DOTTED LINE



Hopper Herding
Technique Card
HOPPER HERDING WITH A PLASTIC CORRAL

Using the Plastic Corral

1. Each member of a team takes an edge of the outstretched sheet.
2. The team walks through the grass and then pulls the sheet down onto the grass quickly, trapping all the critters below.

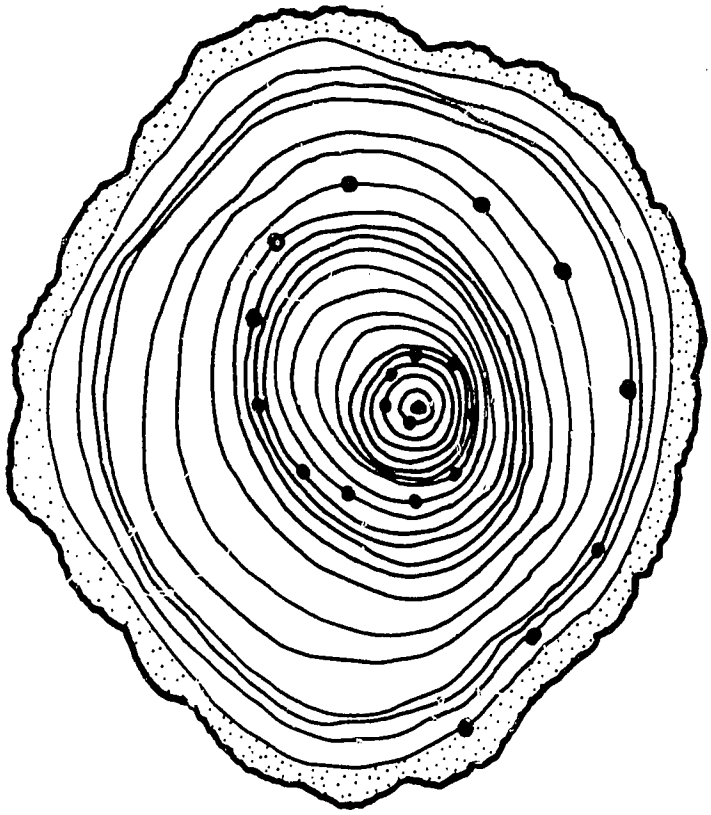
"Bagging" a Hopper

1. One person surrounds the hopper with his hands *over* the plastic sheet.
2. Another person reaches *under* the plastic, grabs the trapped hopper, and places it in a ziplock bag.
3. If the youngsters don't want to handle the hoppers, they can use the plastic bag to scoop the hoppers up. (Hoppers rarely bite. They may, however, "spit" a harmless brown juice.)
4. Sealed hopper bags must be shaded from direct sunlight.

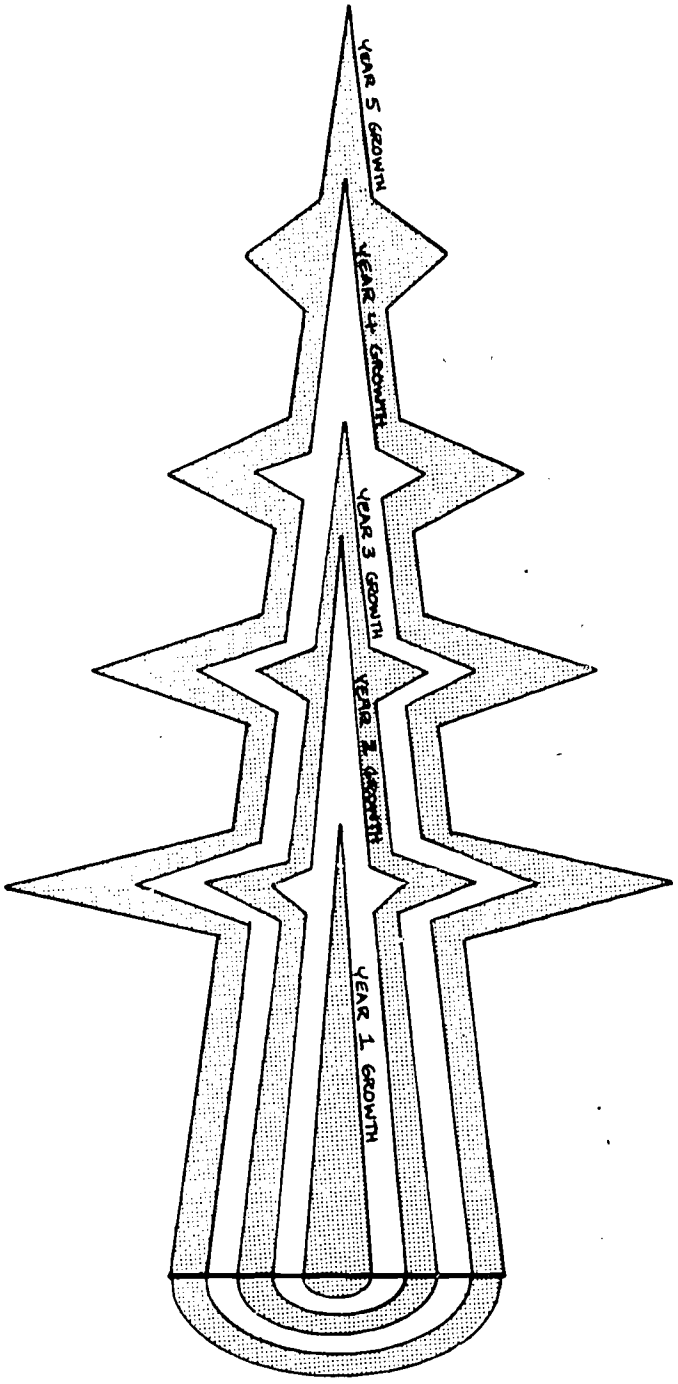
Sawing Away

Technique Card

COUNTING GROWTH RINGS



HOW A TREE GROWS



Wintergreen

MAKING A LIGHT READING
Technique Card

You can use photographic proof paper to measure light intensity. The emulsion-coated (glossy) side of the paper is sensitive to light. A piece of white proof paper turns dark brown when exposed to direct sunlight for about ten minutes, light brown when exposed to moderate light, and light tan to white when exposed to very little light. You can halt the color change by dipping the paper into photographic hypo (fixing solution) for a few seconds and then washing the paper in clear water for a few seconds. Proof paper is insensitive enough to allow for small time delays as well as exposure errors.

MATERIALS FOR ONE PACKET

1 8½" x 11" piece of black construction paper
3 standard sized letter envelopes (3½" x 6½", preferably brown).
9 strips of proof paper, 2 cm x 6 cm
- tape or staples

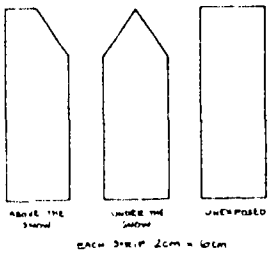
1 paper clip
1 small jar
- photographic hypo crystals
- water

MAKING THE PACKET

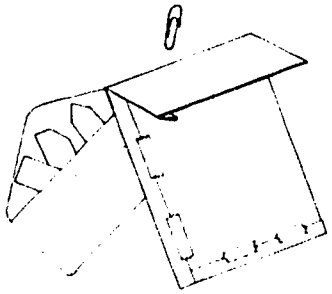
1. Fold the black construction paper in half to form an 8½" x 5½" packet.
2. Fold over one centimeter of one short side and one centimeter of the long open side.
3. Staple or tape the folded edges to make light-proof seams.
4. Fold over a four centimeter flap at the remaining open end, and secure the flap with a paper clip.

PREPARING THE PROOF PAPER

1. *Be careful not to expose the proof paper to direct sunlight.* Cut the sheets of proof paper into 2 cm x 6 cm strips. (One 8" x 10" sheet makes forty strips.) Make sure you have nine strips for each team.
2. Divide the strips into three equal piles. Cut one corner off the strips in one pile. Cut two corners (making a point) off the strips in the second pile. Don't cut the strips in the third pile.
3. The strips are now keyed by shape for use in different locations. Have the kids use each shape in the locations shown in the illustration.



4. Put one strip from each pile into each envelope, and place two envelopes in the black packet. Make a black packet for each team.
5. Put the extra envelopes into your packet to use for the demonstration and for spares.

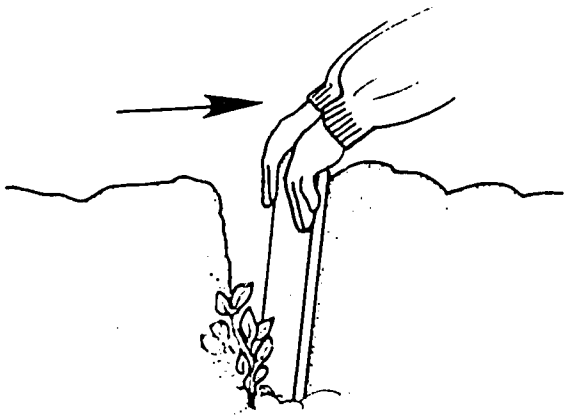


PREPARING THE FIXING SOLUTION

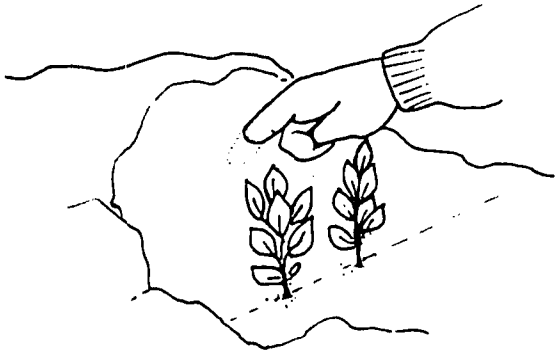
1. In the small jar, combine one tablespoon of photographic hypo crystals in one cup of water.
2. Prepare a jar for each team.

MAKING A LIGHT READING

1. Push a piece of cardboard straight down through the snow next to a green plant. Pull the cardboard horizontally away from the plant to expose it.



2. Make a little cavity with your finger in the snow at the level of the green leaves. The cavity must be large enough to hold the proof paper strip.



3. The uncut strip remains unexposed. Use the pointed strip under the snow and the one-corner-cut strip above the snow.

4. Quickly place one strip on top of the snow and one in the little cavity. Make sure the glossy sides are up. One team member seals off the cavity by holding the cardboard *tightly* against the opening during the exposure period.

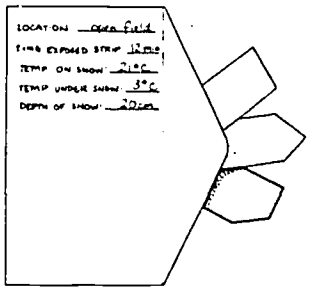
5. Leave the strips in place for at least ten minutes (or longer if the surface strip has not yet turned dark brown).

6. The other team member fixes the unexposed strip by:
   a. placing it in the hypo solution for one minute, and then
   b. rinsing it with water.

7. At the end of the exposure time, fix the other two strips in the same manner.

8. With the ruler, measure the depth of the snow from the surface to the cavity.

9. Record the data on the envelope. Let the strips dry as much as possible and then put them into the envelope.



Wintergreen

THERMOMETER DIP-STICK
Equipment Card

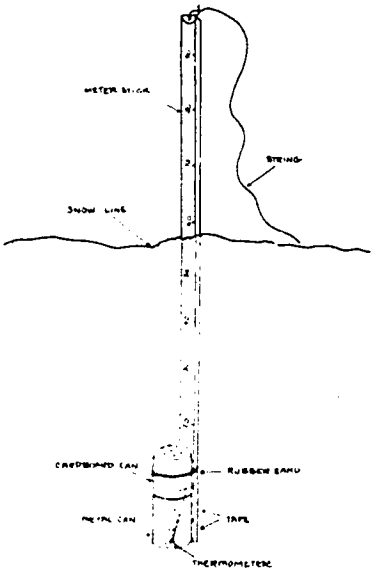
MATERIALS FOR ONE DIP-STICK

1 meter stick
1 roll of plastic electrician's or shipping tape
1 six-ounce metal juice can
1 six-ounce cardboard juice can
1 one-meter length of brightly colored string
1 Celsius thermometer
1 rubber band

MAKING A THERMOMETER DIP-STICK

1. Remove the tops from both juice cans.
2. Poke four to six holes in the bottoms of the cans.
3. Tape the metal can with two bands of the plastic tape to the zero end of the meter stick. The bottom of the can should be even with "0."
4. Cut a slit half way down the side of the cardboard can.
5. Overlap the edges of the slit so that the open top of the cardboard can fits into the open top of the metal can.

6. Loop the rubber band several times around the stick, and then slide the rubber band down over the cardboard can to secure the can to the stick, thus forming a sliding lid for the metal can.
7. Tie a string through the hole in the 100-cm end of the meter stick.
8. Place the thermometer, bulb end down, into the metal can and slip the cardboard can down over it.
9. Your dip-stick is ready to use.



USING THE THERMOMETER DIP-STICK

1. For best results, leave the prepared dip-stick outside or in a cool place for thirty minutes before using it.
2. Poke the 100-cm end of the meter stick into the snow to the depth at which you want to measure the temperature. Rotate the stick to enlarge the hole.
3. Remove the meter stick and turn it can-side down. Push the can (with the thermometer inside) into the snow to the desired depth. Fill the hole with snow.
4. Read the depth of the thermometer in the snow from the meter stick (the number at the surface).
5. Wait fifteen minutes.
6. Pull the stick out of the snow.
7. Quickly open the thermometer case and read the temperature from the thermometer.

LAWN GUIDE

POND GUIDE

USING THE OBIS FOLIOS

OBIS activities are intended primarily for youngsters between the ages of ten and fifteen, but have been used successfully with both older and younger people, including family groups. With some training, older youngsters can lead the activities for small groups of younger children.

Each OBIS folio can provide an enjoyable and interesting outdoor experience. You may either select individual folios for inclusion in your existing environmental program, or combine a number of folios to form a module that provides a broader experience in outdoor biology. You are the only person who can determine how the OBIS activities will best meet the needs of your group at your site.

Look at the section entitled "Currently Available OBIS Folios." You will find a list of all the activities in **OBIS Trial Edition Sets I, II, III, IV,** and **The OBIS Trail Module,** and the sites in which each activity works best. By combining activities from the four sets and the module, your ability to tailor the program to the needs of your participants increases.

CURRENTLY AVAILABLE OBIS FOLIOS

OBIS TRIAL EDITION SET I

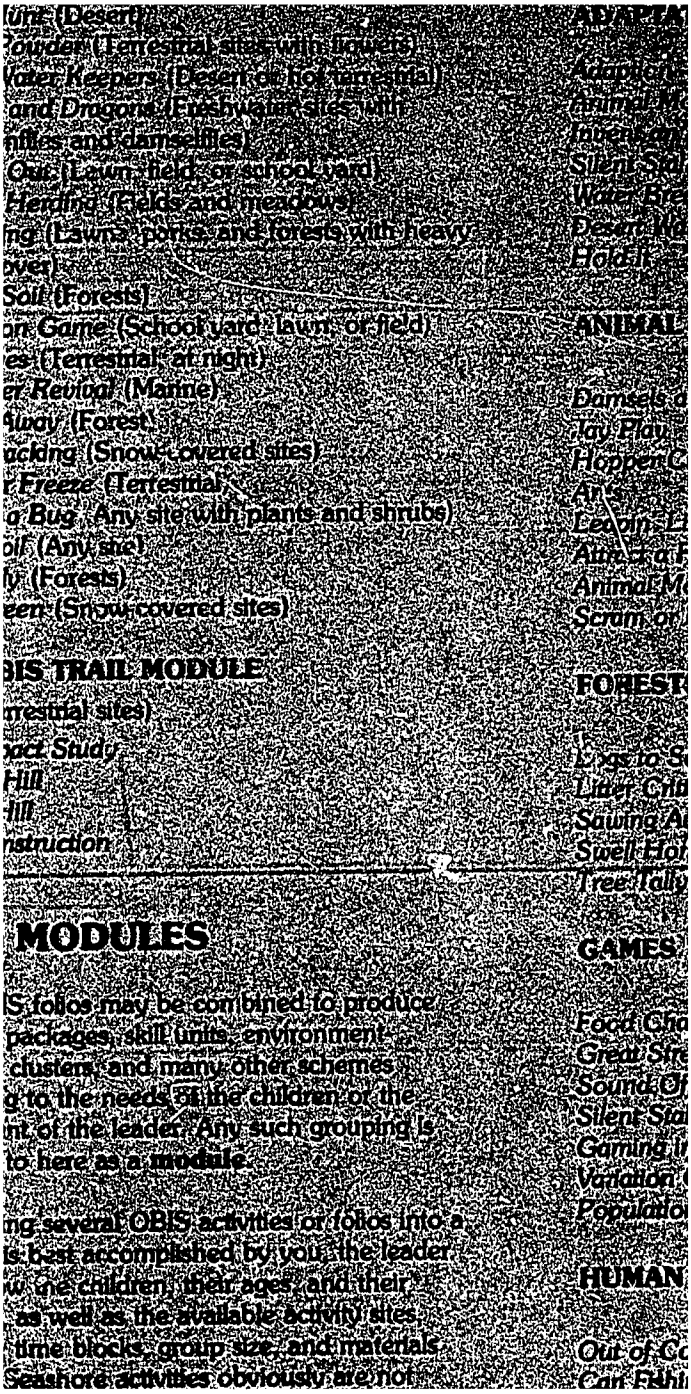
Adaptation — Predator-Prey (Any site)
Animal Movement in Water (Marine or freshwater)
Animals in a Grassland (Lawns, meadows, fields, and vacant lots)
Attention! (Any site)
Bean Bugs (Lawns, meadows, and parks)
Great Streamboat Race (Creeks and streams)
Habitat Sun Prints (Any site)
Habitats of the Pond (Ponds and lakes)
How Many Organisms Live Here? (Ponds, lakes, bays, and estuaries)
Invent an Animal (Any site)
Invent a Plant (Any site)
Mapping a Study Site (Any site)
Moisture Makers (Terrestrial, with a variety of plants)
Natural Recycling in Soil (Terrestrial)
Natural Recycling in Water (Marine or freshwater)
Out of Control (Lawn)
Plant Hunt (Terrestrial)
Plants Around a Building (Building sites)
Seed Dispersal (Any site)
Sticklers (Terrestrial)
Terrestrial Hi-Lo Hunt (Terrestrial)
Water Holes to Mini-Ponds (Any site)
What Lives Here? (Marine or freshwater)
Who Goes There? (Terrestrial, at night)

OBIS TRIAL EDITION SET II

A Better Fly Trap (Warm terrestrial)
Animal Anti-Freeze (Cold terrestrial)
Animal Diversity (Lawns, meadows, fields, and vacant lots)
Attract a Fish (Freshwater)
Beach Zonation (Marine)
Birdfeeder (Any site)
Crawdad Grab (Marine or freshwater)
Flocking to Food (Bay or estuary beaches)
Food Chain Game (Lawn or field)
Gaming in the Outdoors (Terrestrial)
Hopper Circus (Beach, pond, or field)
Lichen Looking (Terrestrial sites with lichens)
Litter Critters (Woodland site with natural litter)
Metric Capers (Any site)
OBIS Oil Spill (Marine or freshwater)
Plant Patterns (Terrestrial)
Rock Pioneers (Rocky, marine beach)
Roots and Shoots (Terrestrial)
Seas in Motion (Sandy beach)
Sensory Hi-Lo Hunt (Terrestrial)
Sound Off! (Lawn or field)
The Old White Sheet Trick (Any site, at night)
Too Many Mosquitoes (Freshwater pond)
Water Breathers (Marine or freshwater)

OBIS TRIAL EDITION SET III

Ants (Terrestrial)
Beachcombing (Sandy beach)
Can Fishing (Freshwater)
Clam Hooping (Bay or estuary)
Enviroiopes (Any site)
Fly a Leaf (Terrestrial, windy day)
Follow the Scent (Lawns)
For the Birds (Urban parks or shoreline)
Hold It (Creeks and streams)
Isopods (Terrestrial)
Jay Play (Parks and gardens)
Junk-in-the-Box (Vacant lots, fields, and other sites containing man-made litter)
Leapin' Lizards (Terrestrial sites with lizards)
Mystery Marauders (Meadows, fields, and vegetable gardens)
Night Shine (Marine or freshwater, at night)
Pigment Puzzles (Any site with a variety of plants)
Shake It! (Terrestrial)
Silent Stalking (Terrestrial site with a noisy walking surface, possibly at night)
Swell Homes (Fields, forests, and meadows)
Variation Game (Lawns)
Water Snails (Freshwater)
Water Striders (Freshwater)
Web It (Terrestrial, possibly at night)
Web Weavers (Terrestrial)


(Desert)
(Terrestrial sites with loose)
Keepers (Desert or hot terrestrial)
Dragons (Freshwater sites with
and damselflies)
(Lawn, field, or school yard)
(Fields and meadows)
(Lawns, parks, and forests with heavy
(Forests)
Game (Schoolyard, lawn, or field)
(Terrestrial at night)
Revival (Marine)
(Forest)
(Snow-covered sites)
Freeze (Terrestrial)
Bug (Any site with plants and shrubs)
(Any site)
(Forests)
(Snow-covered sites)
TRAIL MODULE
sites)
Study
MODULES
folios may be combined to produce
packages, skill units, environment
clusters, and many other schemes
to the needs of the children or the
of the leader. Any such grouping is
here as a module.
several OBIS activities or folios into a
best accomplished by you, the leader,
the children, their ages, and their
as well as the available activity sites,
time blocks, group size, and materials.
Seashore activities obviously are not

LEADER'S SURVIVAL KIT

Trial Edition
Set IV

Junk in the Box	III
OBIS Oil Spill	II
Tools and Mosquitoes	I
Plants Around a Building	I
Super Soil	IV
The OBIS Trail Module	

MARINE ACTIVITIES

	Set
Flocking to Food	II
Beachcombing	III
Seas in Motion	II
Animal Movement in Water	I
Water Breathers	II
Clam Flooping	III
OBIS Oil Spill	II
Salt Water Revival	IV

NIGHTTIME

	Set
Who Goes There?	I
Sound Off!	II
Silent Stalking	III
The Old White Sheet Trick	II
Web It	III
Night Shine	III
Night Eyes	IV

WINTER

	Set
Animal Anti-Freeze	II
Scent Tracking	IV
Wintergreen	IV

SAFETY

The safety of your group is a prime consideration. In order to assure safety, OBIS designs equipment and procedures to be as safe as possible. In addition, OBIS recommends that leaders organize a **Buddy Safety System** when participants explore an aquatic or other potentially hazardous site. As a precaution, you may wish to bring along a first-aid kit.

Buddy Safety System

The Buddy Safety System is designed to insure that no participant will ever be far from assistance should it be needed. Group members choose a buddy they would like to work with. For an odd-numbered group, organize one team of three buddies. When the youngsters are paired off, tell them that each individual is responsible at all times for the whereabouts and safety of his buddy. A participant should never leave his buddy unless his own safety is threatened. In the event of an accident to one buddy, the other should render assistance and call for help.

Other Hazards

Avoid aquatic sites with obvious hazards such as steep banks and slide areas. Look for a site with gently sloping banks for easy water access and unobstructed vision for easy supervision.

CONSERVATION — TAKE 'EM BACK ALIVE

Your youngsters should understand that no organism should be permanently removed from its habitat. OBIS users collect organisms temporarily for observation and investigation, but all should be returned to the place where they were found. (Leaf samples are an occasional exception.) The overall impact of your group on an activity site should be minimal. Setting some rules of procedure will help to emphasize respect for the activity-site environment.

SITE SELECTION

Make sure your selected site is large enough for everyone to investigate without interference, but small enough to allow easy supervision of the group. Site boundaries should be clearly marked and the participants kept within the boundaries.

Secure permission to use a site in advance if such permission is required. Familiarize yourself with any rules or procedures that apply to the use of the site. Some sites, particularly public nature areas, are protected by strict rules regarding interference with living organisms. Make sure the youngsters understand and follow the rules.

WHAT IS OBIS?

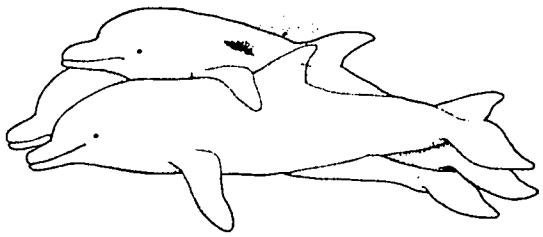
Start with a group of young people in the out-of-doors and a biological concept or process as the basic ingredients. Add a large measure of fun; stir in the discovery approach; and season with a simulation, a game, a craft, or an interesting investigation. Mix thoroughly and you have one of the 100 activities that have been developed by the Outdoor Biology Instructional Strategies (OBIS) Project.

OBIS provides community-sponsored youth organizations and schools with learning activities for use at common outdoor sites such as lawns, local parks, city lots, neighborhood streams and ponds, and the seashore. Although the activities are intended primarily for ten- to fifteen-year-old youngsters, both younger and older people (including family groups) have enjoyed OBIS activities. Their easy-to-follow format, simple preparation and equipment, and short duration (usually one hour) make OBIS activities suitable for both the experienced outdoor-education leader and the first timer with no previous experience in biology. The activities may be used independently or sequenced to create a program to suit your needs. Scouts, Park and Recreation districts, religious groups, service groups, nature centers, summer camps, and schools are a few of the groups that have used OBIS activities in their outdoor-education programs. OBIS activities help youngsters and adults to better understand and appreciate the ecological relationships in their local environment.

WHY OBIS?

Our relationship with our environment must improve. For too long we have considered ourselves independent of nature. We take what we want and change what does not suit our purposes. As we prosper, medicine and technology increase our chances of survival. The growing population of humanity uses an ever-increasing amount of the earth's resources. Until quite recently, we remained uninformed or indifferent to the effects of our increasing demands upon plants, animals, minerals, soil, air, and water. We have just begun to realize that we have reached a point where we can no longer ignore the ecosystem of which we are a part.

If we are to make intelligent decisions on factors that influence our environment, we must have a thorough understanding of basic biological relationships. The awareness and understanding that grow with each OBIS experience will create a base that youngsters can use in the future to make informed decisions on environmental issues. This is the long-term goal of OBIS.



IT'S A BIOLOGICAL WORLD

We offer here explanations of some of the major concepts embraced by OBIS activities.

We are part of the **ecosystem,** which includes living organisms and the non-living environment. Plants and animals, and their interactions with each other and their environment, all affect the ecosystem in some way. The study of the interactions between organisms and their environments is called **ecology.**

Food Chain

Energy input to the ecosystem comes from the sun. Through **photosynthesis,** plants transform the sun's light energy and the earth's materials into food. Animals cannot make food; they must obtain their food by eating plants or other animals that eat plants. The energy in the food is transferred from plants to plant eaters and then to animal eaters. This energy transfer is called a **food chain.**

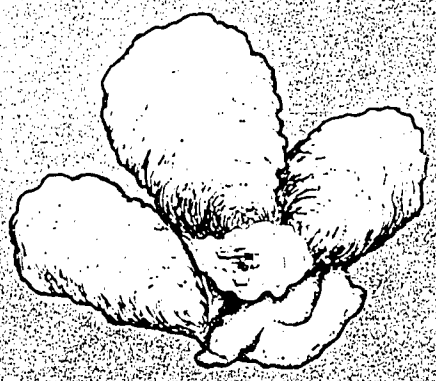
Natural Recycling

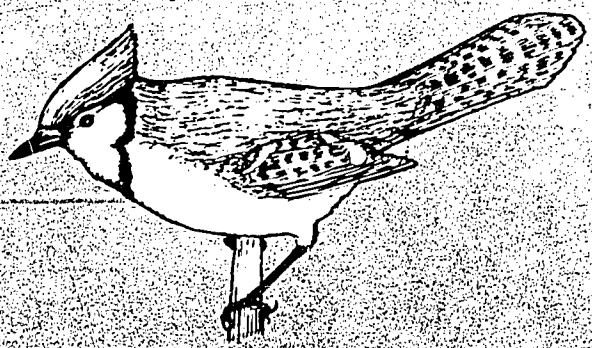
When organisms die, their bodies may be eaten by scavengers as diverse as worms and vultures. Plant and animal tissues not eaten by scavengers are consumed by molds, bacteria, and many kinds of small animals. In the process of obtaining food, these organisms decompose the dead organic matter and eventually reduce it to minerals, water, and carbon dioxide. These materials, returned to the soil, water, and atmosphere, can then be used again by plants to produce food.

Populations and Communities

Each group of organisms of the same kind, such as field mice, that lives and reproduces in a particular area is a **population.** Populations of organisms that live together and depend on each other for food and protection are referred to as a **community** of organisms.

Communities differ depending on their locations. The communities existing in different **physical environments** (oceans, tidepools, lakes, streams, meadows, prairies, deserts, and forests) all consist of different populations of plants and animals **(biological environment).** A pond community consists of different kinds of plants and animals adapted for living in a pond. The lawn that surrounds your house contains a community of plants and animals as does the city park or vacant lot. You do not have to travel long distances into the "wilds" to find natural communities.





Adaptation

Adaptations are features or behaviors that improve an organism's chances of surviving and reproducing in a particular environment. Some animals display color adaptations that allow them to blend into their surroundings, thus avoiding capture. Other adaptations improve the ability of plants and animals to secure food, to reproduce, and to defend themselves. The adaptations that an organism possesses also enable it to survive in certain environments.

An organism's **habitat** is the place where that organism normally lives and where you would ordinarily go to find it. A plant that can withstand high temperatures and a low-moisture environment might be found in an arid habitat like a desert. An animal that can extract oxygen from water, and can tolerate a wide temperature range might be expected to live in a shallow pond habitat.

If a habitat undergoes a radical change as a result of natural catastrophe (flood, fire, landslide, drought) or the intervention of man (land clearing, swamp draining, construction), the new environmental conditions may no longer support the varieties of life that were previously present. Many organisms will therefore die. Some plants and animals that existed in the old environment may already have features or characteristics (adaptations) that will allow them to exist in the new environment. Organisms previously unable to live in a certain habitat may **colonize** it because the environment of that habitat has changed. These first colonizers may not be adapted to compete with some of the organisms that follow later. Many fail and are replaced by still other organisms.

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Outdoor Biology Instructional Strategies

Life Cycle

Every species must reproduce in order to perpetuate its kind. The process by which an organism comes into being, matures, and reproduces is called the **life cycle**. Some life cycles are short, as in the case of a mosquito, which may go through its life cycle in a matter of a few days, while others are long, as in the case of some trees that take years to mature and reproduce.

Humans

One organism that influences every ecosystem is man. Humans have a technology which enables them to survive in a wide range of environments and to influence many other life forms. Because of man's special abilities, he must assume responsibility for the consequences of his actions.

It is clear that the time has come for worldwide adoption of sensible practices that will permit other populations of organisms to coexist with humans. OBIS provides one avenue for young people to develop this understanding.

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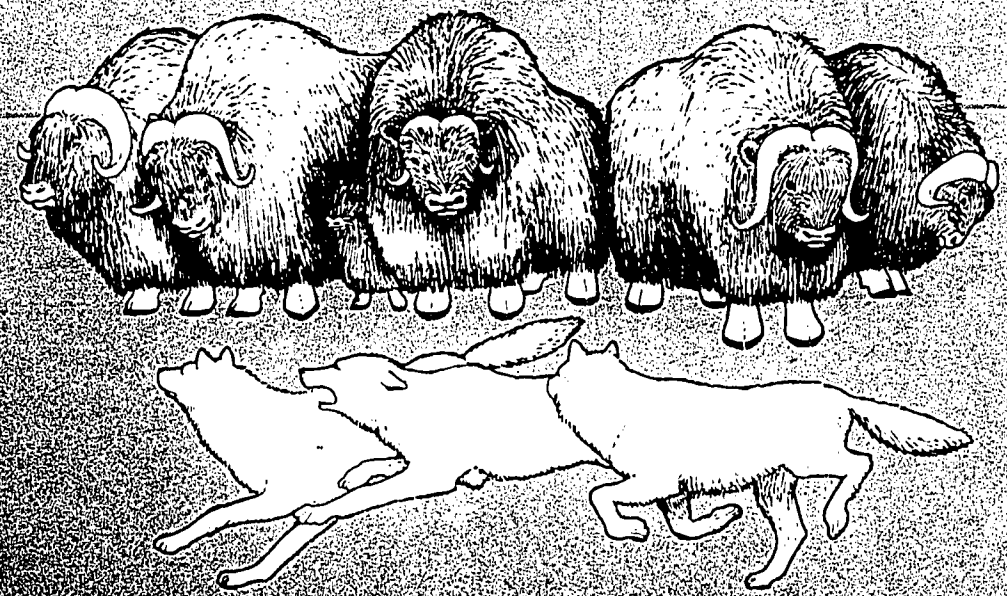


The pika, a small animal that lives high in the western mountains, insures its winter hay supply by collecting and allowing grasses and other plant materials to dry. The pika then stores the material in underground caches.

Chipmunks and squirrels are the

fox squirrels bury their food in many places in the ground. Jays are also winter residents that hide their food in many locations.

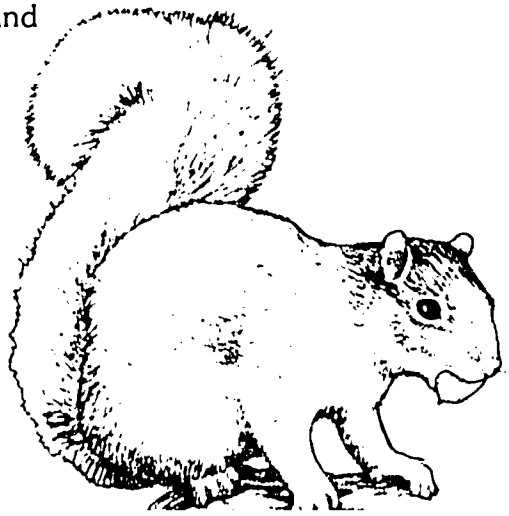
In *Acorns*, your youngsters find out some of the advantages and disadvantages of different ways of storing food by playing a game of winter survival.

CHALLENGE: STORE A SUPPLY OF NUTS AND THEN RECOVER ENOUGH NUTS TO SURVIVE THE WINTER.

MATERIALS

For each youngster:
20 nuts (See the "Preparation" section.)
1 plastic bag
1 marking device (See the "Preparation" section.)
1 3" x 5" index card or small piece of paper

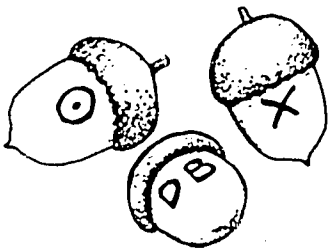
For the group:
4 boundary markers (flagging)
1 large brown paper bag
1 data board
1 marking pen
1 kitchen timer or watch with a second hand



PREPARATION

1. **Site.** Choose a site with plenty of acorns or other nuts and seeds. If such a site is not available, you may prepare an area by "seeding" it with nuts or seeds that you have obtained elsewhere. (Raw lima beans work well.) The site should be covered with a thick layer of leaves or snow. With the four flags, mark off an area about half the size of a tennis court.

2. **Marking devices.** Each youngster will mark his winter nut supply so that it can be distinguished from everyone else's. Fine-tip permanent-ink marking pens work well on light colored nuts or seeds. The youngsters can mark pieces of white adhesive tape and press them onto dark-colored nuts or seeds.



3. **Index cards.** Prepare a 3" x 5" index card for each youngster. Write "red squirrel" on half of the cards and "grey squirrel" on the remaining cards.

ACTION

1. Ask the kids if they can think of any animals that store food for the winter. What kind of food do these animals store? (For example: Chipmunks and squirrels store nuts and seeds.)

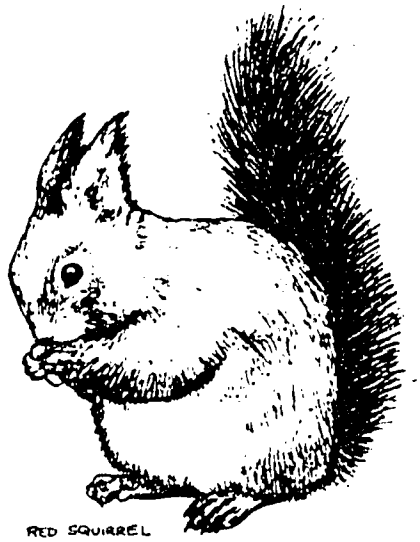
2. Tell the group that different animals have different ways of storing their winter food supply. Mention that red squirrels store all their food in one place and that grey squirrels hide their food in many places. Announce that each youngster is

squirrel or a grey squirrel in a game of winter survival. Let each youngster draw a labeled index card to determine what kind of squirrel he or she will be. Ask them to keep their identities secret. Tell the kids to remember what kind of squirrel they are, and then collect the cards.

3. Give one plastic bag to each of the "squirrels" and tell them that the bags represent their "cheek pouches" for carrying for

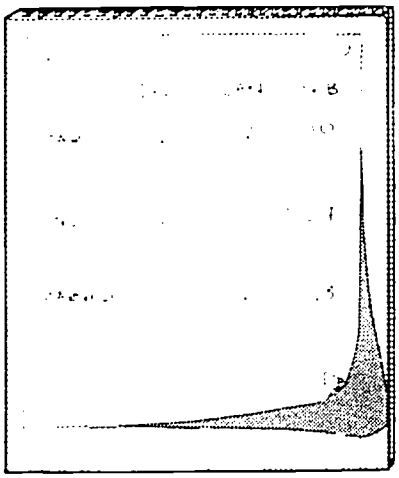
4. Now announce the arrival of fall. Tell the youngsters that it is time for the squirrels to gather their winter food supply. Show the "squirrels" an example of the kind of nut or seed you want them to collect. Point out the boundaries of the squirrel forest, and give the group two minutes to gather nuts. Each squirrel should collect at least ten nuts.

5. Call the group together, and ask each youngster to mark his winter nuts so that they can be distinguished from everyone else's. Pass out the marking materials and show the youngsters how to use them. Let each kid mark at least ten nuts (but no more than twenty). The youngsters can toss any extra nuts aside or share them with a friend. Remind the youngsters that they are either red squirrels or grey squirrels.



6. Tell the "squirrels" that *red squirrels* must bury all their nuts *in one place*, and *grey squirrels* must bury their nuts *in many places* with no more than three nuts in any one spot. Give the squirrels two minutes to bury their nuts.

7. Call the group together and announce that the winter season is three "months" long and that each "month" lasts for two minutes. Write "December," "January," and "February" across the data board as illustrated.



8. In "December," each squirrel will need to recover at least three of his stored nuts to survive. (Each squirrel must recover his *own* nuts.) Give the squirrels two minutes to each bring back three nuts.

9. Record on the data board (as illustrated) the number of squirrels that gathered three nuts. Squirrels that "starved" (didn't bring back three nuts) must wait until the next game to play again. Have the surviving squirrels empty their "cheek pouches" into the large brown paper bag so that they begin the next round with empty pouches.

10. Explain that as the winter season continues, food becomes harder to find in the forest. The squirrels must rely more heavily on their stored nuts. In "January," repeat steps 8 and 9, but

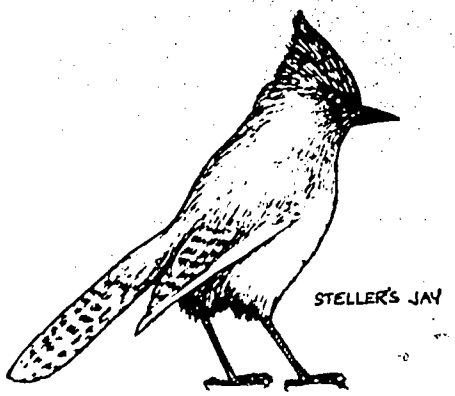
increase the food requirement to four marked nuts.

11. In "February," food is even more scarce. Repeat steps 8 and 9, but this time the food requirement is five nuts and *any marked nut counts* (i.e., the squirrels can gather marked nuts that were buried by other squirrels).

12. Record how many red squirrels and how many grey squirrels survive the entire "winter."

CRACK QUESTIONS

1. What were the advantages and disadvantages of hiding all your food in one place? In many places?
2. Was it easier to survive as a red squirrel or as a grey squirrel? Why?
3. In "February," how many of the survivors brought back nuts that were hidden by other squirrels?
4. How do you think a squirrel or jay finds the food they hide?
5. What happens to nuts that aren't recovered? (They could sprout and grow.)
6. What are some of the other ways that animals survive the winter? (Migrate, hibernate, grow thicker fur or more downy feathers, fatten up, become less active.)



ONE MORE WINTERTIME

Play another game, but this time choose two kids to be hungry jays that can snatch any marked nuts that they find unattended. Since real jays can carry only one nut at a time, restrict each "jay" to carrying one nut at a time to a plastic bag that represents the jay's cache. Place both jay cache bags at the edge of the squirrel forest. Pass out the marked nuts from the first "winter" and let the squirrels decide whether they want to be a red squirrel or a grey squirrel. Have the jays turn their backs while the squirrels bury their nuts. Play the three months and tally the results on the data board as before. How did the jays change the results?

MORE NUTTY IDEAS

1. Set out some nuts or seeds and find out what happens to them over a period of several days. Can you observe any animals taking or storing the food?
2. Look for evidence of squirrel food-gathering in the fall — stripped pine cones, mushrooms set out to dry, or opened acorns or other nuts. Can you locate a squirrel's cache?

WHAT TO DO NEXT

Jay Play	Set III
Food Chain Game	Set II
Birdfeeder	Set II
Seed Dispersal	Set I

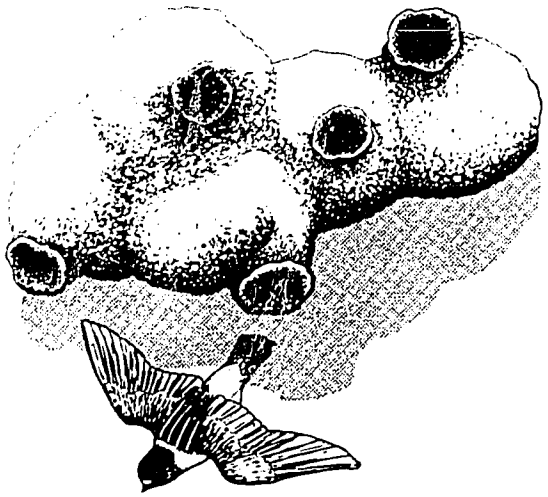
Many animals build nests, and birds are among the most industrious and expert nest builders. Not only do nests hold the eggs and young, but nests' construction and location are factors that provide protection from predators and adverse weather conditions. For example, the woodpecker chisels its nest deep into a tree trunk, while the oriole's finely woven nest hangs from a branch where most predators can't reach it. The barn swallow tucks its cuplike nest of mud in the eave of a building, and the junco's nest is concealed under a low bush. Even the killdeer's simple depression in the ground and other nests out in the open are often difficult to see because they blend in with the surroundings.

Besides nesting in a variety of locations, birds also use a variety of nesting materials. Sparrows use grasses and rootlets; hawks and eagles use twigs; and warblers use bark, leaves, and shredded stems. Cliff swallows form gourd-shaped nests of mud and straw; and hummingbirds use lichen, cobwebs, and sometimes flowers. Most birds line their nests with soft materials such as feathers, hair, and fine grass. The goldfinch uses thistledown, and the chipping sparrow lines its nest with horsehair.

Federal law protects all bird nests, whether occupied or not. No one should disturb nests in any way unless he has a special wildlife permit.

In this activity, the youngsters build nests with materials found in their activity area, and then exchange information to identify nests made by other youngsters.

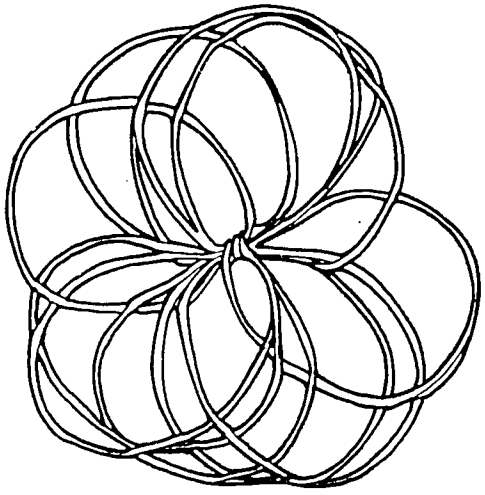
CHALLENGE: BUILD A NEST FOR AN IMAGINARY BIRD, AND PLACE IT IN YOUR ACTIVITY SITE.



CLIFF SWALLOW

MATERIALS

For each participant:
1 copy of "Nesting Notes"
1 pencil
1 length of prepared wire (See "Bird-Nest Frame" Equipment Card.)



1 thin strip of cloth flagging (2 cm x 15 cm)

For the group:
1 data board
1 marking pen
1 "Bird-Nest Frame" Equipment Card
1 "Nesting Notes" card
• colored flagging
1 container of water (for making mud)

PREPARATION

Selecting a site. Choose a site that includes a variety of trees, shrubs, and grasses. Flag two activity areas that are situated in such a way that the team in one area cannot see the team in the other area. If necessary, obtain permission to gather plant materials.

Materials. Make a wire frame for each participant. (See the "Bird-Nest Frame" Equipment Card.) Make one copy of "Nesting Notes" for each youngster.

ACTION

1. Challenge the group to go out in pairs and gather small samples of materials that could be used to build a bird nest. After a few minutes, call the group together and spread out the finds. Discuss these and any other materials that birds might use.

2. Ask the group to describe some bird nests thay have seen. Sketch the shapes described on the data board. Discuss some of the places where birds build nests. Reinforce the idea that birds build nests with a wide variety of shapes and materials.

BIRD NESTS
Nesting Notes

NAME OF BIRD_____

MY BIRD'S NEST IS MADE OF:
(Circle all the materials you use.)

twigs	green grass
pine needles	dried grass
green leaves	hair or feathers
dried leaves	mud or dirt
bark	other: _____

AND IS LINED ON THE INSIDE WITH: _____

_____

MY BIRD BUILDS ITS NESTS:
(Circle one)

on the ground	in a tree
in a clump of grass	in a bush

other:_____

BIRD NESTS
Nesting Notes

NAME OF BIRD_____

MY BIRD'S NEST IS MADE OF:
(Circle all the materials you use.)

twigs	green grass
pine needles	dried grass
green leaves	hair or feathers
dried leaves	mud or dirt
bark	other: _____

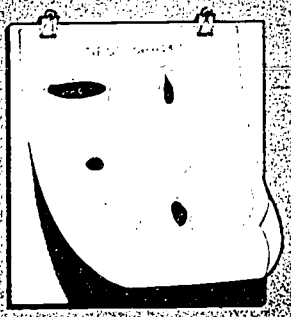
AND IS LINED ON THE INSIDE WITH: _____

_____

MY BIRD BUILDS ITS NESTS:
(Circle one)

on the ground	in a tree
in a clump of grass	in a bush

other:_____



3. Show the group how to mold the wire frame. (See the equipment card.) Explain that materials can be woven or molded into the frame. Tell the youngsters they can use the water in the pitcher for making mud.

4. Give each youngster a wire frame and a "Nesting Notes" card. Divide the group into two teams and assign a team to each site. Challenge each youngster to construct and place a nest in their site, and then to describe the nest on a "Nesting Notes." (At this time, do not tell the teams they will be switching areas later in the activity to locate each others' nests. Otherwise, the youngsters may hide or camouflage their nests too well.)

5. Allow at least twenty minutes for the teams to make and position their nests. Then bring the whole group together. Collect each team's "Nesting Notes" and keep them in separate piles.

6. Announce to the youngsters that they are now going to play the role of naturalists looking for bird nests. As naturalists, they should not disturb the nests in any way since real nests are protected by law. This consideration is important because some birds use the same nests year after year; some birds lay eggs in abandoned nests; and others may use materials from old nests to build new nests.

7. Give each youngster a strip of cloth flagging and one of the other team's "Nesting Notes." Challenge the youngsters to find and identify the nest described on their "Nesting Notes." Briefly outline the flagged activity sites and encourage team members to work together and share discoveries. Instruct each naturalist to tie a flag near the nest that is best described by her "Nesting Notes."

8. After the teams have had a chance to find and identify the nests, bring the whole group together in one of the activity sites. Let each nest builder pair up with the naturalist who has his "Nesting Notes." The naturalist should read the note, then show which nest she matched with the "Nesting Notes." The nest builder can verify the choice. Repeat this procedure at the other site.

9. Collect the flagging and nests at the end of the activity.

BIRD CHIRPS

1. What problems did you have constructing your nests? How do you think birds deal with these problems?

2. Which nests appear to be the sturdiest? What materials were used?

3. Which locations would probably provide the greatest protection against predators? Against weather? Why?

4. What problems did you have as naturalists in matching the nests with the "Nesting Notes"? How could the description on your "Nesting Notes" challenge be improved?

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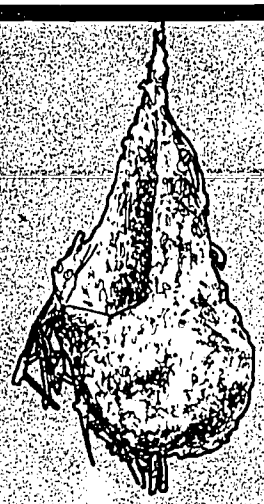
FOLLOW UP

1. Encourage the participants to take their nests home and place them securely in a tree or bush. Tell the youngsters to see if birds come to nest or, more likely, use some of the materials in their own nest building.
2. After this activity the youngsters will be ready to look at real nests and to consider their location, materials, and shape. Again, remind the youngsters that bird nests are protected by federal law and should not be disturbed in any way.



FINCH NEST

WHAT TO DO "NEST"

Snug as a Bug	Set IV
For the Birds	Set III
Jay Play	Set III
Birdfeeder	Set II
Flocking to Food	Set II

WOODPECKER NEST

A ***population*** is a group of plants or animals of the same kind that live together in the same area. Every living organism is a member of some population. Adult members of a population are similar in most ways, but a closer look reveals that every one is unique — just a little different from every other individual in that population. We call these small differences ***variations.***

The rainbow trout in a mountain lake make up a population. They are all rainbow trout and all live together in their lake. However, some are larger than others; some have more spots on their fins; some have darker coloration on their backs; some have longer lower jaws.

The eastern brook trout in the same lake make up another population, different from the population of rainbows. The brook trout display variations, but they are all members of the brook-trout population. Rainbow trout and eastern brook trout are two of the many populations of organisms that live in the mountain lake.

In *Bugs, Worms, and Others,* the youngsters invent populations of make-believe organisms, and select a habitat for them, i.e., the place where they would live. The kids then work together to create a *natural history,* or "life story," for their population. The activity concludes with a discussion of the natural histories of the fabricated populations, a look at the variations within each population, and a quick inventory of the *real* populations living in the activity site.

CHALLENGE: CREATE A POPULATION OF ANIMALS OR PLANTS AND PLACE THEM IN AN AREA WHERE THEY CAN LIVE.

MATERIALS

For each team of three or four kids:

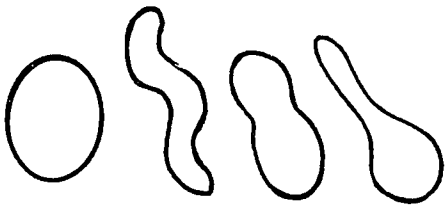
50 or more figures (See the "Preparation" section.)
8 pens or crayons (2 black, 2 red, 2 blue, 2 green)
2 Natural History Sheets
1 15-meter length of string
1 paper bag

PREPARATION

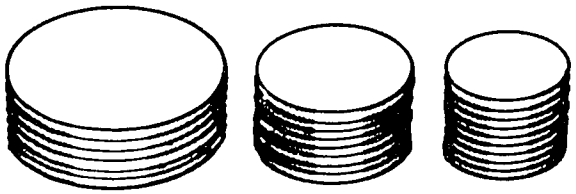
Group size. Three teams of three or four youngsters is the maximum group size for this activity.

Materials

1. Cut out fifty or more figures from light cardboard stock (e.g., index cards) for each team. Each team's figures must be of *one* shape (a different shape for each team) and come in two or three sizes.



You might make ovals, worms, peanuts, spoons — use your imagination! Stack up six to eight index cards and cut them all at once to "cut down" your preparation time.



2. Wind a 15-meter length of string on a small piece of cardboard for each team.
3. Make two copies of the Natural History Sheet for each team.

BUGS, WORMS, AND OTHERS

NATURAL HISTORY SHEET

These organisms are members of a population called ___

_____.

They make their home in _____.

They eat _____ and _____.

Their arch enemy is _____ and they protect themselves by _____.

They look pretty much alike except _____.

Other notable features of this population are _____

_____

_____.

This is a picture of one member of the population:

BUGS, WORMS, AND OTHERS

NATURAL HISTORY SHEET

These organisms are members of a population called ___.

_____.

They make their home in _____.

They eat _____ and _____.

Their arch enemy is _____ and they protect themselves by _____.

They look pretty much alike except _____.

Other notable features of this population are _____

_____

_____.

This is a picture of one member of the population:

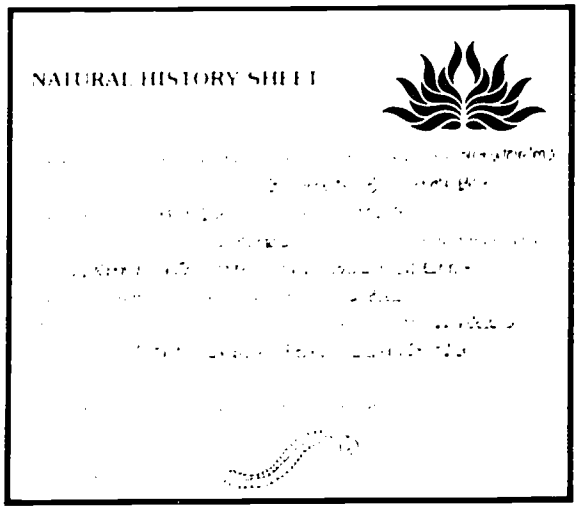
4. Pack fifty or more cut-outs of *one* shape, colored pens, one string, and two Natural History Sheets in a small bag for each team. The sets of materials should differ only in the *shape* of the cut-outs. Save a few cut-outs to show the youngsters when you introduce the activity.

Selecting a site. A site with a variety of habitats (e.g., a park that has lawns, trees, a pond, etc.) is best, but a less diverse site will work if the team areas are separated by 20 to 30 meters.

ACTION

1. Tell the youngsters that a ***population*** is a group of animals or plants of the *same kind* that live together in a particular area. Tell the youngsters that they not only have the opportunity to look at some of the populations living at the activity site, but they will also introduce a *new* population into the site.

2. Hold up samples of the cut-outs and tell the youngsters that they are going to work in teams to turn these figures into populations of animals or plants. Show the kids the Natural History Sheet and discuss it with them.



3. Divide the group into teams of three or four youngsters and give each team a bag containing pens, cut-outs, string, and two Natural History Sheets. Give the teams these instructions:
   a. Find an area you want to work in (a habitat area), and surround it with your string. Don't set up too close to another team.
   b. As a group, decide what kind of critter you want to make. You may make a real animal, or a completely imaginary one. Use your pens to turn your set of cut-outs into a population. While you work, think of ways your population would survive in your area. Place the population in the habitat when all of the critters are completed.
   c. As a team, fill in *one* of the Natural History Sheets with information about your population. Keep the other sheet blank.

4. Send the teams off to create their populations. Circulate among the groups and remind them that a population is made up of *one* kind of organism — no unicorns and flying horses in the same population. Be sure the teams fill out their Natural History Sheets and keep them secret. When the teams place their populations in their habitat areas, the "critters" should not be hidden; other youngsters will have to find and observe them. Allow one-half hour for this portion of the activity.

5. When the populations are all placed in the habitat areas, call the teams together. Tell the youngsters that each team should go to a site set up by one of the other teams. When they get there, they should:
   a. Fill in their *blank* Natural History Sheet with information they get by *observing* the population prepared by the other team. Do not move any of the crafty critters yet.
   b. Collect all the members of the introduced population and arrange them by size or color for easy viewing.

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6. Now call the teams back to a central spot. As a *group*, go from site to site. At each site, the team that prepared the natural history from *observable evidence* (the second team) reads from the Natural History Sheet what they determined about the population. They then compare their observations to the natural history prepared by the team that created the population.

GETTING THE BUGS OUT

As you stop at each site and look at the created populations, initiate discussions with the youngsters.

1. Introduce the term ***variation*** as the differences among individuals within a population. The toads in a population have a different number of warts; dairy cows have different patterns of spots; black-eyed Susans have different numbers of petals; people have different faces. What variations do your created populations display? Did each team create *one* population?
2. Have the youngsters turn their attention to themselves. Are they all members of one population? What variations can they find?
3. What living populations (bugs, worms, and others) share space with your paper cut-outs? Which population has the most members? The fewest members? Look for the largest and the smallest member of each population. Can you find variations other than size in these real populations?

Note: Remember to take in all your strings and papers when you are through.

FOLLOW UP

Duplicate some more Natural History Sheets. Have each of the kids identify a population living in the activity area and fill out a sheet describing how that population survives and interacts with its environment. Then let each youngster read his natural history and let the others guess what population he described.

WHAT TO DO NEXT

Shake It	Set III
Variation Game	Set III
Too Many Mosquitoes	Set II
Bean Bugs	Set I
How Many Organisms Live Here?	Set I

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94720

When a biologist investigates plants and animals in an area, one of her first tasks is to take an inventory of the organisms living there. Counting every single plant or animal in an area would be quite tedious, so biologists have developed a variety of censusing techniques to short-cut the counting process. For example, by accurately counting the number of fence lizards (or any other organism) in a small portion of an area, a biologist can calculate the approximate size of the lizard population in the entire area.

She can go one step further and determine the ***population density***. By calculating the number of lizards that live in a standard unit of area, say, 100 square meters, she could report to other biologists, for instance, that the population density is five fence lizards per 100 square meters. Population density is a valuable concept for comparing the distribution of organisms in different areas of an organism's habitat.

A desert habitat is a good place in which to introduce youngsters to the concept of ***population density***. Desert plants, principally the cacti, are practical study organisms for this activity, because they are generally large and have low population densities compared with those of many other plants. Desert plants are

easy for the youngsters to find and count accurately.

In this activity, the kids use the "cactus-wheel" technique to compare the population densities of a number of different plants. This technique involves establishing a "hub" from which the youngsters radiate to find the nearest plant of a designated type, say, barrel cactus. After everyone has found a barrel cactus, the youngsters pace off the distances from their plants to the hub, and then average these distances to determine the average radius of the circle in which the plants live. The kids repeat this process with other plants, and compare their population densities. Therefore, instead of counting the number of plants in equal-sized areas, the youngsters find the size of areas that contain the same number of plants. The *smaller* the radius of an area containing a certain number of plants, the *denser* the population.

CHALLENGE: DETERMINE THE POPULATION DENSITIES OF SEVERAL DESERT PLANTS.

MATERIALS

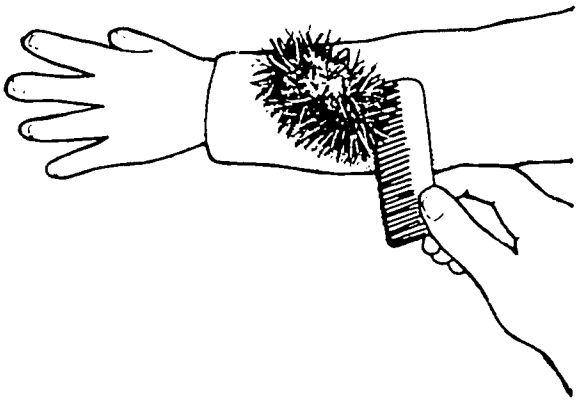
For each team of two:
1 pencil and paper

For the group:
1 data board with two sheets of paper
1 marking pen
1 metric ruler
1 pencil compass for drawing circles
1 comb (only if chollas are present)

PREPARATION

Selecting a site. *Cactus Wheel* is designed for desert areas, but can work at any site with plants. Keep in mind, however, that counting plants is more difficult if the plant growth is dense. The site should contain at least four different kinds of plants.

Safety. *Keep off the cactus!* Be careful while working around cactus, particularly the chollas. A careless run-in with a cactus can end an activity prematurely. If a youngster does happen to get a spiny piece of cholla stuck to him, don't grab the cholla to pull it off. Rather, work a comb in between the skin or clothing and the cactus, and then flip the piece of cactus away. Don't flip it on someone else!



ACTION

PACING OUT THE CACTUS WHEEL

1. At the site, tell the youngsters that they are going to survey the populations of plants living in the area. Inform them that all the individuals of one kind of organism living in an area make a *population*. Point out that there is a *dense* (close together) population of people right where they are, but that the plants in the area are probably not so densely populated.

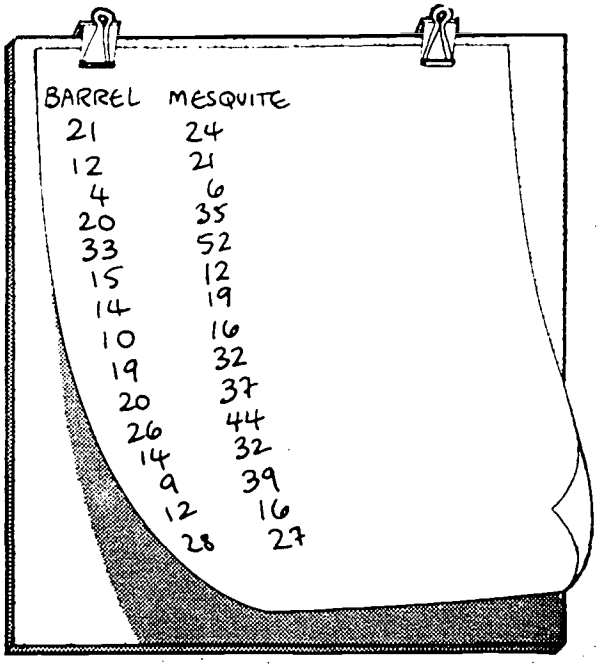
2. Pick out one kind of plant (barrel cactus, for example). Tell everyone that you will stand in place, while they each find a barrel cactus as close to you as possible. The youngsters can move out in all directions to search. Have everyone stand next to their cactus.

3. **Looking Closer (optional).** While the youngsters are standing by their plants, you might ask them some of the following questions. (If not, skip this section and go to step 4.)

a. How does your plant reproduce? Can you find seeds or pieces of plant starting to grow?
b. Does your plant have spines? Are the spines all the same or do they come in different sizes?
c. Does your plant grow alone or in groups?
d. Are there any other plants growing under or close to your plant?
e. What evidence can you find that your plant might be food for an animal? What kind of animal?

4. When everyone has found his cactus, tell the youngsters to walk back to you while counting the number of steps (normal walking strides) they take to return. Have the kids line up and report how many steps they took. Record each youngster's response in a column on the data board, and label the column "Barrel Cactus."

5. Now ask the group to select a second kind of plant. Repeat the process of searching for the nearest plant of the designated type, standing next to it, and counting the number of steps back to you. Record and label the results.



6. Repeat this cactus-wheel procedure with four or five other kinds of plants.

CALCULATING POPULATION DENSITIES

1. Divide the group into pairs and give each pair a column of figures to *average*. Tell the teams to add the column of numbers (i.e., steps from the starting point) and divide the total by the number of plants. (The number of plants is the same as the number of kids.) The result is the average distance of all the plants from the hub.

2. If you think of the population area as a circle, the average number of steps is the *radius* of that circle. The population size of each kind of plant is the same, but the radii of the circles in which the

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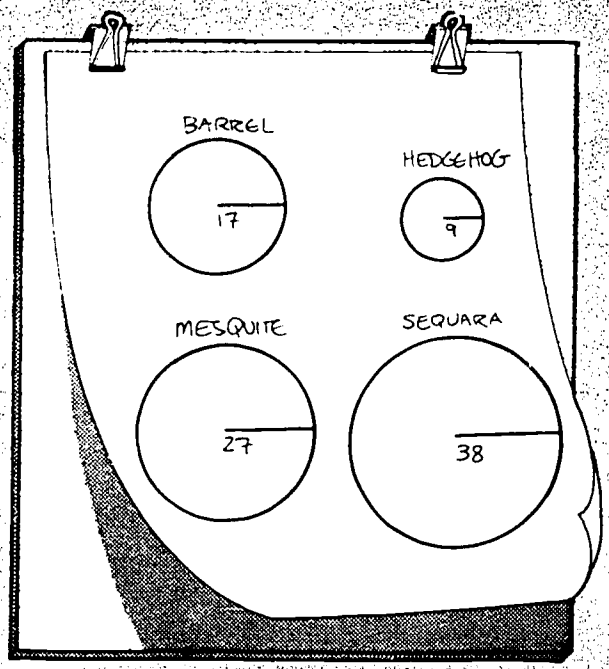
various populations live are different. Therefore, you have different ***population densities*** for each kind of plant. Fifteen plants in a small circle represent a *denser* population than fifteen plants in a larger circle.

3. On another sheet of the data board, use the compass to draw circles that represent the different populations.
   a. Use a scale of 1 cm for each step. Use the metric ruler to set the compass to the average distance for a population and draw a circle.
   b. Label the circle with the name of the population and the length of the radius.
   c. Repeat this process for all of the populations.



GETTING THE POINT ACROSS

1. Ask the youngsters to look at the cactus wheels on the data board. Which population of plants is the most dense? The least dense?
2. What is the relationship between the *size* of the plants in the population and their population density?
3. Does it look like the population density of any plant might vary from place to place? Why might that be?
4. What environmental factors do you think influence the population densities of the desert plants?

FOLLOW THROUGH

Determine the most and the least densely populated plants in the area. Then move to a new site and "roll" the cactus wheel for these two plants. How do the population densities at this location compare with those at the first site? How do you account for any differences?

WHAT TO DO NEXT

Bugs, Worms, and Others	Set IV
Plant Patterns	Set II
Invent a Plant	Set I
Bean Bugs	Set I

Outdoor Biology Instructional Strategies
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All animals must keep their body temperatures within a specific range in order to survive. This temperature range is often different for different kinds of animals.

We can divide animals into two general groups according to the way they maintain their body temperatures. Warm-blooded animals, called *endotherms* by scientists, produce heat within their bodies and maintain a very narrow range of body temperature regardless of outside temperatures. Humans, other mammals, and birds are all endotherms. Cold-blooded animals, called *ectotherms* by scientists, obtain heat from the environment and generally have broader temperature ranges than endotherms have. Ectotherms, such as lizards and snakes, must move into warm or cool spots in their surroundings to keep their body temperatures within the critical range. Ectotherms can also regulate their body temperature by burrowing, and by varying the angle of their exposure to the sun.

In *Cool It*, the youngsters first discover the wide range of temperatures in their activity site. The youngsters then move thermometers (which represent lizards) from a starting area to a feeding area while trying to keep the "lizards'" body temperatures within a certain range.

The youngsters learn that environmental temperatures correspond to the body temperature of their lizards.

CHALLENGE: KEEP YOUR THERMOMETER-LIZARD ALIVE AS IT TRAVELS TO THE FEEDING AREA.

MATERIALS

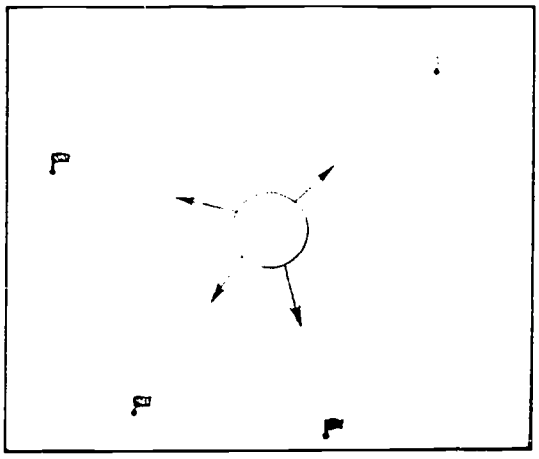
For each team of two:
1 Celsius thermometer (with a metal back, if possible)
1 one-meter length of string

For the group:
4 flags on small sticks or dowels
• masking tape
1 watch with a second hand
1 eight-meter length of rope or string

PREPARATION

Selecting a site. This activity must be conducted on a warm, sunny day. Choose a site with areas of deep shade, bright sun, and mottled or partial shade.

The feeding areas. Mark off a circular starting area in the center of the activity site with the rope. Designate four feeding areas by placing each flag about ten meters from the edge of the starting circle. The path from the starting circle to each feeding area should pass through a different amount of sun. One path should be mostly in sunlight, one mostly in shade, and the others in a combination of sun and shade.

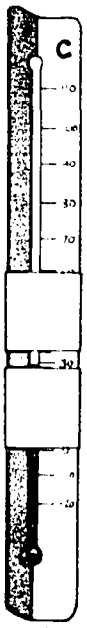


Materials. If the thermometers have both Celsius and Fahrenheit scales, cover the Fahrenheit scale with masking tape.

ACTION

1. Let the youngsters pair up, and give one thermometer to each team. Briefly explain how to read the thermometer, and then challenge each team to find the highest and the lowest temperature in the activity area.

2. After about five to ten minutes of hunting, call the group together and find the average of the highest and lowest temperature reported by the group. Instruct the teams to place one piece of masking tape on their thermometer 3° *above* the average temperature and another piece of tape 2° *below* the average.



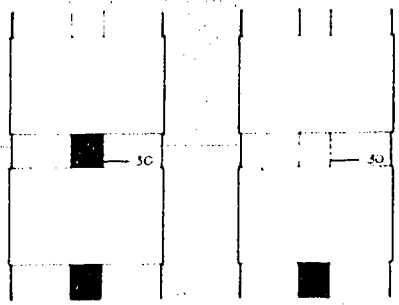
3. Ask if anyone in the group has ever had a fever. Explain that humans and other mammals have a steady temperature inside their bodies, regardless of outside temperatures. If our body temperatures go up or down even a few degrees from 37° C, we can get sick or even die.

4. Explain to the youngsters that they are now going to investigate a group of animals whose body temperatures normally go up and down within a broad range. The western fence lizard survives at temperatures between 25° C and 37° C, a range of 12°. Besides lizards, this group includes snakes and frogs.

5. Tell the youngsters to pretend that the thermometers are a special kind of lizard. These "lizards" can move only one meter before they must rest for thirty seconds, and can survive only if their temperatures remain within the range between the masking-tape marks (i.e., 5° C).

6. Challenge the teams to "be the legs" for their lizards while following these rules:

a. The circle is the starting area and the flags are the feeding areas. Each team's lizard must try to reach one of the feeding areas.
b. The lizards don't have to move in a straight line to the flag; this is *not* a race, but a challenge to keep the lizards alive until they reach the feeding area.
c. Every thirty seconds, the leader will yell "Go!" The teams can move their lizards up to one meter (the length of the string) at a time, and must remain at that spot until the leader says "Go!" again.
d. Team members cannot use their bodies to shade their lizard.
e. If a team's lizard gets too hot or too cold (see illustration), that team must drop out and wait until the next game.



f. Unsuccessful teams may want to practice moving their lizards so that their temperatures remain within the 5° C range until the next game.

7. Assign a feeding area to each team. (More than one team may try to reach a flag.) Give each team one string, and let the game begin.

8. Ask what happened to the lizards' temperatures when they were in the sun and in the shade. Explain that as the temperature of the surroundings changes, *real* lizards' body temperatures tend to change in the same way. Which lizards reached their feeding areas? What strategies did successful lizards use? What problems did unsuccessful lizards have that caused them to "die"?

9. Let the teams switch feeding areas and play another game. Have the teams share any special strategies or problems.

10. Explain that different kinds of lizards live within different temperature ranges. Tell the teams that they can make different kinds of lizards by changing the temperature range on the thermometers. Challenge the teams to change the temperature range for their lizards so that they can move over a previously unsuccessful pathway. Tell them that the high and low temperatures must still be 5° apart. Allow the teams to change their temperature ranges and play another round.

HEATED DEBATE

1. What temperature ranges were successful in the sun? In the shade? In partial shade?
2. What might happen to a desert lizard if you took it home as an indoor pet?
3. What ways could lizards cool off or heat up other than moving to the shade or sun? (Burrowing, lying on a large rock, panting.)
4. How would your life be different if your body temperature responded to surrounding temperatures in the same way as your lizard?

FOLLOW THROUGH

Real lizards commonly burrow into the ground to escape hot and cold temperatures. Let the teams play another game in which they can bury their "lizards" in order to maintain the lizards' temperature at a safe level.

WHAT TO DO NEXT

Desert Water Keepers	Set IV
Leapin' Lizards	Set III
Animal Anti-Freeze	Set II
Sensory Hi-Lo Hunt	Set II

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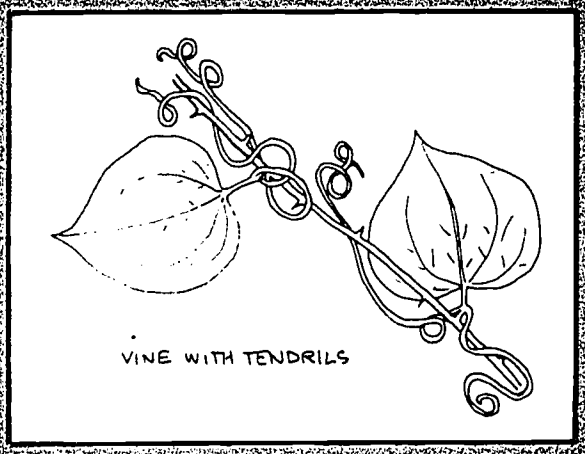
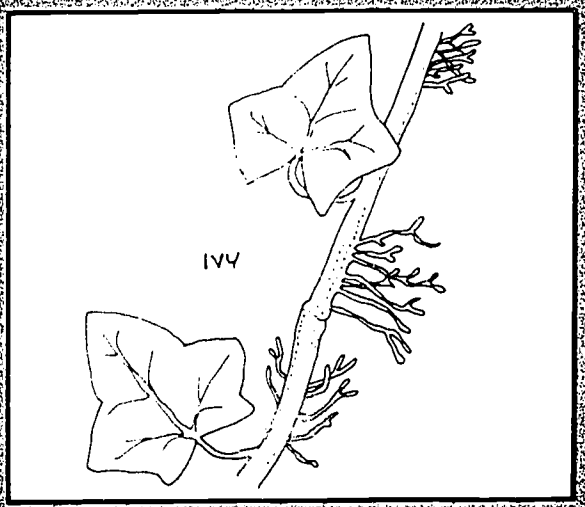
94720

Creeping, climbing, and trailing vines often grow in forests where sunlight is limited. Vines have specialized structures and growth patterns that enable them to compete for sunlight. The modified stems or leaves (*tendrils*) of some vines coil tightly around objects, enabling the plant to compete. Vines with tendrils include the garden pea, vetch, and clematis.



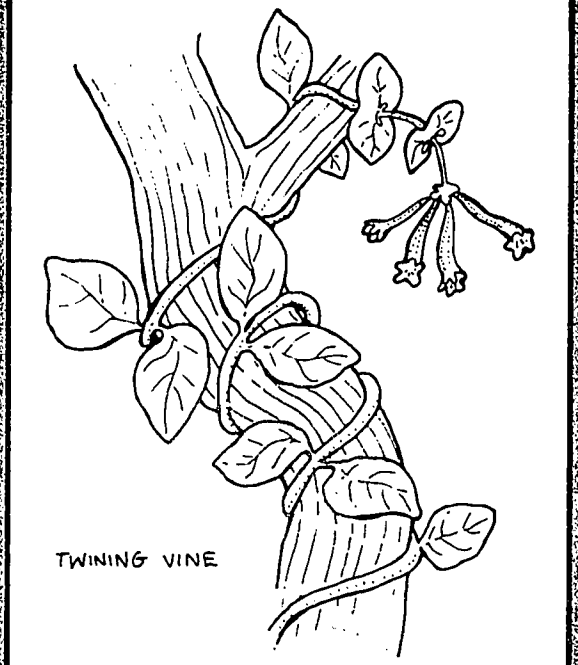
VINE WITH TENDRILS

Other climbers such as English ivy and poison ivy have roots that sprout along the stem and anchor the plant firmly to



IVY

tree trunks, walls, and other supporting structures. Many other vines, such as honeysuckle and morning glory, have stems that coil or twine around supporting plants.



In this activity, the youngsters locate and examine different kinds of vines. They discover and compare structures that twine, such as tendrils, modified roots, and stems. Action Cards encourage the youngsters to further explore the variety of vine structures and growth patterns found at the site.

CHALLENGE: INVESTIGATE THE SPECIALIZED STRUCTURES AND GROWTH PATTERNS OF DIFFERENT VINES.

CREEPERS AND CLIMBERS
Action Card

Vine on Vines

Find a vine climbing on another kind of vine.

OR

Find three or more vine stems twined together to form a living rope.

CREEPERS AND CLIMBERS
Action Card

CREEPERS AND CLIMBERS
Action Card

CREEPERS AND CLIMBERS
Action Card

CREEPERS AND CLIMBERS
Action Card

Travelers

Find a vine that starts growing on one support plant (a tree, bush, or smaller plant) and travels to one or more other plants.

Which vine is the Champion Traveler at your site?

CREEPERS AND CLIMBERS
Action Card

Trailers

Some vines don't grow by climbing, but instead trail or creep along the ground. Find a vine trailing completely on the ground.

CREEPERS AND CLIMBERS
Action Card

Shady Characters

Some vines may grow so densely that they cut out most sunlight beneath them. Find a place made very dark by vines.

Find evidence that a plant on which a vine is growing has been harmed by the vine. (Hint: Look under the thickest vines to see if you can find green leaves on the supporting plant.)

CREEPERS AND CLIMBERS
Action Card

Fine Vine

Find the vine that has the most attractive or most unusual flowers or fruits.

CREEPERS & CLIMBERS

Trial Edi
Se

MATERIALS

For each team of two:
2 Action Cards
1 pair of scissors

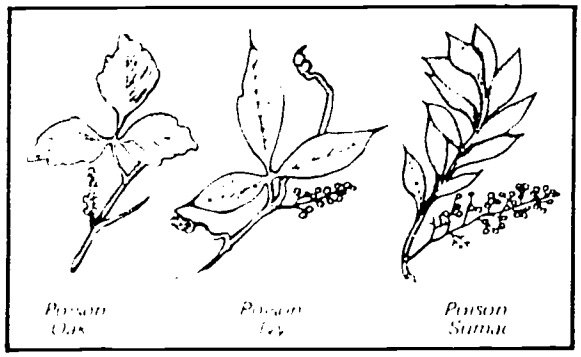
For the group:
1 data board
1 marking pen
- cloth or plastic strips to be used as flagging

2 sheets of Action Cards

PREPARATION

Selecting a site. Choose a site with a minimum of five kinds of vines. Check densely vegetated areas such as thick forests (particularly in the southern states), stream margins, and parks. If necessary, obtain permission to collect small samples of the vines growing at the site.

Precautions. Search the site carefully for poison ivy, poison oak, or other dangerous plants. Place flags next to any dangerous plants and caution the youngsters *before they go into the area* to avoid these plants.



Taking a sample. As you check over the site, take a sample of a vine to use when you introduce the activity. The sample should be twelve to thirty centimeters long and have several leaves and tendrils, roots, or coiling stems.

ACTION

1. Introduce *Creepers and Climbers* by asking the participants to describe some vines. Show them the sample vine Point out the long stem, leaves, and the special parts used for support.
2. Show the youngsters how to use the scissors to cut a small sample (12 to 30 cm) from the growing tip of a vine branch.
3. Encourage the participants to look carefully before reaching or stepping into thickets or bushes. Point out the poisonous plants you have flagged and caution the youngsters to avoid touching them. Tell them how to recognize other dangerous plants that you may have missed when you looked over the site earlier.
4. Divide the group into teams of two. Challenge the teams to find as many different vines as they can and to bring back small samples of each kind. Those vines that cannot be cut should be marked with a flag.
5. Distribute flagging and scissors, and let the youngsters begin. If necessary, establish site boundaries.
6. After about fifteen minutes, call the teams together. Ask one member of each team to show the group one of the vines she collected and to describe how it was growing. Ask what structures held the vines to their supports.

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7. As each of the three main modifications (tendrils, modified roots, and twining stems) is shown for the first time, introduce the term for that modification and write it on the data board. Ask other participants to show vines they have collected that have the same modification.

8. Give each of the team members an Action Card and a piece of flagging. Challenge the kids to find and flag the vine described on the card. Circulate among the youngsters as they work to offer help or encouragement. Offer another card to those kids who complete their challenges early.

9. When most of the youngsters have completed their challenges, call the group together and ask the participants to read their challenges and show the group their flagged vines. Encourage the youngsters with similar Action Cards to compare results.

10. Have the teams collect all the flagging.

WHAT DO YOU THINK?

1. What do vines have in common with other green plants?

2. How are vines different from other kinds of green plants?

3. Many plants must compete with other plants for sunlight — especially in forests. How do vines compete for sunlight? How do trees compete?

MORE VINERY

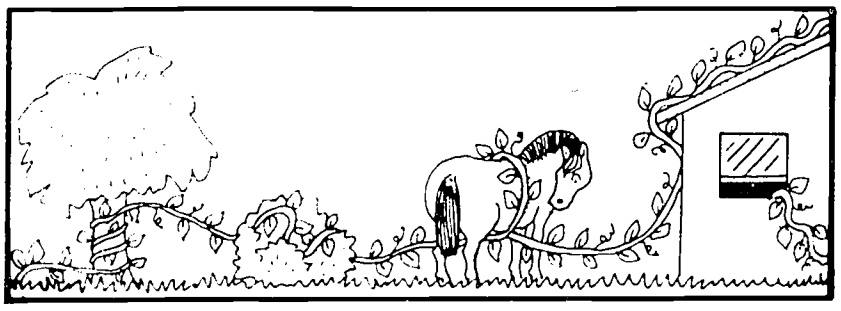
1. If the youngsters discovered several *twining* vines at the site, challenge them to find out if all the vines twine or twist around their supports in the same direction (clockwise or counterclockwise). If the students discover more than one twining direction, have them investigate whether a particular kind of vine (for instance, honeysuckle) always twines in the same direction.

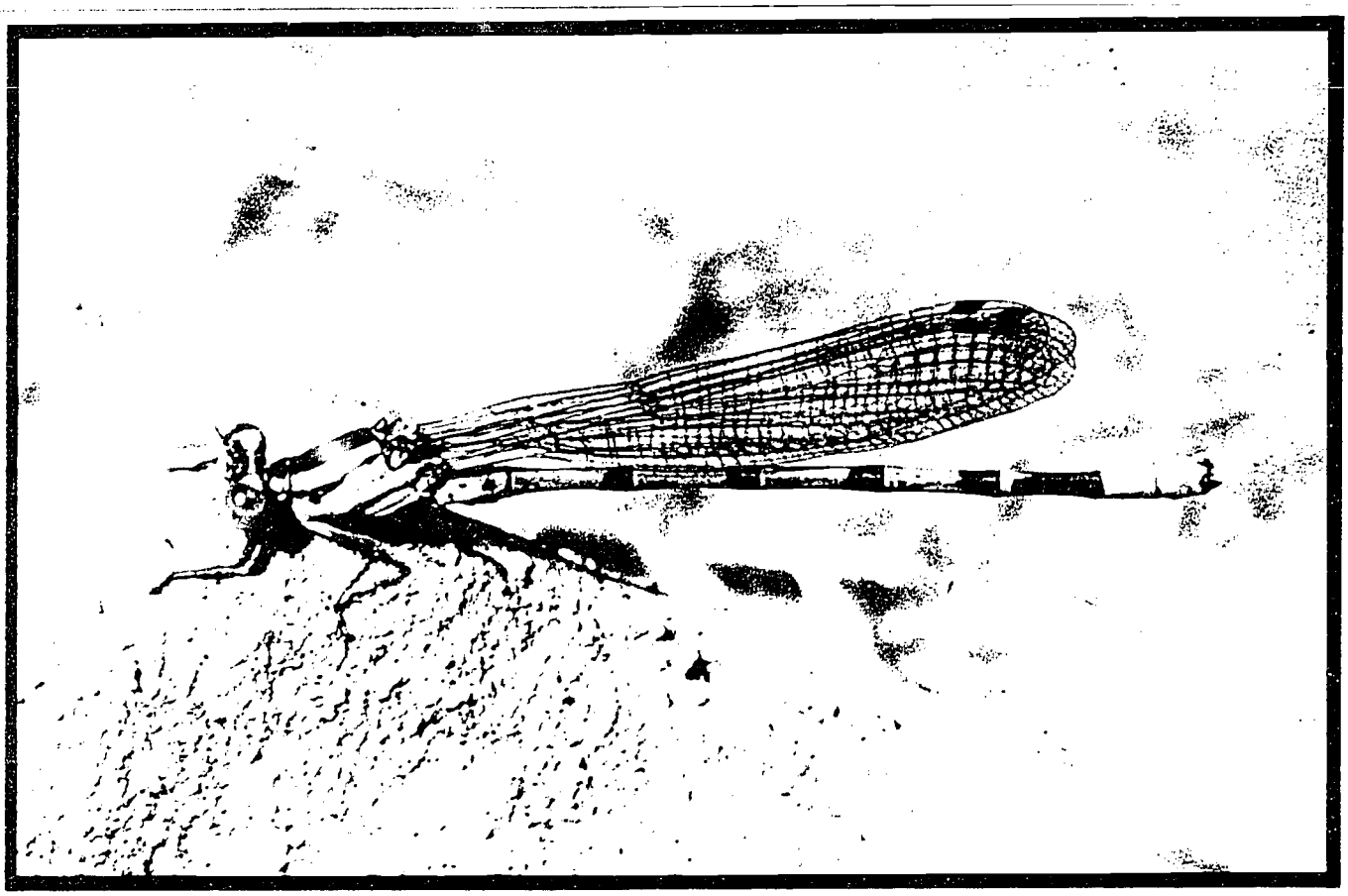
2. Can a twining vine be trained to twine in a new direction? Challenge the teams to reverse the direction of a growing tip of a twining vine by rewinding it around a branch or stick. Some teams may wish to tape the tip into position. Make observations first after several hours, and then after a day or two to see if the vine begins to grow in the new direction.

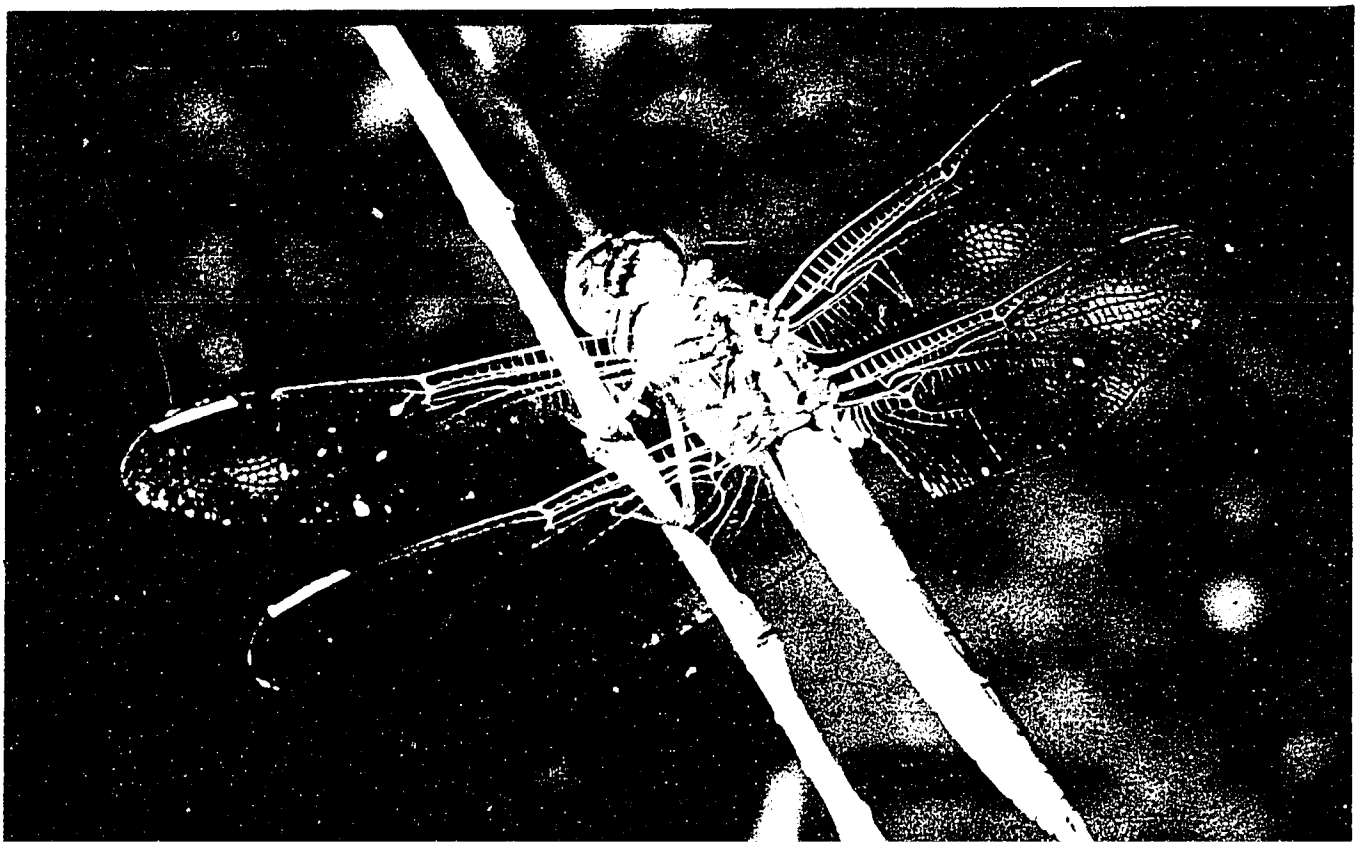
3. Suggest that the youngsters investigate tendrils to see how they grow. Can their growing direction be changed?

WHAT TO DO NEXT

Snug as a Bug	Set IV
Tree Tally	Set IV
Roots and Shoots	Set II
Invent a Plant	Set I







The darting flight of damselflies and dragonflies is a common summer sight around many ponds, streams, lakes, and rivers. These brightly colored insects spend most of the day in the air, or perched on reeds and other vantage points, searching for flying insects. Their wide field of vision and excellent flying ability enable them to detect and catch flying insects in midair.

Dragonflies and damselflies are swift acrobatic flyers. At rest, dragonflies look like tiny airplanes with their wings in a horizontal position. Damselflies look like dragonflies, but are smaller and slimmer. Damselflies hold their wings together above their backs when at rest, the way butterflies hold their wings.

What kinds of perches do damselflies and dragonflies (D-Flies) prefer? How do D-Flies react to small objects that come near them? Do moving objects and certain colors evoke strong responses? These are some of the questions that your group will investigate in *Damsels and Dragons.*

CHALLENGE: INVESTIGATE DAMSELFLY AND DRAGONFLY PERCHING BEHAVIOR AND DISCOVER HOW THEY REACT TO FLYING DECOYS.

MATERIALS

For each team of two:
12 pipe cleaners
1 thin stick (1 to 2 meters long)
1 one-meter length of light monofilament fishing line (4 to 6 pound test)
12 flat toothpicks
1 Landing Record Card
1 Decoy Record Card
1 pencil

For the group:
1 set of colored marking pens (red, blue, green, brown, and black)
1 data board
1 roll of transparent tape
- extra pipe cleaners, toothpicks, and fishing line

1 sheet of Landing and Decoy Record Cards

PREPARATION

Site. D-Flies are most abundant during late spring, summer, and early fall. Choose a freshwater site with a flat, open stretch of shoreline and a large number of D-Flies (about a half-dozen dragonflies and/or a dozen damselflies).

Time. Pick a warm, calm day to conduct the activity.

Safety. Because your group will be working around the water, review the "Safety" section in the *Leader's Survival Kit* for information on buddy teams.

Record cards. Make enough copies of the Record Cards for each team of two to have one of each. Cut the cards apart.

ACTION

PART ONE: D-FLY PERCHING BEHAVIOR

1. Divide the group into teams of two, and explain the buddy system.

2. Show the teams the D-Fly illustrations in the folio, and challenge the teams to find some D-Flies and to quietly watch them for a few minutes. Keep the kids within sight.

Landing Record Card

Perch Number — Make an "X" each time a D-Fly lands.

1	
2	
3	
4	
5	
6	

Perch Height — Make an "X" each time a D-Fly lands.

Low	
Middle	
High	

Decoy Record Card

Decoy Color — What did the D-Flies do?

Plain	
Red	
Blue	
Green	
Brown	
Black	

3. Call the group together and ask the youngsters how the D-Flies behave. If both dragonflies and damselflies are in the area, ask the youngsters how the two D-Flies differ. Use the folio illustrations to make sure everyone knows how to tell them apart.

4. Ask the teams if they think that D-Flies land on certain perches more often than they land on others. Tell the youngsters that you have brought along some pipe cleaners to help them find out.

5. Show the youngsters how to make a pipe-cleaner perch by connecting two pipe cleaners together end-to-end. Then show the group how to prop up the pipe-cleaner perch by sticking it into the ground or bracing it with rocks.

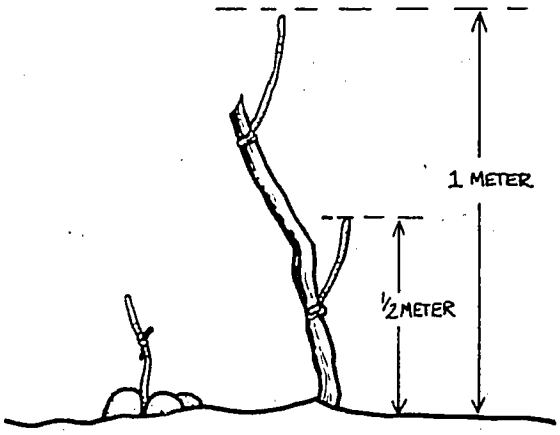
6. Distribute twelve pipe cleaners to each team, and ask each team to make six pipe-cleaner perches.

7. Tell the teams that they will set out their perches and record how many times D-Flies land on each perch.

8. Give each team a Landing Record Card and a pencil.

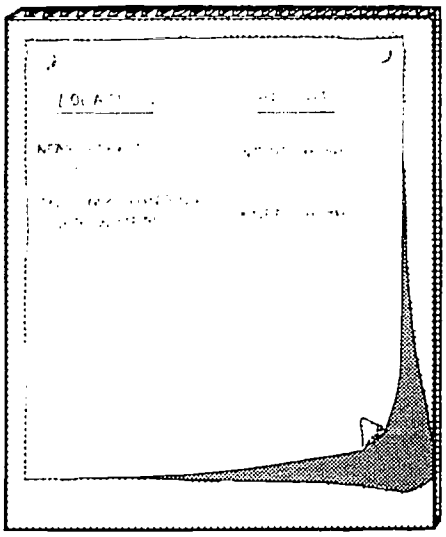
9. Ask each team to select an area with lots of D-Fly activity and to prop their pipe-cleaner perches about a forearm's length apart. All the perches should be at about the *same* height. Suggest that the teams sit two to three meters from their pipe-cleaner perches to avoid disturbing the insects.

10. After about ten minutes, suggest that the teams place two perches above their most successful perch (i.e. the one with the most D-Fly landings) to see if D-Flies prefer taller perches. Have the youngsters twist the ends of two pipe-cleaner perches around a twig so that the top of one perch is about knee-high (one-half meter) and the other is about waist-high (one meter) when the stick is set in the ground. After each team has made a double perch, ask the teams to place it within 20 cm of their most successful perch.



11. Ask the teams to count the number of D-Fly landings on the three pipe-cleaner perches in a ten-minute period.

12. Call the teams together, and write "Location" and "Height" on the data board. Ask each team to describe the location and height of their most successful perch. Record this data on the data board.



Perching Remarks

1. What was the height of the perch that the D-Flies landed on most often?

2. What do each team's most successful perches have in common? How do they differ?

3. Did more than one D-Fly land on a pipe-cleaner perch at the same time? Were all of the D-Flies that landed on the perches the same color? The same kind?

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Outdoor Biology Instructional Strategies

PART TWO: DECOY ENCOUNTERS

1. Ask the kids what happens when a D-Fly flies near another D-Fly. What do the youngsters think would happen if they moved a D-Fly decoy or model near a D-Fly? Explain that you have some materials that they can use to find out.
2. Demonstrate how to make D-Fly decoys.
   a. **Damselfly.** Tie one toothpick to one end of a piece of fishing line so that the toothpick hangs level when dangled from the string. Tie the other end of the fishing line to a thin stick.
   b. **Dragonfly.** Use a bundle of four toothpicks taped together for a dragonfly decoy.
3. Distribute the decoy materials and ask each team to make a D-Fly decoy.
4. With the group looking on, pick up a decoy rig, and demonstrate a quiet, slow approach to a perched D-Fly. "Fly" your decoy by the D-Fly several times, getting as close as you can to the D-Fly. Tell the kids to watch carefully what the D-Fly does.
5. Challenge the teams to fly their decoys by some D-Flies, and carefully watch what the D-Flies do.
6. After five to ten minutes, ask the teams how the D-Flies responded to their decoys. Then ask what the youngsters think would happen if they used colored decoys.
7. Hand out the marking pens and extra toothpicks, and ask the teams to color enough decoys so that each team ends up with five different colored decoys (red, blue, green, brown, and black).
8. Give each team a Decoy Record Card, and challenge the teams to try each colored decoy for two minutes and to record the D-Fly responses on the card. The team members can trade decoy-flying and recording duties.
9. Join in the fun yourself and call the teams together when they have finished.

DECOY DISCOVERIES

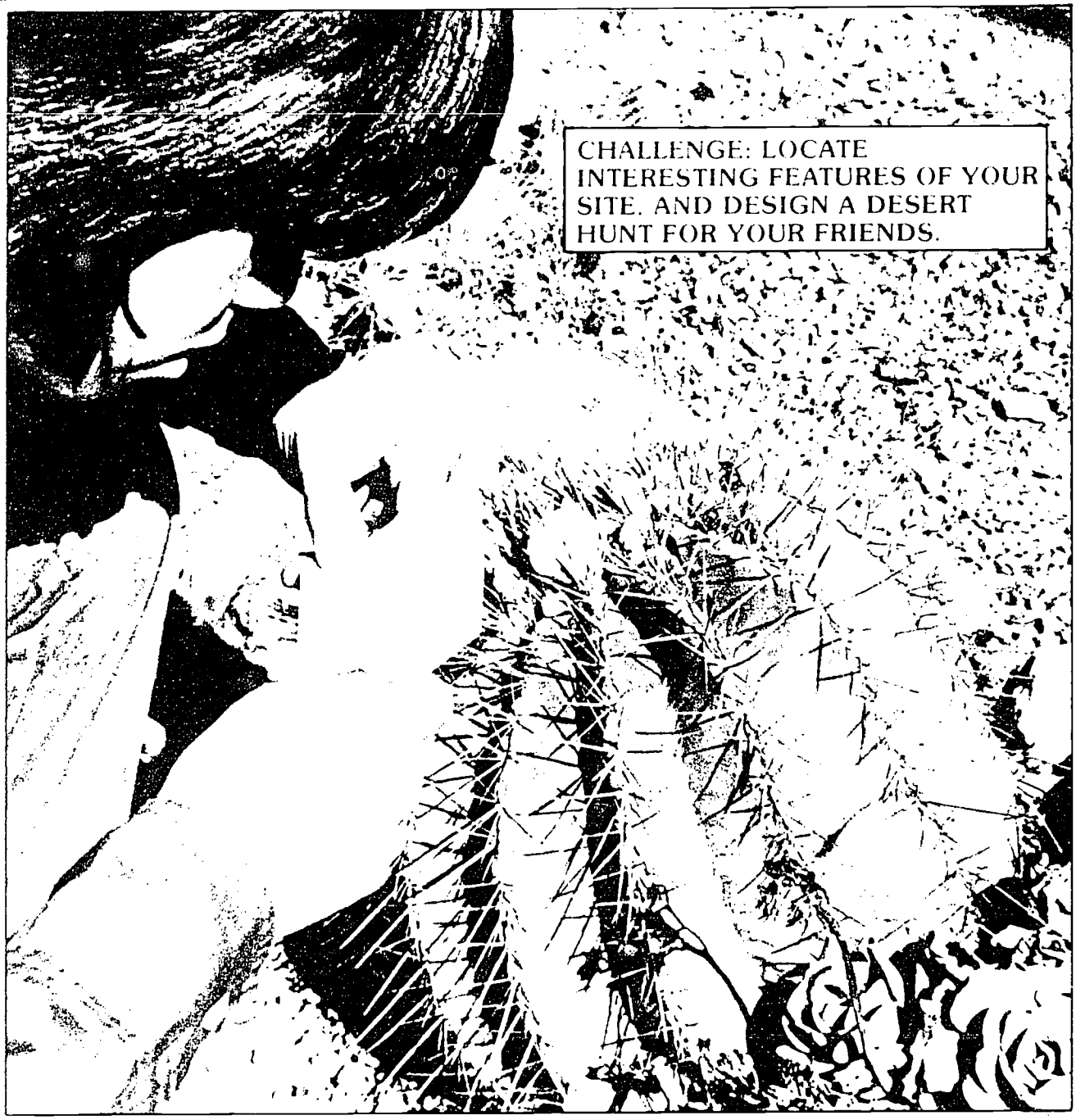
1. Did the decoy color seem to make any difference? What colors got the most and the strongest responses?
2. Why do you think D-Flies respond to your decoys the way that they do? Did any of the D-Flies seem to return to the same perch time after time?
3. Explain that many animals, such as dogs, cats, and many birds, mark out certain areas and defend them against other animals of the same kind. Biologists call these areas ***territories.*** Ask the kids if they think D-Flies have territories. How about people? Ask the kids to explain their answers.

FOLLOW THROUGH

1. Try to get close enough to a dragonfly so that you can watch it breathe. The tail (abdomen) swells up when the dragonfly draws in air and shrinks when it expels air. Compare the dragonfly's breathing rate to your own.
2. Suggest that the youngsters make and set up pipe-cleaner perches of different colors to find out if D-Flies land on one color of perch more often than on others.

WHAT TO DO NEXT

Scram and Freeze	Set IV
Jay Play	Set III
Leapin' Lizards	Set III
Water Striders	Set III
Attract a Fish	Set II



Unusual sights make the desert a fascinating place to visit: Bizarre plants, slithery reptiles, busy birds, and lichen-studded rocks are just a few of the desert's wonders. Although they may appear odd to the casual observer, desert inhabitants are particularly suited to their dry, and very often hot, surroundings.

All the living things in a desert make up the desert community. A ***community*** is made up of all the plants and animals that live and interact in a particular area. *Desert Hunt* introduces the youngsters to some of the plants, animals, and physical features of the desert. Two teams survey separate areas for items described on

hunt cards. Then each team sets up a Desert Hunt for the other team.

MATERIALS

For the group:
1 package of 3" x 5" cards (for hunt cards)
3 different colors of flagging
2 pencils or markers

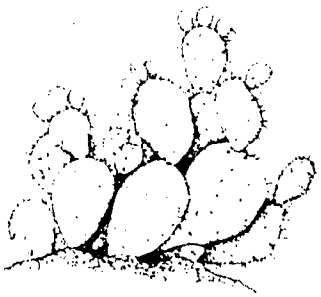
PREPARATION

1. Select two survey areas about 20 m x 20 m each, and use a different color of flagging to mark the boundaries of each site. (The third color of flagging will be given to the youngsters when they survey the areas.) If possible, each area should not be visible to someone in the other area.

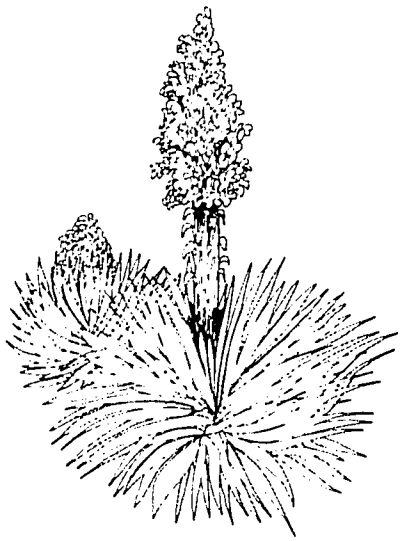
2. Visit both survey areas before selecting about eight challenges for each team (one or more per participant) from the list of Desert Challenges. Some of the challenges may be the same for both teams, but no more than one half should be duplicates. The Desert Challenges list includes appropriate challenges for each of the different desert areas in North America. (If you use challenges dealing with unfamiliar plants, you may want to show the youngsters the illustrations that appear in this folio.)

3. **Desert Challenges**

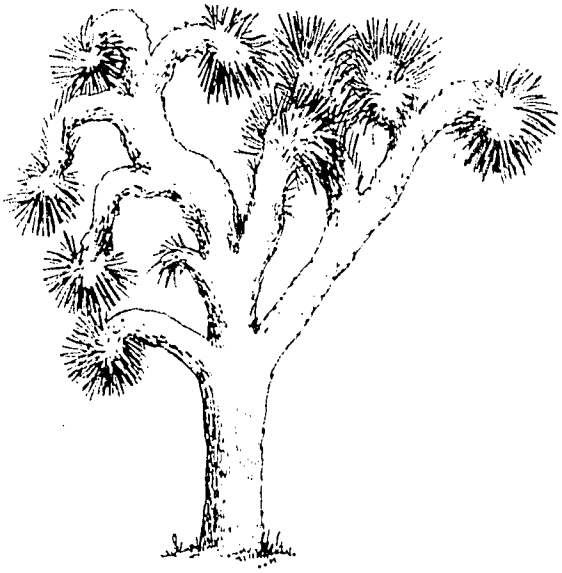
☐ Find the largest prickly pear.



☐ Find the cactus with the most fruits.
☐ Find the cactus with the most holes.
☐ Find the largest patch of shaded ground.
☐ Find the biggest yucca or Spanish dagger plant.



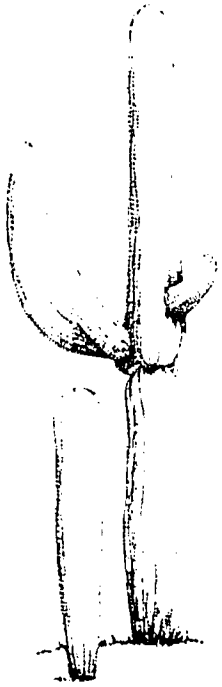
☐ Find the largest cactus skeleton or dead cactus stump.
☐ Find the Joshua tree with the most branches.



DESERT HUNT

- ☐ Find the biggest rock.
- ☐ Find the lowest piece of ground.
- ☐ Find the highest piece of ground.
- ☐ Find the ocotillo with the most branches.

- ☐ Find the clearest set of animal tracks.
- ☐ Find the largest bush with the strongest smelling leaves.
- ☐ Find the largest ant nest.
- ☐ Find the saguaro with the most arms.



- ☐ Find the rock with the most colorful lichen on it.
- ☐ Find the cactus that could hold the most water.
- ☐ Find the tree with the greatest number of plants growing under it.
- ☐ Find the cactus with the most flowers.
- ☐ Find the most visible bird's nest.
- ☐ Find the smallest cactus.
- ☐ Find the largest tree or bush with no spines or thorns.

5. Write each challenge on a 3" x 5" index card. Keep the hunt cards for the two teams separate. Make one card for each team that reads "End of Hunt."

ACTION

The Desert Survey

1. Divide the group into two teams. Explain that first each team will survey its area with its hunt cards, and then each team will set up a Desert Hunt for the other team.

2. Assign each team to a flagged area.

3. Give each youngster at least one hunt card and piece of flagging (the flagging that you did not use to mark the boundaries). Make sure that the youngsters receive the hunt cards that apply to their survey area. Tell the teams that when they get to their sites they should locate and flag the items described on the cards. Tell them that they may not be able to locate every item. As they locate items on the hunt cards, they should sort the cards into piles: "founds" and "not founds." Send the teams off to survey their areas.

4. As you visit each team, assist those youngsters needing help. Encourage team members to help each other and to share observations and discoveries.

5. When each team has found at least five items, they are ready to set up the Desert Hunt.

Trial Edition
Set IV

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Setting Up The Hunt

1. Call the two teams together and give each team an "End of Hunt" card.
2. Outline the following procedure for setting up the hunt.
   a. Each team chooses five or six of the "found" cards. (Both teams should use the same number.) Have each team number the cards, adding the "End of Hunt" card at the end.
   b. Each team returns to its survey area. One team member reads card #1 aloud. The team moves to the location of the flagged item that matches the card.
   c. Another team member reads card #2 aloud (so the team remembers what the next item is), and then hides the card on or within 15 cm (about one handspread) of the object described on card #1. At least 3 cm of one end of the card should be in plain view. The team removes the flag and keeps card #1.
   d. The team then proceeds in a group to the location of the item that was described on card #2. Another youngster reads card #3 aloud and conceals it on or near item 2, removing the flag.
   e. Each team continues this procedure, placing the "End of Hunt" card at the location of the final item and checking to make sure that all flags have been removed from the site except for boundary flags.
3. Send the two teams back to their survey areas to set up the Desert Hunt courses. Check on their progress and answer their questions as they work.

The Desert Hunt

1. When both teams are ready, have the team leaders exchange their #1 cards. Tell the teams to switch areas and go hunting. Ask the players to pick up the hunt cards as they find them.
2. Before the session ends, call everyone together to report on the results of their hunts. Have the teams show each other where unfound items or cards are. Pick up the boundary markers.

DESERT TALK

1. In what ways were your two areas different from each other?
2. Consider all of the different plants that you found in your areas. What are some words that describe most of them?
3. What was the most interesting thing that you found in the desert today?
4. Tell the youngsters that all of the plants and animals living together in the desert make up the desert ***community.*** What things does a desert community have in common with a forest community? In what ways do the two communities differ?

FOLLOW THROUGH

1. If possible, make a second trip to your desert site several days after a heavy rain. In what ways has the site changed since you first saw it?
2. Go back to the site at night. Bring flashlights covered with red cellophane. (Since animals' eyes are not sensitive to red light, the animals will not be startled by your flashlight beams.) Look for animals. Do any of the plants appear different than they did during the day?

WHAT TO DO NEXT

Cactus Wheel	Set IV
Habitat Sun Prints	Set I
Invent a Plant	Set I
Gaming in the Outdoors	Set II

Special adaptations that conserve water allow certain plants to survive in the hot, dry conditions of the desert. An ***adaptation*** is any special feature of an organism that improves its chances of surviving and reproducing. Listed below are four types of adaptations that some desert plants have.

1. A leathery or waxy coating on leaves reduces for many plants the water loss through the leaves.

ied stems or other parts of
ide water-storage space.
eaves or spines (modified
uce the area of the plant
the sun, thus reducing water
e plants, such as the ocotillo
erde, shed their leaves during
further reducing their surface

4. Some plants have spines and fine hairs, which shade the plant and reduce the air currents over the plant's surface.

Many plants have a combination of these adaptations. For example, the hedgehog cactus has enlarged stems; a thick, waxy coating; and a dense cover of spines. All these adaptations enable the plant to store or conserve water.

In *Desert Water Keepers,* the youngsters investigate some of the ways plants have adapted to survive in deserts. The youngsters first make leaf models and measure the amount of water the models lose. They then cover *real* desert plants with plastic bags to determine the amount of water these plants lose.

CHALLENGE: FIND OUT HOW DESERT PLANTS CONSERVE WATER.

MATERIALS

For each team of two or three:
6 drinking straws
6 balls of clay (golf-ball size)
1 plastic coffee stirrer
2 sets of paper-towel leaves (See the "Desert Leaf Models" Technique Card.)
1 permanent-ink marking pen
1 metric ruler
6 plastic bags (about 20 cm x 20 cm)
6 40-cm lengths of string
2 pieces of flagging
1 jar of water colored with blue food coloring

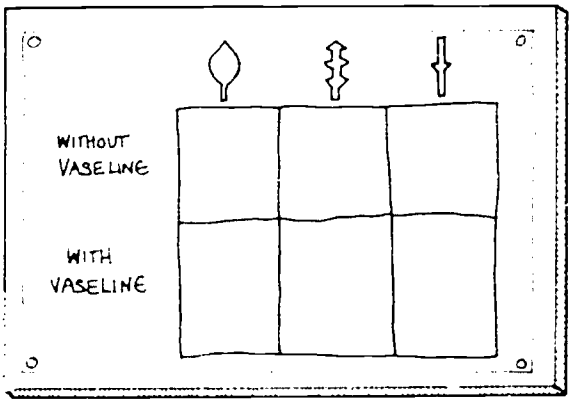
For the group:
- vaseline
- masking tape
1 data board
1 marking pen
1 large comb (needed only if cholla are present)
1 "Desert Leaf Models" Technique Card
1 "Desert Leaf Patterns" card

Optional for "Follow Through":
- clear plastic cups
- clear plastic wrap (Saran Wrap)

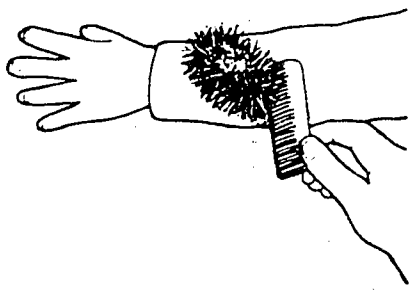
PREPARATION

Site and Day. This activity has been developed for the desert, but can be modified for use in other areas. Wait for a hot, dry day on which to conduct the activity. If necessary, obtain permission to take small samples of the plants.

Materials. Make two sets of paper towel leaves (six in all) for each team of two or three youngsters. (See the technique card and the "Desert Leaf Patterns" card.) Draw the illustrated chart on the data board.



Safety. Caution the children to walk carefully among the cacti. Parts of the choila plant break off the main plant when brushed against and may stick to the youngsters. Use a large comb—*not* bare hands—to remove these cholla parts from clothing or skin.



ACTION

Tell the youngsters that they are going to find out how plants survive in the desert without drying out. Have the youngsters divide into teams of two or three.

Testing Paper Models

1. Distribute two sets of paper-towel leaves to each team. Ask the group to describe the differences in the shapes. Explain that the teams are going to find out which leaf shape gives up the most water and what effect the leaf coating has on the amount of water lost.

2. Use the following procedure for setting up the models:

a. Demonstrate the procedure for making and filling a drinking-straw leaf holder. (See the technique card.) Have each team make and fill six holders.

b. Have the teams moisten *one* leaf of each shape (three in all) and coat the "blade" part with vaseline. (Tell them not to coat the stem.)

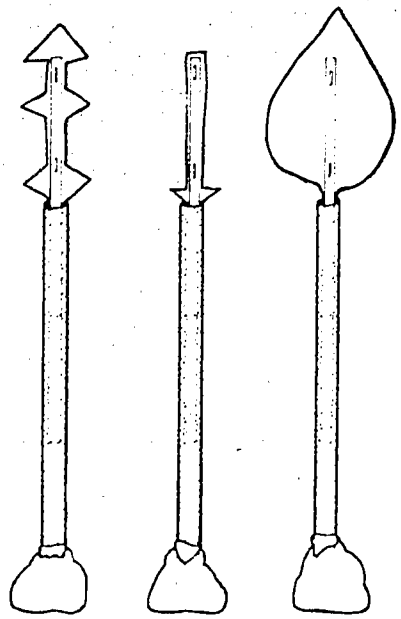
c. Show them how to use the extra coffee stirrer to gently push the leaf stem down into the drinking-straw holders.

d. Have the teams moisten the other three dry leaves.

e. Instruct the teams to put all six leaves into the holders quickly. The leaves should go into the water *at the same time.*

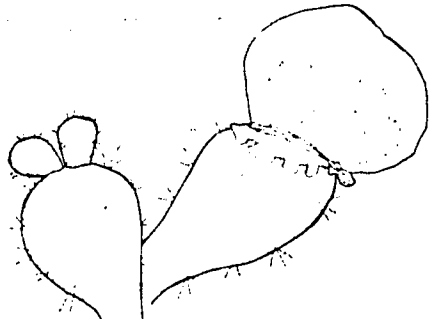
f. Have the teams mark the water level in each straw with a permanent-ink marking pen.

g. Note the time, and place the leaf models in the sun for at least fifteen minutes.



Testing Real Plants

1. After the leaf models are placed in the sun, challenge the teams to find plants with leaves that resemble each leaf model. Hand out the flagging, and tell the youngsters to pick one leaf (no spines!) from each plant and to flag any plants with spines. Let the hunt begin.



2. Call the teams together after about five minutes and ask them to share their findings. Compare the leaves' shapes and sizes with the model leaves.

3. Show the youngsters how to position and tie a plastic bag around some of the leaves or spines on a plant. Tell them not to worry if a few spines puncture the bag.

4. Distribute the bags and string to the teams, and let the youngsters place the bags on some of the plants examined earlier.

5. After the teams have placed their bags, call the youngsters back to the leaf models.

Water Rationale

1. Have the teams mark the new water level on each straw with the marking pen. Have the t ams measure the difference in the water levels with the metric ruler and record the measurement on the chart.
   a. What happened to the water in the straws? (It went into the paper leaves, then into the air, i.e., it evaporated.)
   b. Which kind of leaf lost the most water? The least water?
   c. Why do you think the size of the leaf affects the amount of water lost?
   d. How does the amount of water lost by the vaseline-coated leaves compare to the amount of water lost by the uncoated leaves? How can you explain the difference?

2. Tell the teams to return to the plants they "bagged" and find out how much moisture has collected in the bags.

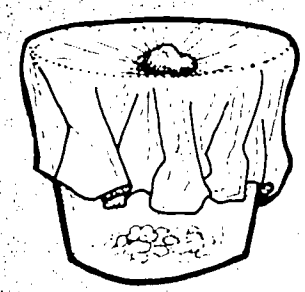
3. Call the youngsters together to discuss their findings. You may wish to use the following challenges and questions to stimulate discussion:
   a. Describe the leaves that lost the most moisture into the bags.
   b. Describe the leaves that lost the least moisture into the bags.
   c. Compare the amounts of water lost by the models to the amounts lost by the *real* leaves with the same shapes.
   d. An ***adaptation*** is any special feature of a living thing that improves its chances of surviving or reproducing. Which plants appear to have the best adaptations for living in the desert?

4. Collect all the bags, string, and flagging before leaving the area.

FOLLOW THROUGH

1. Challenge the group to compare the effects different locations have on the loss of water from leaves. Have the youngsters prepare the leaf models as before and set some in the sun, others in the shade; some exposed to the wind, others protected from the wind, etc.

2. Many desert animals do not *drink* water but obtain it from the plants or animals they feed on. Have the group collect various materials that desert animals eat, other than leaves and stems, e.g., seeds, roots, or flowers. You may also want to put out some raw meat to represent animals eaten by other animals. Tell the youngsters to place each kind of material into a clear plastic cup, cover the cup with plastic wrap, and then place a small pebble in the center of the wrap. Have the teams place the cups in the sun. Which materials contain the most water? How can you tell? Can you think of a way to collect the water? What does the water taste like?



WHAT TO DO NEXT

Cactus Wheel	Set IV
Desert Hunt	Set IV
Sensory Hi-Lo Hunt	Set II
Invent a Plant	Set I
Moisture Makers	Set I

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For many plants, the production of seeds that will grow depends on the transfer of pollen from one flower to other flowers of the same kind. In many cases, wind or animals move the pollen.

Animals such as bees, hummingbirds, and moths visit flowers to collect nectar or pollen for food. In the course of gathering their food, these animals brush against the specialized structures in the flower where pollen is found, and become agents in the transfer of pollen. For example, a bee lands on a flower to gather food, and pollen sticks to its legs, body, or head. When the bee goes to another flower for more food, pollen from the first flower falls onto the second flower. Pollen from the second flower may then stick to a part of the bee's body to be carried to yet another flower.

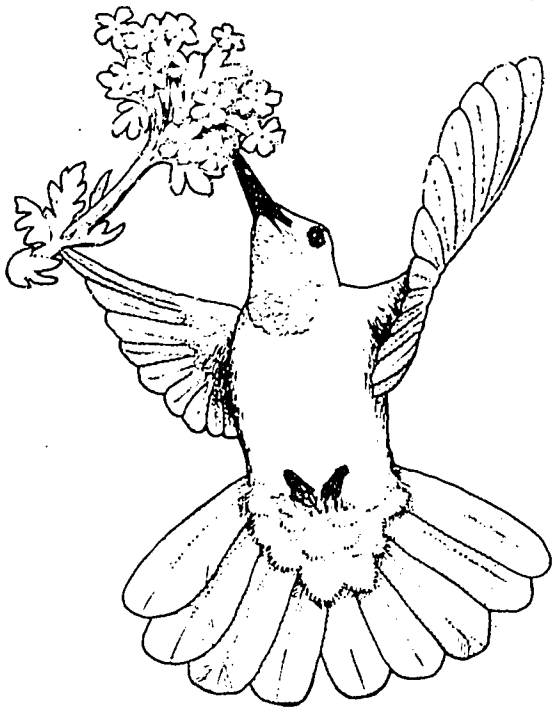
In this activity, your youngsters investigate pollen-moving agents and the pollen-covered structures of flowers. The youngsters first search for pollen on a variety of flowers. Then, with the aid of artificial bees and paper flowers, they find out how pollen is transferred.

CHALLENGE: USE PAPER MODELS OF FLOWERS IN YOUR AREA TO FIND OUT HOW ANIMALS MOVE POLLEN FROM ONE FLOWER TO ANOTHER.

MATERIALS

For each team of two:

1 pollen board (See the "Pollen Collectors" Equipment Card.)
2 artificial bees (See the equipment card.)
1 set of paper flower shapes (See the *Flower Powder* "Shapes" Card.)



1 magnifying lens
- flagging

1 extra 3-oz paper cup

For the group:

- tape
- cotton swabs
- pipe cleaners cut into various lengths
- cotton balls
- yarn
- glue
- clay
- scissors
- popsicle sticks

3 small containers of "Pollen" (one of cornstarch and one each of two colors of tempera paint powder)
1 "Pollen Collectors" Equipment Card
1 *Flower Powder* "Shapes" Card

PREPARATION

This activity works best with ten to twelve youngsters. If your group is larger, divide it into two smaller groups with separate leaders.

Materials

1. **Flowers.** Trace one set of paper flower patterns on construction paper for each team of two and cut out the disk and cone shapes. Tape the cone sides together as illustrated.

2. **Pollen collectors.** Make one pollen board and two artificial bees for each team.

Selecting a site. Choose a site with at least three kinds of flowering plants. Test several flowers with a pollen board to make sure the flowers have pollen. Select one plant with a lot of pollen and flag it for use in your demonstration at the beginning of the activity.

Safety. Before starting the activity, caution any youngsters who are allergic to bee stings against working near flowers with bees on them.

ACTION

1. Gather the youngsters around the flagged plant. Gently press one of its flowers against the pollen board, and show the group the results. Ask them what the dust on the board could be. If no one suggests pollen, tell them the powder is *pollen* and that flowers need pollen to make seeds. Add that, for many plants, the pollen from one flower must be moved to another flower of the same kind to make seeds that will grow.

2. Show the youngsters how to use the pollen board. Tell them the flowers are *not* to be picked for collecting the pollen. Have the group pair up.

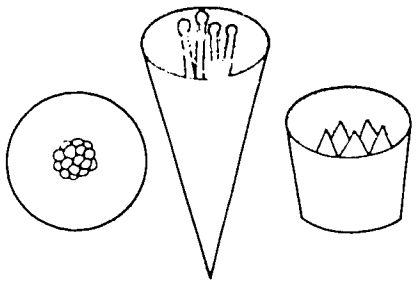
3. Explain that flowers have pollen at certain times, and that some flowers in the area may not contain pollen. Hand out one pollen board and three or four pieces of flagging to each team. Challenge them to find pollen with the pollen boards and to flag those plants that have pollen on them. Encourage them to collect as many different kinds of pollen as they can.

4. After about five minutes, call the group together. Ask the teams to display their pollen boards and point out different colors and textures of pollen.

5. Show the group the paper flower shapes (cone, disk, and 3-oz. paper cup) and ask them to describe the differences in shapes. Tell the youngsters to pretend the paper forms are flowers and ask if they saw any *real* flowers that resembled those shapes.

6. Challenge the teams to find flagged plants with flowers that resemble any two of the different paper shapes. Then tell them to look very closely at the flowers to see what parts or structures in the flower have pollen on them. Give each team one magnifying lens and one set of shapes. Send the teams out to hunt.

7. After five minutes, call the group together. Spread out the craft materials. Challenge each youngster to construct the pollen-bearing structures observed on one of the real flowers and then make a model of the flower by attaching the structures to the appropriate paper shape. Tell the youngsters you will add the "pollen" to the paper flowers after they are completed.



8. Allow at least twenty minutes for the teams to make their pollen-bearing structures and to attach them to the forms.

9. As the youngsters complete their flower models, ask them to point out the

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parts of the model that correspond to the real flower parts that held pollen. Carefully add "pollen" (tempera paint powder or cornstarch) with a popsicle stick to each paper flower at those places. Use a different color of "pollen" in each of the different shapes. Display the finished paper flowers in one area.

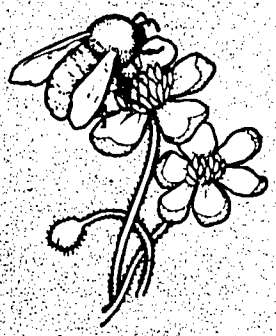
10. Mention that bees visit flowers to collect pollen and sweet juices (nectar) for food. Hand out one artificial bee to each team and tell the kids to "buzz" or visit several of the paper flowers as if the "bees" were collecting food.

11. Ask the kids to describe what happens to the "bees" when they visit the paper flowers. (The "pollen" sticks to the bee's body.) Then have the kids describe what happens to the pollen in the flowers as the "bees" move from flower to flower. (The "pollen" gets mixed up.) Tell the youngsters that flowers must have pollen from the same kind of flower to make seeds.

12. Now challenge the teams to take their "bees" to *real* flowers. Tell them to notice where the pollen sticks to their "bee" bodies as they visit different kinds of flowers. Also ask them to look for insects other than bees visiting the flowers. Give each team a paper cup for collecting other pollinators and a clean artificial bee. Send the teams out to hunt.

13. After the teams have had a chance to work with real flowers, call them together to share their discoveries.

14. Collect the flagging.



MORE BUZZING

1. What kinds of insects other than bees visit the flowers? Let the group pass around any insects they brought back.

2. Besides insects, what other agents could move pollen from one flower to another? (Wind, water, larger animals.)

3. What might happen to plants if we killed all the insects with sprays or poisons? How would we be affected?

4. Could we artificially pollinate flowers? What problems might we have?

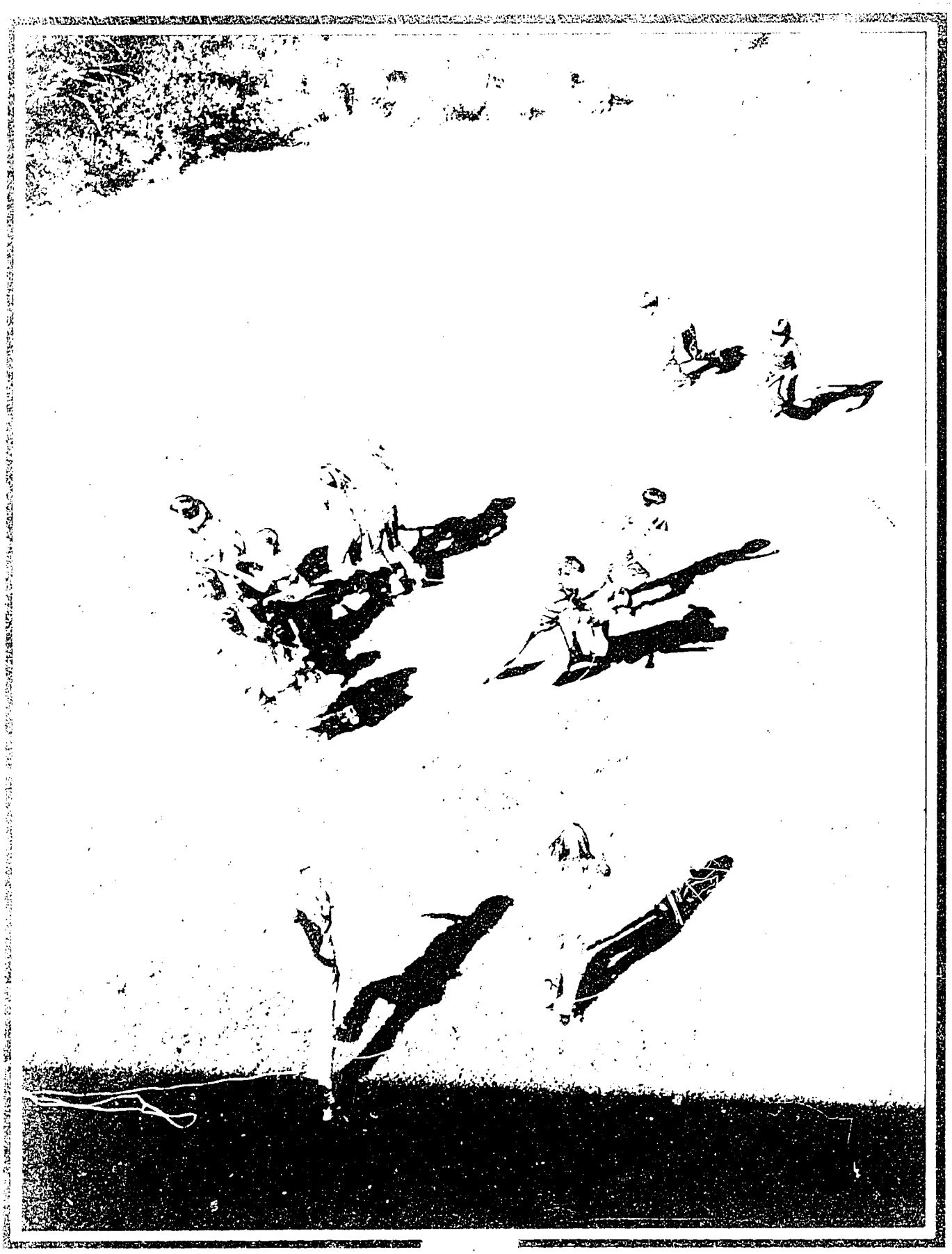
FOLLOW THROUGH

1. Some flowers have shapes that are adapted to the feeding parts of certain animals. Let each youngster use a 5-cm piece of pipe cleaner to represent an animal, such as a butterfly or hummingbird, with a long, thin mouth part. Challenge the team to take their "bee" and the pipe cleaner to different flowers to see which one seems better suited for gathering food from the flowers.

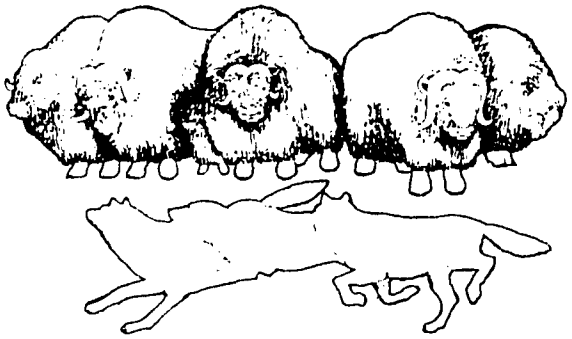
2. Some animals have certain color preferences. Challenge the kids to observe the different animals visiting flowers. See if your youngsters can discover any color preferences.

WHAT TO DO NEXT

Snug as a Bug	Set IV
Mystery Marauders	Set III
Shake It!	Set III
Plant Patterns	Set II
Attention!	Set I
Invent a Plant	Set I



Many animals that live together in groups cooperate to obtain food. For example, a group of dolphins working together can surround a school of fish, making it easier for each of the dolphins to catch enough food. Likewise, a pack of wolves working together can kill larger animals than a single wolf can. Other animals often cooperate to defend themselves. Male musk oxen form a protective circle around the females and young when threatened by approaching wolves. When antelope feed, a few individuals keep watch for danger while the others graze.



Termites (and other social insects such as bees and ants), fish, pelicans, ground squirrels, dogs, and humans all exhibit cooperative behavior. Except for humans, however, this behavior is probably not a matter of conscious choice — especially for the insects — but the end result is much the same: the group as a whole benefits.

In *Helping Out*, the kids learn about the advantages of cooperative hunting and defense by assuming the roles of wolves and antelope. The "wolves" search for ways to improve their hunting success, and the "antelope" look for ways to defend themselves.

CHALLENGE: DISCOVER HOW COOPERATION HELPS WOLVES AND ANTELOPE SURVIVE.

MATERIALS

For the group:

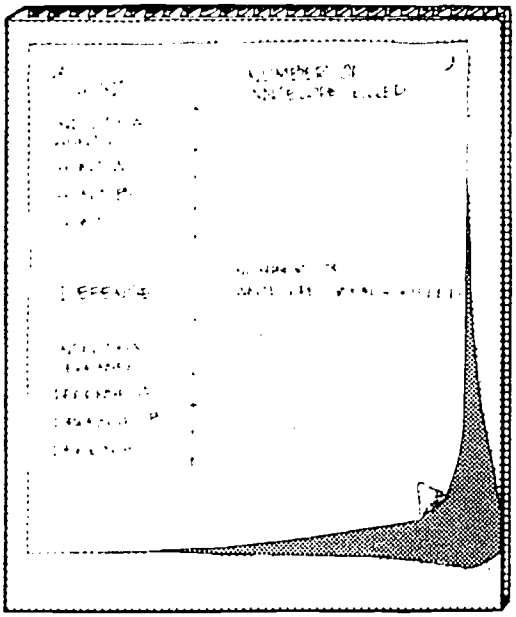
2 sets of colored sashes, 10 cm x 100 cm (See the Preparation section.)
1 data board
1 marking pen
1 50-meter length of rope
1 10-meter length of rope
- chalk

PREPARATION

Materials

1. **Sashes.** The sashes should be strips of two different-colored cloths. Make enough sashes for one-third of the kids (antelope adults) to have one color and another one-third (antelope young) to have sashes of the other color.

2. **Data board.** Copy the illustrated chart onto the data board.



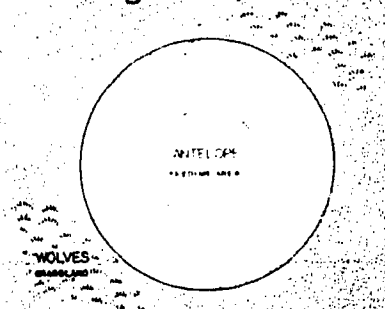
Preparing the site. Any fairly flat section of lawn, ground, or pavement that has a diameter of fifteen meters is sufficient. On a lawn or on the ground, make a circle fifteen meters in diameter with the 50-meter length of rope. Then make a small circle about three meters in diameter in the center of the large circle with the 10-meter length of rope. On pavement, use chalk to mark off the circles.

ACTION

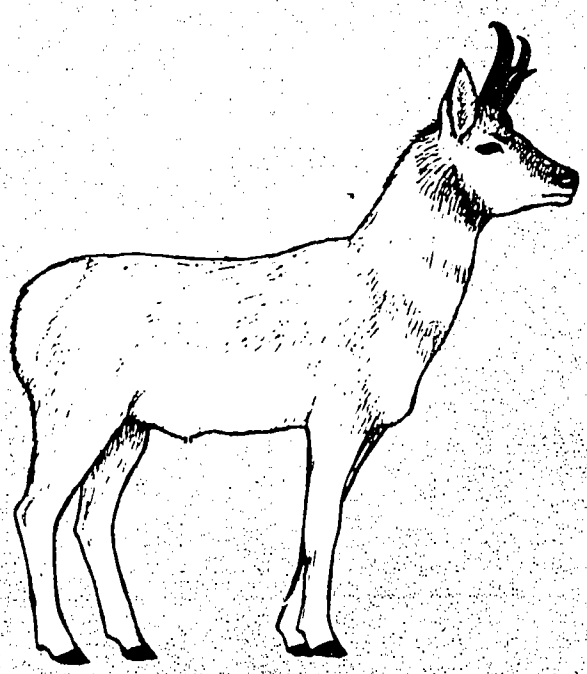
The game has two parts. In the first part, the wolves search for the most effective strategy for hunting the antelope. In the second part, the adult antelope must find ways to defend their young against the wolves.

PART ONE: THE HUNT

1. Designate one-third (but no more than six) of the children as wolves and the remaining youngsters as antelope.
2. The game starts with the antelope in their feeding area (the small circle) and the wolves in the surrounding grassland (outside the large circle).



3. Inform the kids that the wolves hunt and "kill" the antelope by tagging the antelope. As soon as any wolf leaves the grassland (i.e., crosses the boundary of the large circle) to go into the feeding area, the antelope may run to safety in the grassland. Any area outside the large circle is safe.



4. Let one wolf hunt the antelope. After the hunt is finished (i.e., all the antelope are either "killed" or safe in the grassland), call the antelope together. Determine how many antelope were tagged and write the number on the data board next to "Individual Hunts." Let each wolf try his skill at hunting by himself and record each score on the data board.
5. Ask the wolves to think of ways to catch *more* antelope. Choose a wolf, and give him two minutes to whisper his plan to you and the other wolves. Make sure none of the antelope overhear. Call this plan "Hunt A" and inform the wolves that they must *all* follow it. Now let them hunt as a group. When the hunt is finished, find out how many antelope were "killed." Record the number on the data board next to "Hunt A."
6. Suggest that the youngsters try several different plans for hunting. If an antelope comes up with an idea, let her exchange places with one of the wolves. Designate each plan with a letter and record the number of "killed" antelope on the data board.

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PART TWO: THE DEFENSE

1. Divide the antelope into pairs. Give every pair one sash of each color and have each youngster tie one of the sashes around her arm. Tell the youngsters that the kids wearing one color are the young antelope and the kids wearing the other color are the adult antelope.

2. Inform the youngsters that wolves usually hunt young, sick, or old members of an antelope herd; and that real antelope, when cornered by an approaching wolf, protect their young by kicking the wolf. In this game, however, the wolves hunt *only* the young antelope, and the adult antelope protect the young from the wolves by tagging the wolves. The antelope may not hunt (i.e., chase) the wolves. A wolf that is tagged must wait in the grassland for twenty seconds before he can return to the hunt.

3. The wolves must choose *one* hunting plan to use throughout this part of the game. After they decide on which plan to use, let the wolves hunt the young antelope as a group. After the hunt, count how many young were "killed." Record the number on the data board next to "Individual Defenses."

4. Ask the antelope if there are better ways to defend the young. Select one youngster and give her two minutes to whisper her plan to you and the other antelope. Call this plan "Defense A" and tell the antelope that they must *all* follow the plan. Try it out. Record the number of "killed" young antelope on the data board next to "Defense A." (If the kids choose a plan that involves the adults holding hands in a circle around the young, remind them to tag, not kick the wolves. Disqualify anyone who kicks.)

5. Try out the defense plans of other youngsters, making sure that each new plan is different from the others. Designate each defense plan with a letter and record the number of "killed" young antelope on the data board.

WHAT DO YOU THINK?

1. Show the kids the data board, and ask them to identify the most successful hunt and the most successful defense. Discuss how the hunts or defenses made by individuals compare with those made by groups. Why did some plans work better than others?

2. Introduce the term ***cooperation*** as a characteristic of animals that work together. Ask if the kids know of other animals that cooperate.

3. How is cooperation among termites, dolphins, or wolves similar to or different from human cooperation?

FOLLOW THROUGH

Find some animals near you that live in groups, either in the wilds or at a zoo. Challenge the kids to find out if these animals cooperate and, if so, how cooperation appears to help them survive.

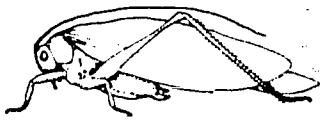
WHAT TO DO NEXT

Population Game	Set IV
Follow the Scent	Set III
For the Birds	Set III
Leapin' Lizards	Set III
Food Chain Game	Set II

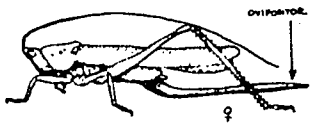
Walk through a grassy field on a warm, sunny day and you will see hoppers jumping and flying out of your path. If you stop to take a closer look, you will find that these insects are of many sizes, shapes, and colors, and make up a conspicuous part of the field community. Hoppers — grasshoppers, katydids, crickets, and mantids — are the focus of this activity.

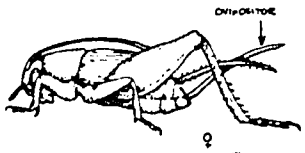
There are several ways to distinguish one kind of hopper from another. For instance, not all hoppers have *antennae* of the same *length*. You can use antennae length to separate hoppers into two subgroups: *short-horned* hoppers (antennae short relative to body length) and *long-horned* hoppers (antennae long relative to body length). The *shapes* of hoppers' *heads* are also different. Some

hoppers have angular heads; others have more rounded heads. The tail-like *ovipositer* is a feature that not only distinguishes (by its length and shape) hoppers of different kinds, but also



distinguishes males from females of the same kind. (Only female hoppers have ovipositers, which they use to lay their eggs in the ground.)





Antennae length, head shape, and ovipositer length and shape are called *key characteristics*. A ***key characteristic*** is any distinguishing feature that can be used to separate different kinds of organisms.

In *Hopper Herding,* the youngsters round up hoppers in a plastic sheet corral. They decide how many *kinds* of hoppers are in their herd, and learn about some of the key characteristics of hoppers. Then the youngsters play a game in which they guess the identity of a hopper after one of the youngsters describes its key characteristics.

CHALLENGE: ROUND UP HOPPERS AND FIND OUT HOW MANY DIFFERENT KINDS ARE IN YOUR HERD.

MATERIALS

For each youngster:
1 large ziplock bag
1 hand lens

For each team of three or four youngsters:
1 clear plastic sheet (for the corral), 100 cm x 130 cm (Two-mil-thick plastic drop cloths make ideal corrals. Most paint and hardware stores have drop cloths in 9′ x 12′ sheets — enough to make nine corrals.)

For the group (up to fourteen youngsters):
2 data boards with paper
2 marking pens
• extra ziplock bags
1 "Hopper Herding with a Plastic Corral" Technique Card
• stiff wire to make cages (optional, for "Follow Through")

PREPARATION

Selecting a Site and Day

1. The site is very important for the success of this activity. Find a grassy field that is thickly populated with a variety of hoppers (at least three different kinds). The site should be literally "hopping" as you walk through it.

2. Order up a warm, sunny day for conducting the activity.

Materials

1. Read over the "Hopper Herding with a Plastic Corral" Technique Card so you can explain the technique to the youngsters.

2. During "The Hopper-Characteristic Game," you will be preparing two Game Bags of assorted hoppers for use in the game. You may want to read this section before conducting the activity. (See step 1 in the game section.)

ACTION

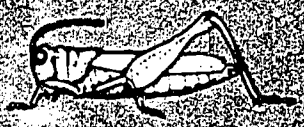
HERDING THE HOPPERS

1. Tell the youngsters that they a
to examine the hopping animals
grassland. With the aid of three
youngsters, demonstrate the use
plastic corral to herd and trap the
hoppers. Give the youngsters a c
see the hoppers move about und
plastic corral and then show them
"bag" a hopper. Remind the kids
the animals should be handled ca
the animals must be released unh
at the end of the activity.

2. Divide the youngsters into tea
three or four. Give each youngste
ziplock bag, and each team a plas
corral. Challenge the youngsters t
as many *different* kinds of hopper
they can.

3. Circulate among the teams,
encouraging each youngster to ob
all the animals in the mini-commu
underneath their plastic corral whi
bag the hoppers.

4. After each youngster has colle
number of different hoppers (abo
fifteen minutes), call the teams toc
and ask the youngsters to pair up.
each youngster a hand lens for a
look at his hoppers. Challenge ea
to decide how many different kinc
hoppers they have in their two ba
*Caution the youngsters to keep cl
bags out of direct sunlight so the
don't "cook."*



HOPPER HERDING

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5. Ask your youngsters how they distinguished one kind of hopper from the others. Record the differences the kids mention on one of the data boards. Their list should include some of these characteristics:

a. Length of the antennae (as compared to body length).
b. Shape of the head.
c. Color.
d. Markings on the legs, back, and head.
e. Length of the wings (as compared to body length).
f. Overall size.
g. Shape and length of the female "tail" or ovipositor.

If the youngsters don't mention all these characteristics, add the ones they missed to the list. Make sure the youngsters understand what the various characteristics are.

6. Introduce the term ***key characteristic***. Tell the kids that they have made a list of the key characteristics or distinguishing features of hoppers. Review the key-characteristic list as you reproduce it on the second data board. (You will need two lists for the Hopper-Characteristic Game.)

7. Place one of the hoppers into a plastic bag. Describe the hopper to the youngsters, using the list of key characteristics. For example, you might say, "This hopper has antennae longer than its body. It has no special markings, and is all green. Its wings are also longer than its body. And this female has a very long, spearlike ovipositer that points straight back from her body." Pass the bag around so everyone can see the hopper.

THE HOPPER-CHARACTERISTIC GAME

1. **Preparing for the game.** Seven youngsters is the maximum number for one game. If your group is larger, divide it into two equal groups. Each group plays a separate game. Collect all the youngsters' hopper bags. Take a variety of hoppers from these bags and make a Game Bag of assorted hoppers for each group.

2. Give each group one Game Bag along with one of the data-board lists of key characteristics. Explain the rules.

a. One youngster is the key witness. He secretly chooses a particular hopper from among those in the Game Bag. The chosen hopper remains in the bag along with the others for the group to see.

b. The key witness then describes the secret hopper with its key characteristics while the rest of the group views the bag of hoppers.

c. When the key witness is finished, the group guesses which hopper the key witness described.

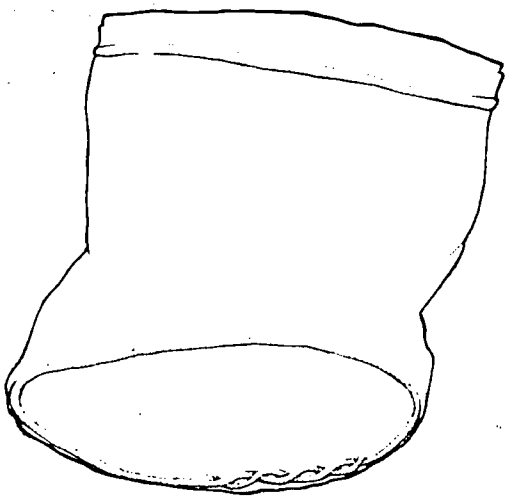
d. Give each youngster a chance to be the key witness.

3. After each youngster has been a key witness, challenge the youngsters to choose only one or two key characteristics. Can the group still guess which hopper the key witness describes?

4. Give each of the youngsters a bag of hoppers and challenge them to find out what happens when the hoppers are released. How do they escape? Do they hide? Hop? Fly? Where do they go?

FOLLOW-THROU

Hoppers are voracious plant eaters. Ch[illegible]ge the youngsters to find out how [illegible] hopper can eat. The youngsters [illegible]ke a hopper cage by forming a bu[illegible] piece of stiff wire into an oval and placing it into the bottom of a large ziplock bag. They should make air holes near the top of the bag. The youngsters can keep a hopper in the cage for a few days and feed it different kinds of green leaves to see how much it eats. What might a large number of hoppers do to an agricultural crop?



WHAT TO DO NEXT

Bugs, Worms, and Others	Set IV
Mystery Marauders	Set III
Animal Diversity	Set II
Hopper Circus	Set II
Animals in a Grassland	Set I
Invent an Animal	Set I

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In many areas, a brilliant color display in forests, parks, and yards announces the onset of autumn. After a few weeks, the colors fade and the leaves die and drop to the ground, forming a deep, drifting, crunchy layer. This leaf layer is a place to hide, a place to hunt, a place of shelter, and a source of food for a variety of small animals. Birds, mice, and shrews scratch and scurry among the leaves to look for food. Worms, snails, beetles, and

an occasional spider seek protection or food under the leaves. The close observer might even spy some ants, a pillbug, or tiny mites in the leaf layer.

To discover what life is like in this leafy world, the youngsters create a giant leaf layer and dive in. They play two games while cavorting in the leaf pile: Predator versus Prey and Getting Around.

CHALLENGE: FIND OUT WHAT LIVING IN OR UNDER A LAYER OF LEAVES IS LIKE.

MATERIALS

For each youngster:
1 leaf rake (If you can't get enough rakes, use large pieces of stiff cardboard.)
1 plastic bag (optional for "Follow Through")

For the group:
1 three-meter piece of string
1 apple
4 thermometers (optional for "Follow Through")

PREPARATION

Selecting a site. Choose a site with plenty of leaves on the ground.

Clothing. The youngsters will enjoy their under-the-leaves experience more if they *do not* get leaves inside their clothes. Recommend that the kids wear clothing that fits tightly around the neck and wrists. Tell the youngsters to tuck their shirttails in and to tuck their pants legs into their socks. Stocking caps or garments with hoods are "deluxe" for this activity.

Safety

1. Make sure that your leaf pile contains no sharp sticks.
2. If some kids are allergic to leaves or pollen, keep them out of the leaf pile. They can, however, participate in other parts of the activity.
3. In some parts of the country, ticks may inhabit leaf piles. Be aware of this possibility, and have the kids check each other for ticks after the activity.

ACTION

PART ONE: MAKING THE PILE

1. Point to the layer of leaves under the autumn trees, and tell the youngsters that the layer provides a great home for small animals. Then tell the kids that they are going to make a pile of leaves that is deep enough for people, so they can find out what living in the leaves is like.
2. Distribute rakes and cardboard sheets. Have the youngsters make a very large pile of leaves. Make two piles if your group has more than eight kids. A pile one meter deep and three meters on a side is about right for eight youngsters.
3. Let the kids dive and roll in the leaf pile for a few minutes; then call them out to play the two leaf games: Predator versus Prey and Getting Around. Pile the leaves up again if necessary.

PART TWO: PREDATOR VERSUS PREY

A *predator* is an animal that seeks and captures living organisms for food. The organism that a predator captures and eats is the *prey*.

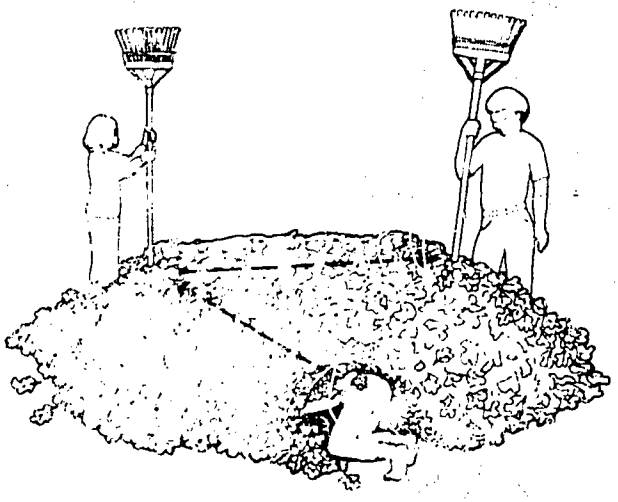
1. For each round, select four youngsters: two predators and two prey. Let the rest of the group watch.
2. The "predators" hide their eyes while the "prey" hide in the leaf pile.
3. Each predator looks the pile over and makes three *strikes* in an attempt to capture a prey. A *strike* is a reach into the pile where a predator suspects a prey is hiding. No feeling around — only a straight reach in.
4. Play enough rounds for everyone to participate

Prey Tell

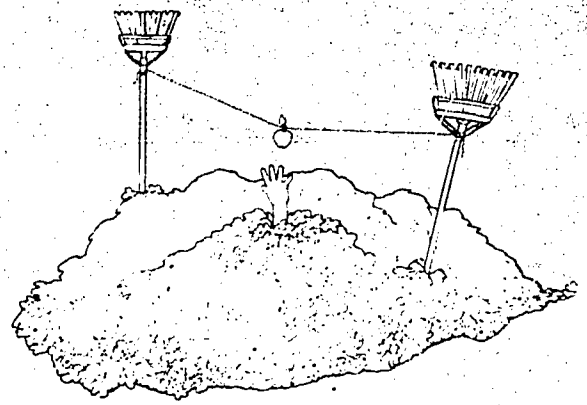
1. How many prey were captured? How were they located? Bumps in the pile? Movement? Noise? Breathing?
2. How did you feel when you were a prey? Was it scary? Exciting? Did you hold your breath?
3. Why would you hide in a leaf pile from a predator?
4. If you were a predator, how would you hunt in leaf piles?

PART THREE: GETTING AROUND

1. Stick two rake handles straight down into opposite sides of the pile, and ask two youngsters to hold the rakes up.



2. Challenge one youngster to wiggle on her belly to one rake handle, then turn and make it to the other handle. She must stay in the pile — no peeking! Sound easy? Try it!
3. Hang a string between the two rake handles. Tie another string around the stem of an apple; and hang the apple from the string line directly over the pile.
4. Challenge one youngster to enter the pile from the edge and belly-crawl to a spot where she can reach up through the pile and grab the apple. A reverse apple bob!!



5. Let the youngsters try their skill at navigating in the pile of leaves as long as time and interest permit.

Leaf 'em Thinking

1. What senses are most useful for navigating in the leaf pile?
2. What abilities would make navigating in the leaf layer easier for you? How would you change your body for easier navigation in the leaves?
3. What animals can you think of that are adapted for moving through the leaves?

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FOLLOW THROUGH

1. Ask the youngsters to search for leaf-layer animals in an area where the leaves have not been disturbed. Let the youngsters determine whether the animals are potential predators or prey. The kids might find a mouse or toad, but more likely they will find spiders, moths, grasshoppers, flies, pillbugs, and grubs. Suggest that the youngsters put several animals into a plastic bag with a leaf or two to see how the animals interact.

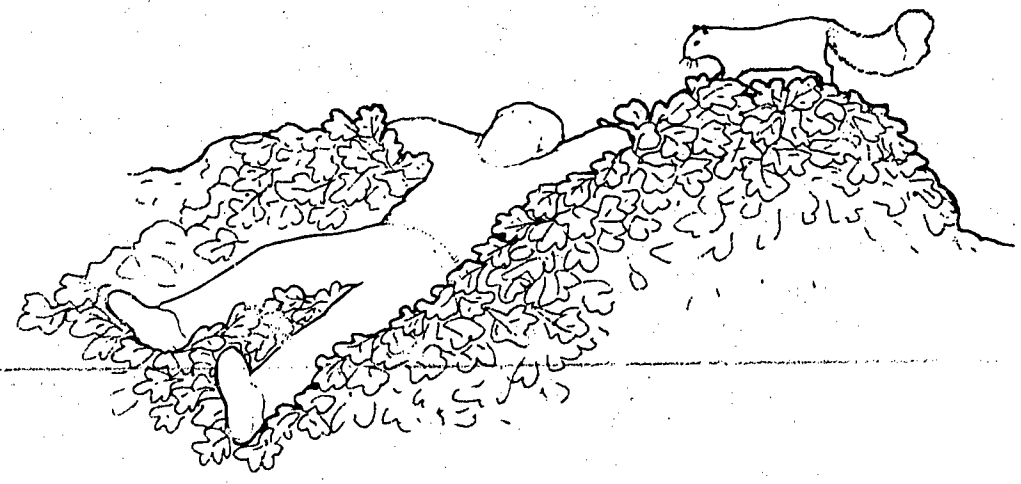
2. Challenge the youngsters to check out the physical environment of an undisturbed leaf pile. Have them compare the temperatures found inside and outside the pile with thermometers. They can use their hands to check for moisture.

3. Does the leaf pile offer protection from the elements? Send some kids into the pile and turn on a sprinkler to see if the pile would protect them from rain. (Those inside will want to wear wet-weather gear.) Would the pile also offer protection from the wind?

4. The youngsters can use the leaf pile for a survival experiment during mild weather. If occasions permit, let the kids sleep in the leaf pile without blankets or sleeping bags.

WHAT TO DO NEXT

Fly a Leaf	Set III
Pigment Puzzles	Set III
Silent Stalking	Set III
Litter Critters	Set II
Adaptation — Predator-Prey	Set I
Invent an Animal	Set I



Have you ever walked across a woodland floor and found yourself stumbling over large bumps? If you had stopped to push away some of the leaves and twigs covering these mounds, you might have discovered a tree — or what was once a tree.

Something caused the tree to fall, perhaps the wind, a fire, a flood, disease organisms, or even the action of humans. In the form of a decaying log, the tree serves as a source of nutrients and shelter for millions of organisms. Most of these organisms are microscopic. Larger organisms that inhabit the log include a variety of fungi and small critters such as bristletails, wood lice, millipedes, ants, termites, and beetles. Germinating seeds and roots of other adult trees often grow in the decomposing log. Given enough time and the proper environmental conditions, the log will break down completely and return to soil.

In *Logs to Soil*, your youngsters unravel the mystery of the life and death of a fallen tree. They cut through a decaying log with a saw and remove a slice of wood to expose a vertical profile. While investigating their log profiles for evidence of the tree's life history, the youngsters take samples from the top of the log down to the soil level. Each team then creates a mix-and-match game of log samples and challenges another team to discover the proper order of the samples.

CHALLENGE: UNRAVEL THE MYSTERY OF *LOGS TO SOIL* BY SAMPLING A ROTTEN LOG.

MATERIALS

For each team of three or four:

1 box saw or crosscut hand saw
1 bag
1 trowel
1 egg carton for storing samples
• hand lenses or bug boxes*
1 marking pen
1 meter tape* or ruler
1 large envelope (8½" x 11")
12 4 cm x 8 cm cards (Four 3" x 5" index cards cut into thirds)
12 paper clips
• white glue
1 Action Card

For the group:

1 piece of flagging for each log "bump" (See the "Preparation" section.)
1 sheet of Action Cards
• extra egg cartons

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

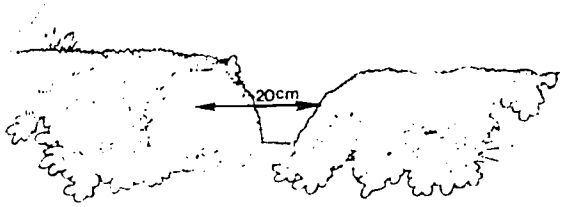
PREPARATION

Selecting a site

1. Any site (yard, woodland, or moist field) with soft pulpy rotten logs will do for this activity. The logs should *not* be newly fallen trees. (Save these for *Sawing Away*.) Look for lumps on the ground; they should be identifiable as logs once the ground litter is removed, and should be very well decomposed. You should be able to tear the log apart with your hands. If necessary, obtain permission to cut the rotten logs.
2. Find and flag one log for each team and one for your demonstration.

Sampling technique. Select a log to use in demonstrating the sampling technique to the youngsters. You may want to practice the technique first.

1. Clear away the litter and dirt around the log down to the soil.
2. Make two parallel cuts about 20 to 25 centimeters apart with the saw.
3. Remove the slice of wood from between the two cuts and toss it aside. You may have to dig it out with a trowel. You now have two vertical profiles remaining on the log for study.



4. Measure the profile with the meter tape. Then remove a chunk of log material from the profile every 3 cm starting from the forest litter on the top of the log down to the ground side. If you can't get a sample with your fingers, use the trowel. Store and label the samples in an egg carton. Remember to keep the samples in "profile" order in the cartons.

LOGS TO SOIL
Action Card

Logging Observations

1. What might have caused your tree to fall? How long has it been down? How old was it when it fell?
2. Which part of the log is *decomposing* or rotting fastest? How can you tell?
3. Where in the log do you find the most moisture?
4. What kinds of plants and animals can you find living in or on your log?

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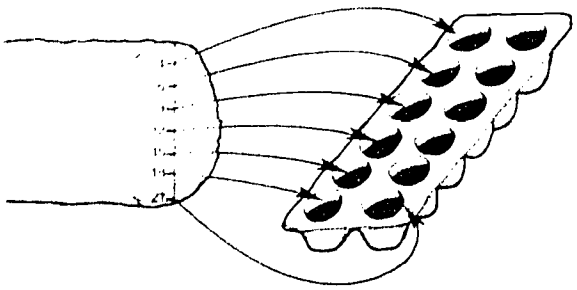
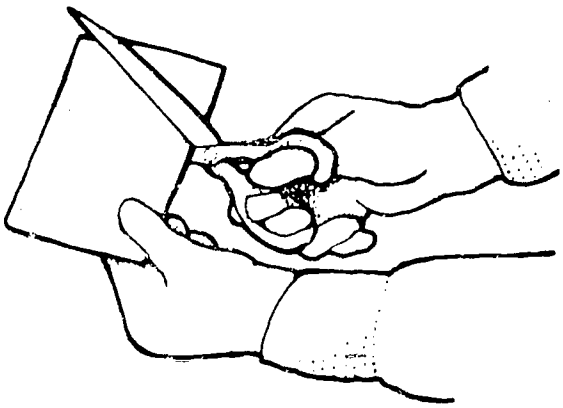


5. When you are finished, replace the cut-out section and cover the log with litter as it was before.

Materials

1. Put a trowel, an egg carton, a marking pen, hand lenses or bug boxes, and a meter tape or ruler into a bag for each team.
2. Make one Action Card for each team.
3. Cut four 3" x 5" index cards into thirds for each team. Place these twelve cards along with twelve paper clips into a large envelope for each team.



Safety. Give the youngsters these rules about saw safety:

1. When using a saw, keep your fingers (and thumbs!) well out of the saw blade's way.
2. *Walk* when holding a saw. Point the saw teeth toward the ground.
3. When you are not using the saws, pile them out of people's way.

ACTION

1. Explain to the group that there is a mystery to solve in these woods. Stand on one of the log-lumps and ask the youngsters what it is. If they can't figure it out, reveal that the lump is a fallen tree. Ask the youngsters how it is different from a tree that is still standing.
2. Show the youngsters the demonstration log. Have them help you remove the litter, and then dig down to the bottom of the log with their hands. Go over the saw-safety rules. Show the students how to use the saw to make two parallel cuts in the log. Remove the section of log between the cuts, and show the youngsters the vertical profiles remaining on the log. Then show them how to take log samples from the profile, and how to store and label the samples in an egg carton. (See the "Preparation" section.)
3. Inform the kids that they are going to locate a flagged log, saw through it as demonstrated, and collect profile samples. Challenge them to look back in time to solve the mystery of *Logs to Soil* by answering the questions on the Action Card:
   a. What might have caused your tree to fall? How long has it been down? How old was it when it fell?
   b. Which part of the log is *decomposing* or rotting fastest? How can you tell?
   c. Where in the log do you find the most moisture?
   d. What kinds of plants and animals can you find living in or on your log?
4. Divide the group into teams of three or four. Give each team an Action Card, a saw, and a bag of equipment. Help them get started. In some cases, the youngsters will have difficulty in making a clean vertical profile. Encourage the teams to do their best and to look for life as they go. Have the youngsters take samples every 3 cm and label the

samples as they place them in the egg carton.

5. If a team finishes early, encourage the kids to make a second profile at a different portion of the log, or to sample another log. Provide another egg carton for this purpose.

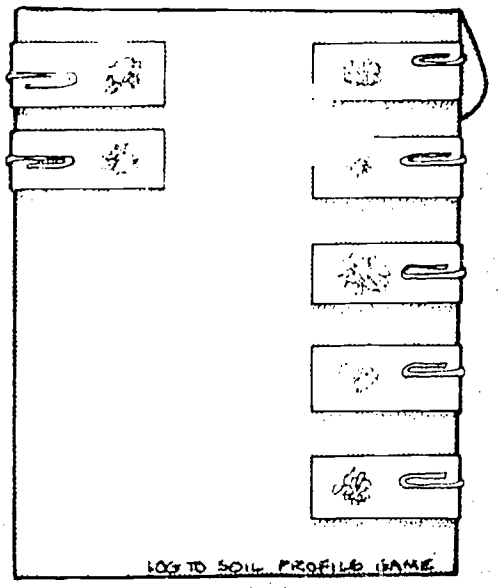
6. Call the teams together and ask them to discuss their answers to the Action-Card questions. Encourage them to show their samples as evidence for their answers.

7. All the logs should be "reassembled" at the end of the activity — complete with litter on top. Challenge the teams to make the logs look as if the youngsters were never there.

THE LOGS-TO-SOIL GAME

1. Give each team an envelope containing twelve cards, twelve paper clips, and a container of white glue.

2. Have each team member take small bits of their log samples from their egg cartons and glue the pieces onto a separate card. Then have them clip the cards to the envelope in *random order*. Make sure that the remainder of each sample stays in the egg carton to serve as a permanent record of the proper order.



3. After the teams have finished their puzzles, have them exchange envelopes. Challenge the teams to arrange the sample cards in the proper profile order, i.e., the same order as the samples appear in the egg cartons from which they came.

LOGGING OBSERVATIONS

1. What difficulties did you have in putting the samples into the proper order? What clues did you look for?

2. What similarities and differences did you find in the samples from different logs?

3. What evidence is there that the fallen tree is beneficial to the plants and animals in the environment?

WHAT TO DO NEXT

Sawing Away	Set IV
Tree Tally	Set IV
Swell Homes	Set III
Lichen Looking	Set II
Litter Critters	Set II
Natural Recycling in Soil	Set I

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CHALLENGE: INVESTIGATE MYSTERIOUS EYES IN THE NIGHT

MATERIALS

For the Night-Eyes Simulation:

For each team of two:

2 flashlights with fresh batteries

For the group:

1 15-cm length of reflective tape
1 red-orange crayon or red grading pencil
- black construction paper

1 pair of scissors
1 hole punch (optional)
1 6- to 8-meter piece of flagging or rope
1 data board
- carpet tacks or other dark-headed tacks

For the Mystery-Eyes Hunt:

For each team of two:

1 tablet or small data board
1 pencil or other marker
2 flashlights

PREPARATION

Night Eyes is most suitable for small groups. If you have more than twelve youngsters, you should form two equal groups, each with its own leader and site.

Selecting a site. Choose an open field or a large clearing that borders on a forest or pond for the Mystery-Eyes hunting site. In addition, select a smaller area (or one corner of the larger site) at which to set up the Night-Eyes Simulation. Avoid lighted areas and areas that could be dangerous after dark (e.g., areas with obstacles, steep grades).

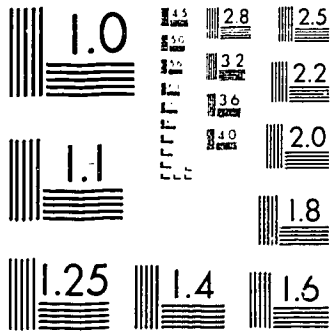
Choosing a time. Schedule the activity to begin at least one hour after sunset. Wait for a warm night when many insects or other small animals are about.

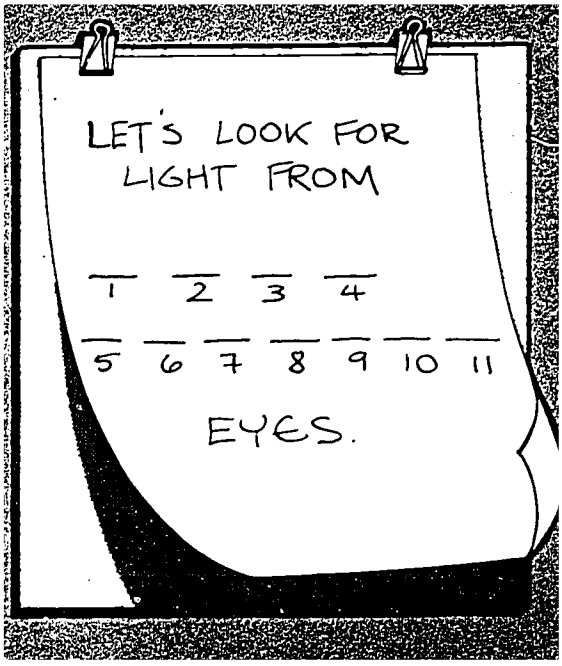
Practicing the Mystery-Eyes Technique

At the site, hold a flashlight at eye level and sweep the beam slowly over the grass, bushes, and trees at various distances. Look closely for sharp points of light that might be reflected from animals' eyes. Eye-shine may be discernable across amazingly long distances. When you see small specks of green, white, or orange light, keep your flashlight beam on the source as you approach the specks to get a better look. Watch carefully. Larger animals will run or hide as you approach. However, you can often get a good look at spiders, moths, and some bi

Setting up the Night-Eyes Simulation

1. Choose one or two code words that contain about twelve letters. "Wolf Spiders" (common sources of eye-shine in fields) is a possible choice.
2. Write a sentence containing the code word on the data board, but leave numbered blanks in place of the code-word's letters.




LET'S LOOK FOR
LIGHT FROM
1 2 3 4
5 6 7 8 9 10 11
EYES.

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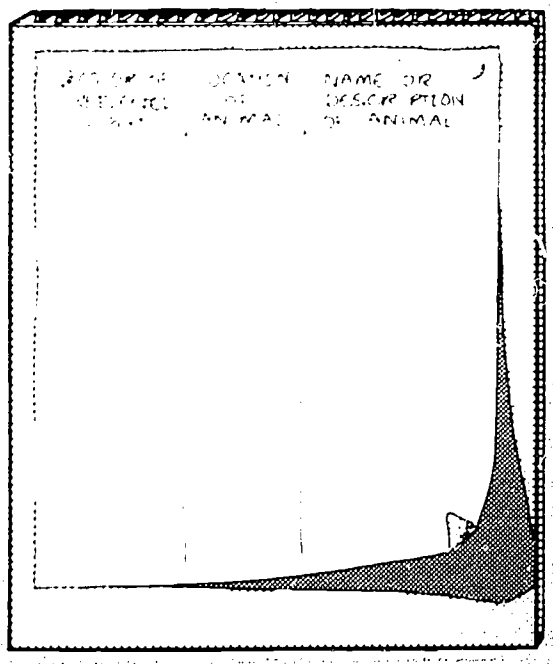
MYSTERY-EYES HUNT

1. Inform the children that many creatures that are active after dark have eyes that reflect light. Tell them that now they are going to use the eye-shine technique to look for spots of white, green, and orange light that could be reflected from the eyes of animals.

2. Give each team of two a tablet or small data board and a pencil. Read the column headings on the illustrated chart to the youngsters. Ask them to copy the headings and use them to keep a record of the eyes they spot. Suggest that they will have better results if they are quiet and scan the area thoroughly.



3. At first, work with the whole group. Find one or two spots of light and have the kids fill in the data on their charts. Encourage the youngsters to *guess* the identity of the creature whose eyes they spot before carefully approaching for a better look.

4. Now let the teams work individually. Keep them within easy calling distance so they can share discoveries.

5. Save a few minutes at the end of the session to share observations and discoveries.

DARK SECRETS

1. What animals did you find most often?

2. What was the most unusual or most exciting discovery your team made during the Mystery-Eyes Hunt?

3. Animals that are active at night are called ***nocturnal*** animals. Did you come across any animals that did not appear to be really nocturnal? What were they doing? Did they have reflecting eyes?

4. What other lights in the night (besides eye-shine) did you find? (Fireflies, glow worms or other grubs, certain fungi, snail trails, tiny animals in pond water, and bits of litter are all possibilities.)

FOLLOW THROUGH

1. Did you spot eye-shine from animals that fled before you could identify them? These are often mammals. Let the youngsters devise and try out a plan to get a better look at the mystery creature on other nights.

2. Try the Mystery-Eyes Hunt at several different habitats and compare the number and kinds of creatures observed.

WHAT TO DO NEXT

Silent Stalking	Set III
Night Shine	Set III
The Old White Sheet Trick	Set II
Who Goes There?	Set I

CHALLENGE: FIND OUT HOW MANY DEER CAN SURVIVE IN YOUR HERD'S HOME RANGE.

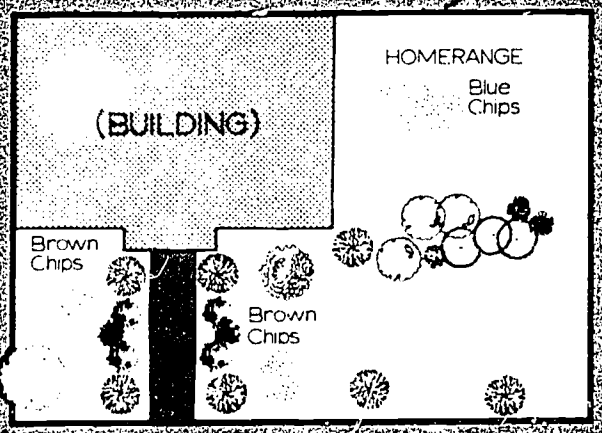
MATERIALS

For each youngster:
- 10 home-range poker chips (one color)
- 6 new-range poker chips (another color)
- 4 plastic sandwich bags

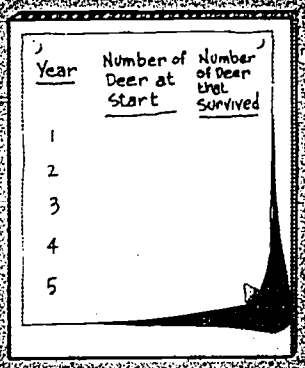
For the group:
- flagging or rope for marking off the home range
- 1 kitchen timer
- 1 data board
- 1 marking pen

PREPARATION

1. Mark off a circle approximately ten meters in diameter to be the home range. Scatter the home-range chips throughout the circle.
2. Choose two areas that are visually obscured from the home range and at least ten meters away. Scatter half of the new-range chips throughout each area. These areas will serve as new feeding ranges (available in the fifth round of the game).



3. Reproduce the "Number of Survivors" chart on the data board:



ACTION

Introducing the Game

1. Explain to the youngsters that in *Population Game* each plastic bag represents a deer. All of the bags together represent a population of deer. Define ***population*** as a group of organisms of one kind living together in a particular area. Tell the youngsters that the chips in the circle represent the plants that deer eat. The challenge for the youngsters is to collect food for the animals in the herd.
2. For a deer to survive a two-minute year, it must have at least five chips. The youngsters may collect more than five food chips per deer, but not more than ten. Sharing or pooling of chips by different players is not permitted in this game.

Note to the leader: At the end of each round you will be collecting the "deer" (bags) that have not survived that round. At the beginning of each new round you will be handing out an additional bag for each deer that survived (simulating reproduction). If any youngsters are left without deer, redistribute the bags among the youngsters so that everyone can participate.

POPULATION GAME

Trial Edition
Set IV

Playing Round One: The First Year

1. Give each child one plastic bag (one deer).
2. Set the timer for two minutes and turn the kids loose in the home range to collect food chips for their deer.
3. At the end of the two-minute period, recall the group and ask how many deer survived.
4. Record on the data board the number of deer that started the round and the number that survived the first year. Collect any "deer" that didn't survive.

Introducing the Second Year

1. Explain to the youngsters that populations grow through reproduction. Tell them that they will simulate the effect of reproduction by adding one deer for every deer that survived the last year.
2. Hand out the additional bags. All of the participants should now be collecting food for two deer.
3. Redistribute the collected food chips in the home range.

Playing Round Two: The Second Year

1. Explain to the youngsters that they are in the process of determining the carrying capacity of the home range. Tell them that ***carrying capacity*** is the greatest number of animals of one kind that can survive in a certain area. Point out the number of deer entering Year Two and ask the group to predict the number that will survive. (At this point, you might add a Predictions column to the chart.)
2. Set the timer. On signal, each youngster should try to collect at least five food chips in each of his or her two bags.
3. At the end of the round, add the number of surviving deer to the data board. Compare the number of survivors with the group's predictions of carrying capacity. Collect the casualties.

Year	Number of Deer at Start	Number of Deer that Survived
1	11	11
2	22	14
3	28	
4		
5		

Introducing the Third Year

1. Once more announce that surviving deer will reproduce, and give each surviving deer an additional bag. Some youngsters must now collect food for as many as four deer.
2. Redistribute the collected food chips in the home range.

Playing Round Three: The Third Year

Play the round exactly as Round Two was played, recording the results on the data board.

Introducing the Fourth Year

1. Hand out one more bag for every surviving deer.
2. Announce that because of the large number of deer feeding on the range in the last year, the plants that deer eat have been damaged, and food production has been lowered. Remove one-fourth of the food chips and redistribute the remaining chips in the home range.

Playing Round Four: The Fourth Year

1. Point out the number of deer that are entering the round and remind the youngsters of the lowered food supply. Ask for estimates of the carrying capacity of the range under the new circumstances. How many deer do they think will survive now?

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2. Set the timer and let the round begin. Record the results.

Introducing the Fifth Year

Ask the group what a herd of deer might do when its home range does not produce enough food for most of the deer to survive. If necessary, introduce the idea of dispersal to a new feeding area. Tell the group that in this round, after all the available food in their home range has been eaten, the herd may disperse and search for new feeding areas.

Playing Round Five: The Fifth Year

1. Hand out one more bag for each surviving deer.
2. Redistribute the reduced number of chips (the same number used in Round Four) in the home range.
3. Let the round begin.
4. At the end of the round, call everyone together and find out how dispersal affected the number of deer that survived.

THINKING ABOUT POPULATIONS

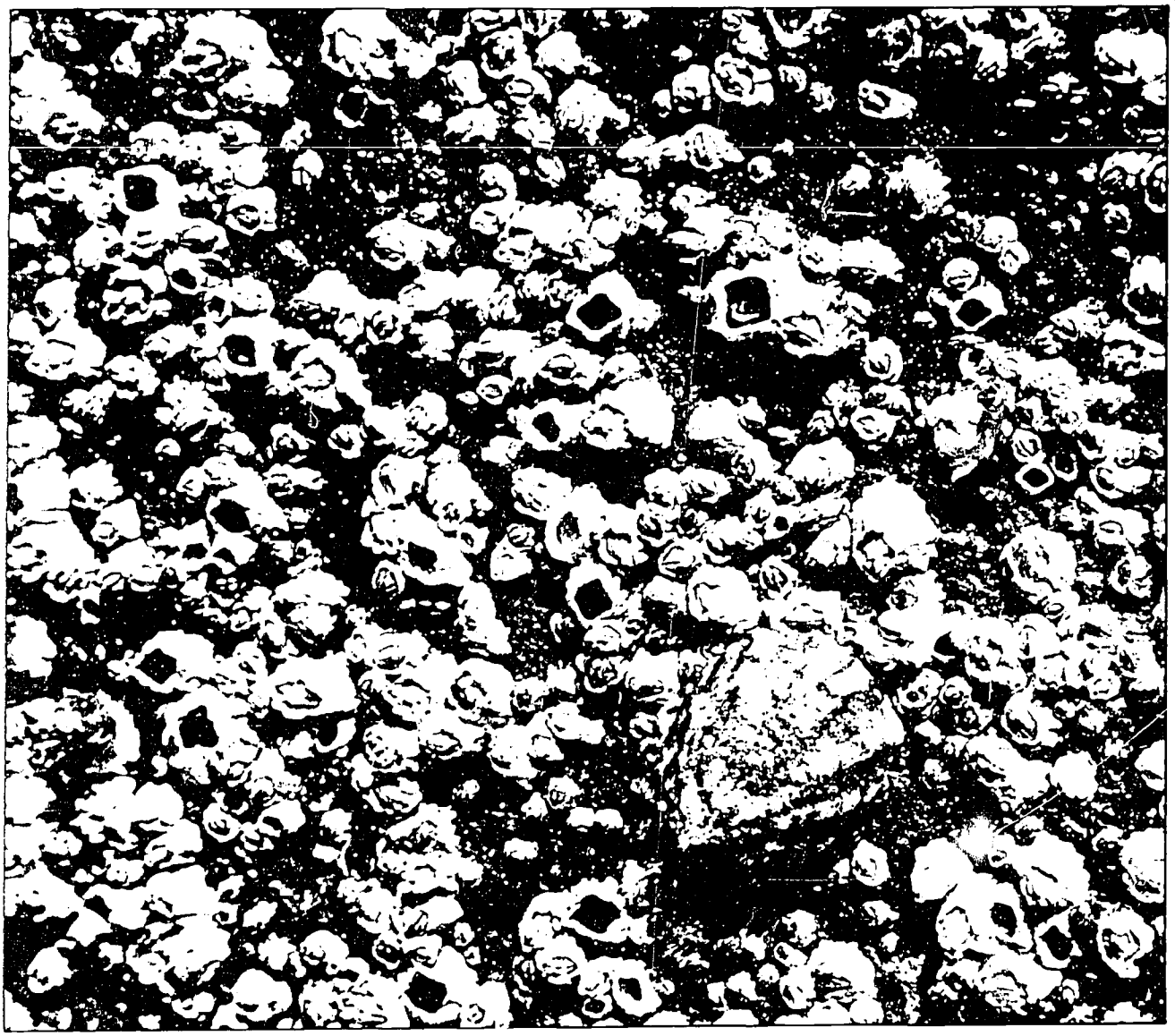
1. In what round of the game was it easiest for each of your deer to survive? In what round was it hardest? Why?
2. In this game, what two things determined the carrying capacity of the home range? (The amount of food and the number of deer competing for the food.)
3. If a person regularly, and over a long period of time, put out a lot of corn for deer in a small area, what would happen to the carrying capacity of that area for deer? What would be the effect on the deer population? What would happen to the deer if the person moved away?
4. What factors reduce the size of populations? (Predation, starvation, disease.)
5. How is the growth of human populations similar to the growth of other animal populations? How is it different?

FOLLOW THROUGH

Watching changes in real populations. The youngsters may wish to maintain a small population of animals and observe changes in the population over a short period of time. Guppies are good subjects for population growth experiments. Starting with three of the little fish (one male and two females) in a properly maintained aquarium, youngsters can follow changes in the size of the population over several months.

WHAT TO DO NEXT

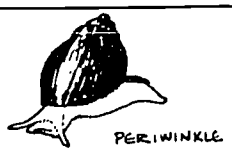
Bugs, Worms, and Others	Set IV
Adaptation—Predator-Prey	Set I
Bean Bugs	Set I
Food Chain Game	Set II
Variation Game	Set III



When the tide ebbs, many of the plants and animals that inhabit rocky intertidal zones are left high and dry, or they are corralled in shallow tide pools. This fascinating world is on display until the high tide returns. Scurrying crabs, brightly colored sponges, and starfish are popular attractions. Tidepools are good places to observe hermit crabs, snails, sea anemones, and small fish. Near the ocean, a living carpet of marine organisms completely covers many of the rocks. With so much to see, it is not surprising that many seashore visitors don't notice the inanimate "lumps" on many of the rocks in the intertidal zone. They seldom discover that these "lumps" are living organisms (barnacles, limpets, snails, chitons, oysters, tubeworms, or mussels) that have retreated into their shells until high tide returns. But you and your youngsters don't have to wait for high tide and put on a mask and snorkle to see these marine animals in action. With the aid of an artificial high tide, you can revive many of these retracted animals and observe their behavior and hidden bodies.

CHALLENGE: CREATE A HIGH TIDE AND SEE HOW IT AFFECTS INTERTIDAL MARINE ANIMALS.

MATERIALS



For each team of two:
1 large milk carton or similar sized container for water
1 lump of soft, plasticene clay (about the size of a tennis ball)
1 hand lens*

For the group:
- extra clay
- tide table (available at boating, fishing, and diving shops)

For the "Follow Through" (optional):
For each team of two:
1 permanent-ink marking pen (a different color for each team)
1 index card and pencil

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. Visit the coast during low tide, and choose a rocky site that is well populated with barnacles, snails, limpets, or other marine organisms. These animals live mainly in the upper half of the intertidal zone, so a low tide of two feet or less is fine. Look in crevices or other shaded places among the rocks. Try out the artificial-high-tide technique before conducting the activity. (See "Action," step 4.)

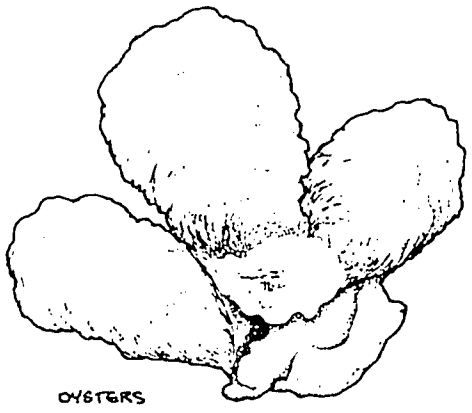
Time. Use a tide table to pick a time when low tide is two feet or less for the activity.

Safety

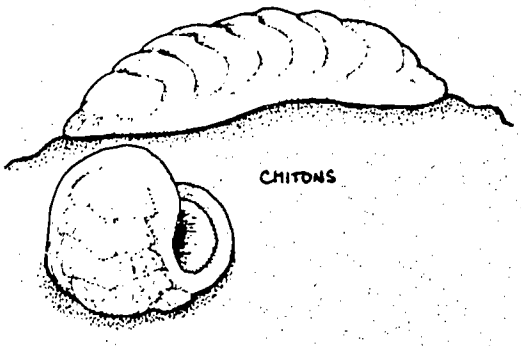
1. No one should work alone around the water. Use the buddy system.
2. Intertidal rocks are extremely slippery. Caution your youngsters to use care when walking in the intertidal zone.
3. Be careful that you and your group won't be trapped in the site by high water in case you miscalculate the high tide's return.

ACTION

1. Caution the youngsters about the slippery rocks before taking the group into the intertidal zone.
2. Gather around a cluster of barnacles or other retracted animals and tell the youngsters that these animals pull into their shells during low tide. Ask the youngsters to think of ways to get the animals to come out of their shells so that the youngsters can observe them in action. Someone will probably mention waiting until high tide. Then suggest that they won't need to wait if they create an artificial high tide to revive the animals.



3. Announce that you have brought materials the kids can use to create an artificial high tide. Show the youngsters how to splash the animals with water from a milk carton, simulating wave action. Then show them how to build a clay dam to hold water around the animals. (Pulling the animals off the rocks to place them in a bucket of water causes trauma and injury to the animals. It is better to bring water to the animals than to take the animals to water.) Tell the youngsters that the clay may harm the animals; they should *not* press the clay against any animal.



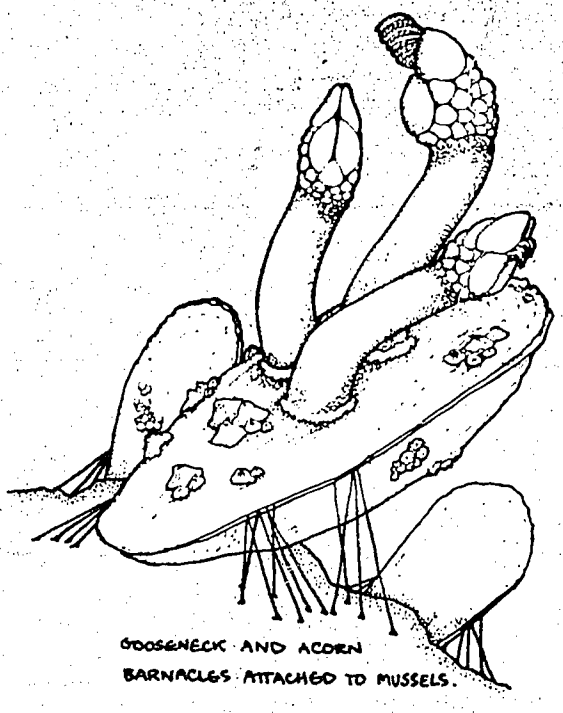
4. Divide the group into buddy teams. Give each team one water container, one lump of clay, and one hand lens (for close observation).

5. Challenge the teams to duplicate and observe the effects of a high tide on different marine animals. Help the teams locate animals that have drawn into their shells. (Begin with barnacles, because a little bit of splashing usually triggers them into movement. Snails, limpets, chitons, and mussels are slower to respond.) Ask the youngsters to cover animals that

don't respond to splashing with miniature seas and check them periodically for movement. To prevent the animals from overheating or using up all the oxygen in the water, ask the teams to replace all the water every ten minutes.

6. Circulate among the teams as they work with the animals, and lend encouragement and assistance as needed.

7. Ask the teams to collect their clay dams before gathering for the discussion.



Outdoor Biology Instructional Strategies

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This material is based upon research supported by the National Science Foundation under Grant No. SED72-05823. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author and do not necessarily reflect the views of the National Science Foundation.

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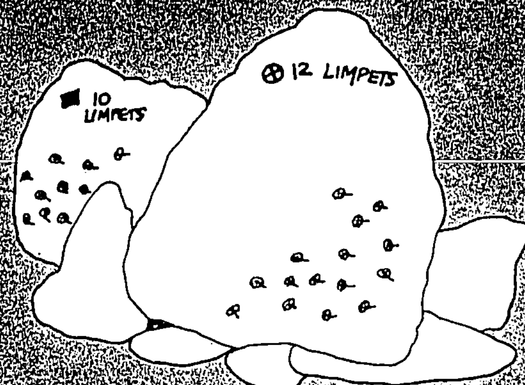

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2. If possible, return to the limpet site the same night during low tide. With flashlights, look at the marked limpets. (It doesn't matter if you can't come back the first night. The ink marks last about a week.) Ask each team to record on a card how many of the marked limpets are "at home" and how many are gone. Can the teams locate any of the missing marked limpets? What are the limpets doing?

3. Return to the site the next day at low tide. Have the teams check their limpets. How many limpets are at home? Are they in the same position as they were when marked (i.e., does the mark on the shell match the mark on the rock)? Ask the youngsters what they can tell about limpet behavior from this experiment.

AFTER THE REVIVAL

Hold It	Set III
Night Shine	Set III
Rock Pioneers	Set II
Water Breathers	Set II
Animal Movement in Water	Set I

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and winter, when growth slows considerably. Thus, a cross section of a log reveals alternating rings of light and dark wood. By counting the number of rings of light wood from the center of the tree out to the bark, we can determine the age of the tree.

The Technique Card illustrates the way a tree grows. Notice that new growth is added at the top and around the sides of the tree during each year. The true age of a tree can be determined only by counting the rings at ground level. Counting the rings at any other height would reveal only the age of the tree at that height. (Note: Don't give this information to the children before doing the activity.)

Many factors affect the speed at which a tree grows. Available sunlight, water, nutrients, and warmth are vital growth factors. Competition among trees for light, water, and nutrients can also affect growth. In addition, different kinds of trees grow at different rates.

During years of good environmental conditions, trees grow rapidly and more wood is produced. The resulting growth ring is relatively wide. On the other hand, narrow rings indicate years of poor or stunted growth, perhaps brought about by disease, insect attack, or other poor environmental conditions. By looking at a tree's growth rings and the patterns they take, your youngsters can begin to understand how trees grow.

CHALLENGE: FIND OUT IF THE TOP OF A TREE IS OLDER, YOUNGER, OR THE SAME AGE AS THE BOTTOM.

MATERIALS

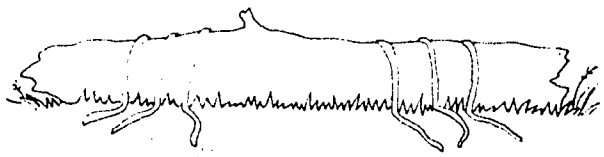
For each team of two:
1 bow saw
2 fine-tipped colored marking pens
2 small pieces of sandpaper, 10 cm X 15 cm

For the group:
1 data board and marking pens
1 first aid kit
• brightly colored yarn
1 "Sawing Away" Technique Card

PREPARATION

Selecting a site. Any forested area with downed trees is a possible site for *Sawing Away*. Check out local wooded parks, state and federal forests, or private woodlots. You will need one log for every four kids (two teams). Look for logs at least five meters long and six to forty-five centimeters in diameter. Make sure the logs are close enough to each other so that you can oversee the sawing and help out when necessary. Test one of the logs beforehand by sawing out a section to be sure that the wood is not rotten and thus unsuitable for counting rings. (Rotten logs are good for another OBIS activity, *Logs to Soil.*) Don't select logs that are "hung-up": either end suspended off the ground. Be sure to obtain permission to cut the fallen logs.

Tagging the logs. The teams will work at opposite ends of each log. Each team will make three saw cuts to remove two sections of wood, one section for each member of the team. After selecting your logs, drape three 30-cm pieces of yarn over the logs at both ends to mark the spots where the teams will saw. The three cuts should be about 15 cm apart.



Materials. Bow saws are designed for cutting logs and are easy and safe to use. Ask your kids to borrow saws from parents and neighbors.

ACTION

PART ONE: COUNTING RINGS

1. Ask the youngsters if the top of a tree is younger, older, or the same age as the bottom of the tree. Tell the kids to think about how children grow. Are their heads younger than their feet? Do they think trees grow the same way kids do? Ask them if they know of any ways to tell how old a tree is. If no one mentions counting the growth rings, introduce this method.

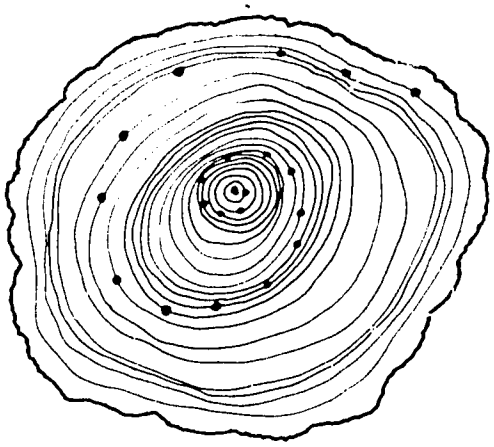
2. Point out the marked logs and tell the kids that they can tell how old portions of the logs are by cutting sections of wood from each end of the log and counting the rings. Divide the group into teams of two and assign one team to the top end, and one to the bottom end of each log. (The top ends of the logs are the narrow ends.) Tell the kids to saw the logs where you have draped the yarn. Assign your more energetic teams to thicker logs.

3. Before distributing the saws and sending the teams off to "saw away," give the teams these saw-safety rules:

a. While walking with a saw, hold the blade away from your body.
b. Clear away all debris and branches that the saw might catch on where you are sawing.
c. One partner should hold the log steady while the other partner saws. Exchange places often.
d. Keep your hands away from the blade while sawing.
e. While sawing, be careful not to pinch your fingers between the saw handle and the log.
f. When a saw is not being used, lay it flat on the ground. Do not prop it up.

4. When the teams finish cutting their two sections, have them bring their sections to a central location. Give each youngster a piece of sandpaper and a colored marking pen. Tell the kids that a light sanding of the sections helps expose the growth rings. Now show the youngsters the ring-counting procedure.

a. Choose the end of the section that most clearly shows the growth rings. You can dab a bit of saliva on the wood to "bring out" the rings.
b. Make a dot with the marking pen on each ring of light wood. Start at the center, and move toward the edge, making a spiral pattern as you go.



c. Count the dots to determine the age of the section.

5. Have the youngsters count the growth rings in their sections. Each team should average the ages of their two sections to determine the age of the end of the log where the section was. Each team's sections are close enough together that the sections' ages (number of rings) should be within two years of each other. If the two sections differ by more than five years, help the kids take another count.

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6. Draw one tree shape on your data board for each team's log. Let the teams record the ages of their log ends in the appropriate place on the tree shapes. Now ask the kids if the tops of trees are older or younger than the bottoms. After reviewing the results, explain basic tree growth with the aid of the technique card.

PART TWO: A STEP INTO TIME — BACKWARDS

1. Ask the youngsters to pretend that their trees fell (and stopped growing) this year. Then ask one of the kids for his age. Have everyone count off the rings on their log section, from the outside toward the center, until they count off the same number of rings as that kid's age. Tell the youngsters that that ring was produced in the same year many of them were born. Ask the youngsters to compare the width of that growth ring with the width of other growth rings in their sections. Was it a good year with a wide ring, which indicates lots of growth, or was it a narrow ring, indicating little growth?
2. Make a list on the data board of factors the kids feel might influence the growth of a tree. The list should include: sunlight, water, nutrients (food), competition from other trees, and disease.
3. Have each team tell a story reconstructing the growth history of the tree from which they cut the sections by looking at the patterns of th growth rings. You might start off by holding up a log section and telling a story like this: "This tree has large center rings, which means that it grew very fast as a seedling. But there was a drought for several years. The tree's growth slowed down and the rings got narrow. Finally the drought ended, and the tree started growing fast again. The last five rings are the widest of all."

LOG RHYTHMS

1. How many different kinds of trees did you look at? Compare the growth patterns of two different kinds of trees. How are they similar? How are they different?
2. Try to estimate the age of some of the surrounding *living* trees.
3. What is the oldest log you worked on?

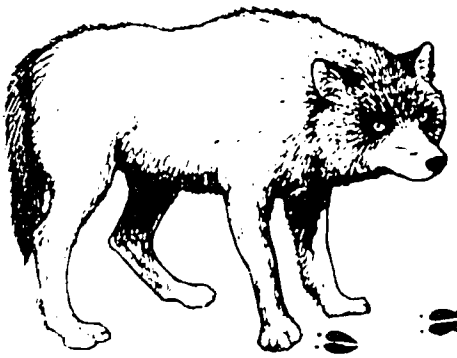
Note: Return the log sections to their original locations. If the kids want to take their sections home, be sure that you have permission to do so.

SAWING FURTHER

1. Saw through a log that shows evidence of fire damage.
2. Saw through a log at a place where a branch sticks out.
3. Saw through a section of log from end to end.

WHAT TO DO NEXT

Logs to Soil	Set IV
Tree Tally	Set IV
Litter Critters	Set II
Plant Patterns	Set II



CHALLENGE: LOCATE YOUR PREY BY FOLLOWING ITS SCENT.

Humans and other animals leave their "odor signatures" everywhere they go. An animal's odor lingers on everything that the animal touches long after the animal has gone. In addition, urine and feces are concentrated sources of animal scents that convey information about the size, age, condition, and sex of the animal that deposits them. Skunks, goats, deer, house mice, and a few other mammals have specialized scent glands, which produce substances that allow these animals to mark their territories and defend themselves.

STRIPED SKUNK

Animals use their senses of smell to locate food, track prey, find mates, sense approaching predators, and keep track of their young. In this activity, the kids assume the roles of deer and of wolves that track the deer by scent. The simulation is followed by a search for animal tracks and scents.

MATERIALS

MOUNTAIN LION

For each team of four:

1 plastic sprayer (or "plant mister," available at hardware and grocery stores)
20 strips of flagging
1 small paper cup
1 20-ml bottle of liquid flavoring extract (See the "Preparation" section.)

For the group:

1 bottle of yellow food coloring

WOLF

PREPARATION

Site. Select an untrampled, snow-covered area about 50 to 100 meters on a side. A moderately wooded area works best. Try to locate a site that contains animal tracks and urine or feces deposits. You can also conduct this activity on a beach or in other areas that are covered with light-colored sand.

Group size. *Scent Tracking* works best with three to four teams of four kids. If you have more than sixteen participants, divide them into two equal groups, and use a different site for each group.

RED FOX

Materials

1. **Scents.** Use a different liquid flavoring extract (no oils, please!) for each team. Peppermint, anise, coconut, and almond are good choices. Pour half a bottle of extract and about 150 ml of water into a plastic sprayer. Then add enough yellow food coloring to make the solution bright yellow. (Use red food coloring for sandy sites.) Set the plastic sprayers to produce streams of liquid (as opposed to sprays).

2. **Flagging.** Cut or tear twenty cloth strips 40 to 50 cm long for each team. Use a different color for each team.

3. **Cups.** Fill a cup with snow for each team, and liberally spray each cup of snow with a *different* scent.

SCENT TRACKING

ACTION

1. Tell the kids that many animals have a much keener sense of smell than people have. As an example, you might mention that bloodhounds can track a person by following the odor that the person leaves behind on the ground and on other objects. Add that animals such as wolves foxes, and weasels often track their prey by following the prey's scent.

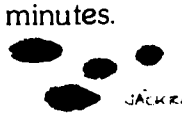
2. Inform the youngsters that some of them are going to pretend to be deer and the others are going to pretend to be wolves. The "wolves" are going to "sniff" the tracks of the "deer."

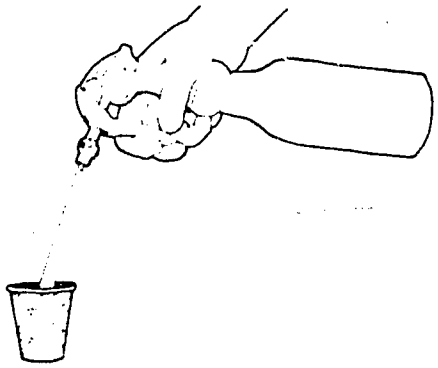
3. Tell the kids that the deer will use scented water to represent the odor they leave on anything that they touch. Hold up a plastic sprayer and squirt a couple streams of scented water onto the snow near your feet to show the youngsters how to use the sprayer.

4. Divide the group into teams of four, and select one person from each team to be a deer.

5. Mark a starting line in the snow. Tell the deer that they will each make a scent trail by squirting a scent next to their tracks *every ten paces*. Add that since the deer live in a fairly small area, their tracks should cross each other's several times. The deer should stick fairly close together and move in the same general direction. Each deer should end her trail in a concealed place (e.g., behind a tree or snow drift). Indicate the general limits of the site.

6. Give one plastic sprayer to each of the deer and challenge each of them to make a trail about twenty scent marks long. Turn the wolves around so they can't watch the prey, and send the deer off to make their scent trails. Give them ten minutes.





7. While the deer are making tracks, give each team of wolves one of the cups of scented snow. Although a keen-nosed predator can usually keep track of a particular odor when other odors are present, suggest that the "wolves" carry their prey's scent with them to use as a reference.

8. Inform the wolves that each team will track a particular deer by following its scent. For example, the wolf pack with the peppermint-scented snow will track the deer that sprays peppermint. Each time the team finds their deer's scent, they should mark the spot with a piece of flagging. (They can either lay the flag on the snow or tie it to a bush.) If a team comes to a scent spot left by another deer, the whole team must back-track to the last recognizable scent spot of their deer and find the trail's continuation from there. The team must smell the scent spots without disturbing them; i.e., they should not pick up the scented snow to smell it. Emphasize that this is not a race! The team members must walk together to prevent the prey's scent spots from being trampled.

9. After ten minutes (or after the prey are all concealed), challenge the wolves to find their deer by following its scent. Join a team and follow the scent!

10. When all of the teams have located their prey, have the youngsters retrace their steps, pick up their flags, and regroup at the starting line.

Trial Edition
Set IV

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Outdoor Biology Instructional Strategies

FIVE "SCENTS" WORTH

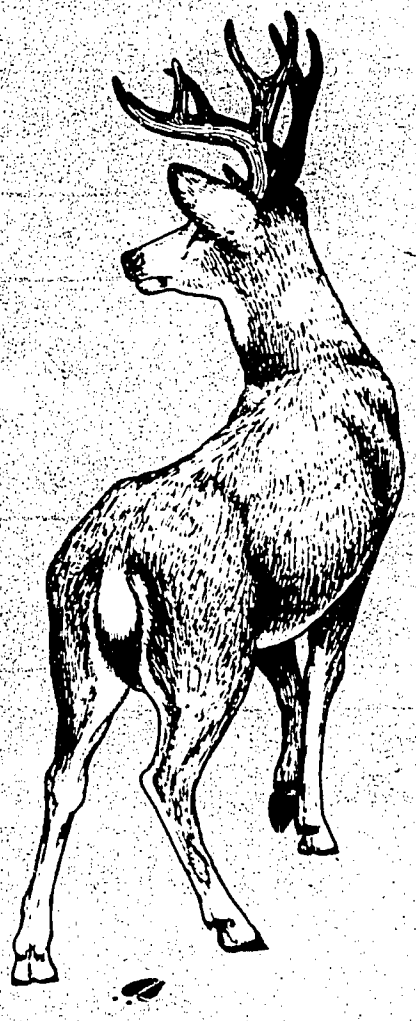
1. Were the scent trails easy or difficult to follow? Why?
2. Did any of the wolf teams get thrown off the track and have to back-track to relocate their prey's trail? Did any of the wolf teams "catch" the wrong deer?
3. Ask the kids to compare their tracking game with their ideas on the way wolves or other predators might track their prey. What parts of the tracking game are not realistic?
4. As animals grow older, their sense of smell becomes less sensitive. What problems might this cause in a wolf? A deer?
5. How would your life be different if you had a highly developed sense of smell like that of a dog?

KEEP ON TRACKING

1. Challenge the kids to search for non-human tracks and scents in the site and to follow them. Where do the tracks go? How was the animal moving? (Running? Walking? Hopping?) What animal made the tracks?
2. Move to an untrampled area and play the "track-matching" game. Ask everyone to turn their backs to you. In the snow, make a pattern of tracks that you think will be difficult for the youngsters to match (e.g., scoot backwards while sitting; backstroke through the snow). The pattern should be about four meters long. Now ask everyone to turn around and figure out how you made the pattern. Have the kids show you how they think you made the tracks. Divide the group into teams of four or five and challenge the team members to take turns stumping their teammates with track patterns. After everyone has had a chance to make a set of tracks, gather the teams and let each team challenge the other teams to figure out their patterns. End the game by challenging the kids to "read" any animal tracks they encounter in the future.

WHAT TO DO NEXT

Night Eyes	Set IV
Follow the Scent	Set III
Silent Stalking	Set III
Sound Off!	Set II
Who Goes There?	Set I



Biologists use the term ***cryptozoic*** (derived from two Greek words: *kruptos*, "hidden"; and *zoikos*, "of animals") to describe animals that live under objects or in other concealed places. Salamanders, spiders, isopods, beetles, crickets, and snails are a few of the large number of cryptozoic animals that live under logs, boards, rocks, and other types of ground cover. Many cryptozoic animals are active mainly at night (nocturnal), seeking shelter during the day in the night-like (cool, moist, and dark) environments underneath various objects.

By turning over a rock or log, you suddenly expose the animals that live underneath to noise and light. Some cryptozoic animals react to these sudden changes by scurrying immediately for cover, while others remain motionless. Such "scram" and "freeze" reactions often enable these animals to avoid capture by a would-be predator.

In this activity, the participants first assume the roles of predators and cryptozoic animals and play the Scram-or-Freeze game. The youngsters then search for cryptozoic animals underneath objects at the site and sort the animals according to their escape behavior. The kids then share their discoveries and discuss the kinds and numbers of "scrammers" and "freezers" that they find.

CHALLENGE: LOOK FOR ANIMALS THAT LIVE UNDERNEATH OBJECTS, AND OBSERVE THESE ANIMALS' ESCAPE BEHAVIOR.

MATERIALS

For each team of two or three:
2 large ziplock bags
2 clear plastic cups

For the group:
2 brightly colored four-meter pieces of yarn
2 large containers (dishpans or boxes with light-colored bottoms)
- bug boxes* or magnifiers
1 marking pen
1 half-gallon milk carton
- OBIS *Lawn Guides** or other field guides for animal identification (optional)

*Available from the Lawrence Hall of Science. See the "OBIS Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. The Scram-or-Freeze game requires a fairly level area about 15 m x 5 m. Find a site with a lot of logs, boards, rocks, and other debris on the ground for the cryptozoic-animal survey. Turn over a few objects at the site to make sure that a variety of animals is available.

Materials

1. **Milk carton.** Cut the carton open along one long seam and two short seams. Write the term ***cryptozoic*** on one of the inside walls, and then close up the carton so that the term is hidden.

2. **Bags and containers.** Label half the ziplock bags and one of the containers "SCRAM" and the remaining bags and container "FREEZE" with the marking pen.

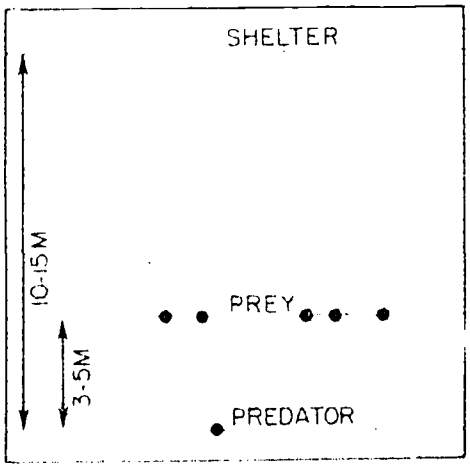
Safety. Do *not* conduct this activity in areas containing poisonous snakes. Although most cryptozoic animals are harmless, caution the kids against using

their bare hands to pick up animals such as spiders, centipedes, and scorpions.

ACTION

PART ONE: THE SCRAM-OR-FREEZE GAME

1. Lay out one piece of colored yarn on the ground at one end of the game site to mark the boundary for the prey's shelter. Then pace off 7 to 10 meters from the shelter boundary and lay out the other piece of yarn on the ground for the starting line.



2. Assign one youngster the role of predator; everyone else plays the prey.

3. Ask the prey to line up on the starting line facing the shelter. The predator should stand about 3 meters behind the starting line with her back to the prey.

4. Instruct the predator to start the game by shouting "Scram!". When she does so, the prey may start moving toward the shelter. The predator can turn around at any time, but before doing so, must growl loudly. When the prey hear the predator's growl, they must freeze. Any prey that the predator sees moving are considered caught and eaten. Prey that are "caught" should stand at the sidelines until the next game.

5. Continue the game until all the prey are either caught or reach the shelter.

6. Give other youngsters a chance to be the predator. Play for ten to twenty minutes and join in the fun yourself.

PART TWO: THE CRYPTOZOIC-ANIMAL SURVEY

1. Introduce Part Two by telling the kids that now they are going to look at the escape behavior of animals that live under objects such as rocks and logs.

2. Tell the kids that they are going to be predators that eat animals that live under objects. Divide the group into buddy teams. Discuss safety and animal handling with the teams. (See the "Preparation" section.) Show the youngsters how to scoop up an animal with a cup and dump it into a ziplock bag. You might use a small rock for your demonstration.

3. Give each team one SCRAM bag, one FREEZE bag, and two cups. Say that the bags are their "stomachs." Ask the teams to look for animals beneath various objects at the site, encouraging the youngsters to make sure that they return all objects to their original positions after looking under them. Tell the kids that some of the animals are dangerous (e.g., poisonous snakes and scorpions), and caution them about turning over rocks or logs in areas where they might find such dangerous animals.

4. Challenge the kids to identify the animals as either "scrammers" or "freezers" by watching what the animals do when they are uncovered. Tell the youngsters to sort the animals by placing them into the "stomach" that identifies

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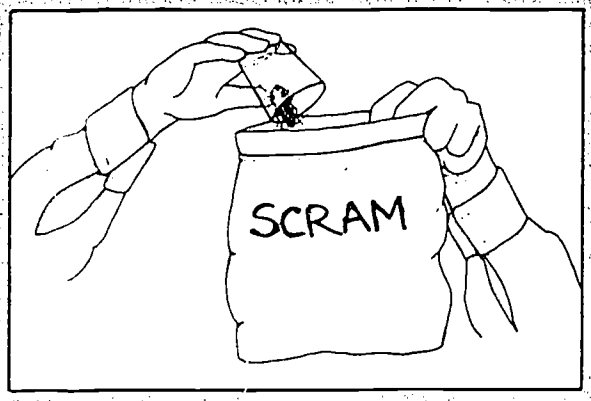
their escape behavior. Each team needs to collect only *one* of each kind of animal.

5. Keep all the teams within eye range and join in the search yourself.

6. When about ten minutes remain in the period, call the teams together to share their discoveries.



CRYPTIC COMMENTS

Have the teams empty their SCRAM stomachs into the large SCRAM container, and the FREEZE stomachs into the large FREEZE container. Ask the kids to look at the critters while you discuss these questions:

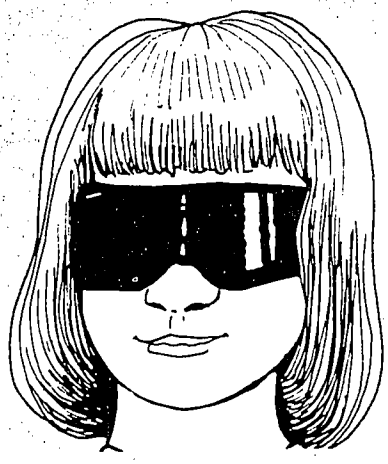
1. How would scramming help an animal survive? How would freezing help?
2. Did any of the animals both scram and freeze? Which ones?
3. Were the "scrammers" easier to find than the "freezers"? Why?
4. Is there a difference in the sizes and shapes of the "scrammers" and "freezers"?
5. Do the "scrammers" tend to be the same color? What about the "freezers"?
6. How would color help an animal survive?
7. Explain that the place where an organism lives is called its ***habitat.*** Tell the youngsters that biologists use a special term to describe animals that live underneath objects or in other hidden habitats. Pull open the milk carton that you prepared and display the term ***cryptozoic*** to the group. Explain that *crypt* means "hidden" or "concealed" and *zoic* means "animal." Ask the group if they can think of any cryptozoic animals that they did not catch today.

Releasing the animals

Let half the group release the "freezers" and the other half release the "scrammers." Ask the two groups to release the animals next to the logs or rocks where the animals were found, and to watch the animals' behavior when they are released.

FOLLOW THROUGH

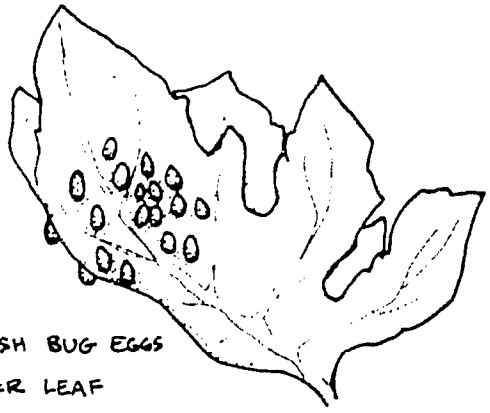
Repeat the scram-or-freeze search on another occasion, but have the kids wear red or green gel masks to simulate one-color vision. Unlike humans, who see several colors, many animals see only varying shades of a single color. How does one-color vision affect your ability to detect the animals?



WHAT TO DO NEXT

Night Eyes	Set IV
Isopods	Set III
Animal Diversity	Set II
Invent an Animal	Set I

tiny animals protect themselves from adverse conditions by using leaves and twigs. The youngsters may find that some animals simply lay their eggs or spin tiny webs on the undersides of the leaves. They also may discover quite elaborate shelters constructed from two or more leaves wrapped tightly with silk, snug and secure. And there is always the chance that the youngsters will find . . . . But this is what the activity is all about. Take your group to the woods and find out how small animals make constructive use of their plant environment.



SQUASH BUG EGGS UNDER LEAF

CHALLENGE: FIND SHELTERS THAT ANIMALS HAVE CONSTRUCTED ON AND AMONG LEAVES AND TWIGS.

MATERIALS

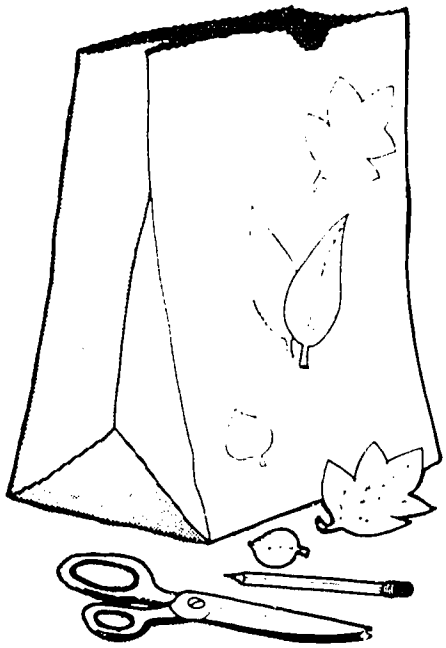
For each team of two:
1 hand lens
1 plastic bag

For the group:
- several large brown shopping bags
1 pair of scissors
1 pencil
8 paper plates
- white glue
- tape
- thread
- cotton

PREPARATION

1. **Site and time.** This activity is designed for use in a deciduous forest (trees that shed leaves) on a summer or fall day. Pick a site about 50 m X 50 m. Then find trees and shrubs that have animal-made constructions on them. Look at the undersides of the leaves, at the buds, and at the stems of sycamores, alders, willows, and oaks. Pick the *two* kinds of trees or bushes that have the most animal structures for use in the activity.

2. **Materials.** Take a leaf from each of the study trees or bushes, and trace it on a large brown shopping bag. With scissors, cut out about two dozen "make-be-leaves" in each of the two shapes.



ACTION

PART ONE: MAKE-BE-LEAVES

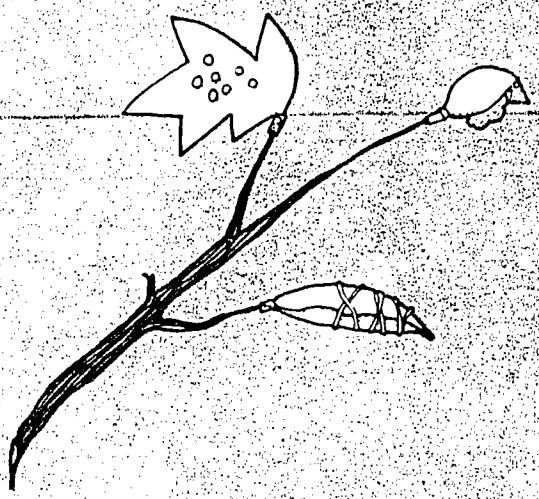
1. Take your group to the area you have selected, and point out the site limits.

Challenge the kids to move out into the site and collect small seeds the size of rice grains or smaller. Give them no more than two minutes. While the youngsters are searching, find some seeds yourself.

2. Pool the seeds on two paper plates. Pick out one small seed and tell the kids to pretend that it is a "bug" that needs protection from wind, rain, and other animals. Hold up one of the "make-be-leaves" and tell the kids they are going to build a protective structure in which a "seed-bug" can live on the make-be-leaf surface.

3. Divide the group into buddy teams. Show the youngsters the craft materials and give each team four make-be-leaves. Challenge each youngster to make a safe, snug home for one or more seed-bugs upon one or more of the make-be-leaves. Make sure the kids put the seed-bugs inside their homes. Give each team a small puddle of glue on one-fourth of a paper plate, and let them start constructing.

4. Circulate among the teams while they work. As the teams complete their make-be-leaf seed-bug homes, direct the youngsters to find dead twigs about one-half meter long, and to tape their creations to these twigs.



5. After all the teams have created at least two make-be-leaf homes and have attached the leaves to a twig, call the teams together. Let the teams swap twigs. Challenge the teams to find the seed-bugs without teaming the home-structures apart. Distribute hand lenses and ask the kids to look closely for the seed-bugs without prying into the structures. Then tell the youngsters to open the structures carefully and look for the seeds.

6. Give the youngsters a chance to describe the seed-bug homes they have opened. Let them explain how a seed-bug might have built the structure. Encourage the kids to speculate on the structure's effectiveness as a shelter from weather and predators.

PART TWO: REAL LEAVES

1. Tell the kids that there might be small animals in the activity area that use real leaves as a surface for building protective structures. Give each team a plastic bag, and make sure the youngsters have their hand lenses. Assign each team to one kind of tree or bush that harbors animal constructions. (You may assign several or even all of the teams to one kind of tree.) Direct them to look *very* closely and to use their lenses. Ask them to collect one sample of each *different* kind of structure they find. Ask the youngsters to remember where they find structures that cannot be collected, such as spider webs and hornet's nests. Send the teams off to look for animals' constructions.

2. Call the youngsters together at a picnic table, bench, or on a flat piece of ground. Tell the youngsters to spread out their finds. Give each team a chance to show and describe their structures to the group. Let the kids open the structures and find out what kinds of animals made them.

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3. All the animals should be released on their "home" plants at the end of the activity.

NURSERY SPIDER NEST IN MILKWEED

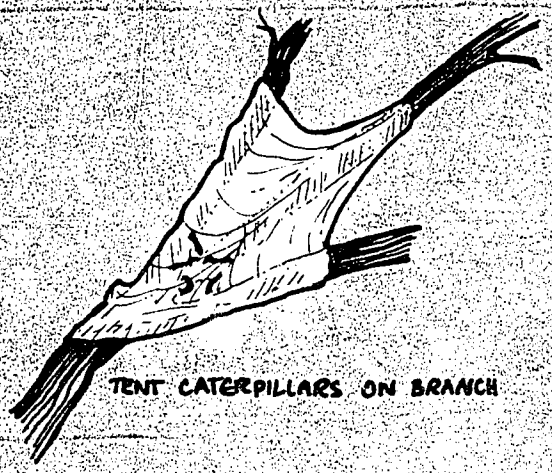
CONSTRUCTIVE CONVERSATION

1. What kinds of animals were most commonly found in the structures? (Ants, flies, grubs, spiders, beetles.) Were these larvae (young) or adult? Were they found alone or in groups?
2. What kinds of materials did the animals produce themselves? (Cotton? Silk threads?) Was the material hard? Sticky? Do you suppose the animals build the homes themselves, or do parent animals do the work?
3. Which structures do you think would be most effective at warding off the cold? The wind? Wetness? Predators?
4. Did any of the protective structures appear to be damaging the plants in any way?
5. If you were only as big as a grain of rice, what kind of leafy structure would you build to protect yourself?

FOLLOW THROUGH

Find other foundations on which animals build their shelters. Look at boards, rocks, dead branches, and old cloth. Turn these objects over carefully and look for small animal structures. Look for the different materials used in the constructions. How are foundations that are built on *ground* materials different from leafy foundations?

Note: Make sure you return the rocks and boards to their exact positions when your investigation is complete.



TENT CATERPILLARS ON BRANCH

WHAT TO DO NEXT

Junk in the Box	Set III
Swell Homes	Set III
Litter Critters	Set II
Invent an Animal	Set I
Plant Hunt	Set I

Soil is more than just "dirt." Soil is a mixture of water, air, minerals, organic matter, and living organisms. In proper balance, these ingredients make a healthy soil that fosters plant growth.

Organic matter, which we find most abundantly in the top few centimeters of soil, consists of decomposing plant and animal material. Soils with the proper organic-matter content are black or brown, and have a loose, crumbly texture. Such soils easily absorb and retain air and water and are excellent for growing plants. The decomposing organic matter makes additional nutrients available to plants.

A shortage of organic matter is a common problem with the soil of agricultural fields and backyard gardens. Farmers often grow a "cover crop" of rye grass or clover in large fields, later plowing the cover crop into the soil to increase the soil's organic-matter content. Home gardeners often add organic supplements such as compost, manure, or peat moss to the soil in gardens before planting vegetables and flowers.

In *Super Soil*, the kids use a simple "alum-profile" test to compare the organic-matter content of local soils with that of a commercial garden mix. (Alum helps to separate soil into its different components.) The youngsters discover that the local soil is low in organic matter. The kids then determine how much organic matter (compost, manure, or leaf mold) they must add to the local soil to match the organic-matter content of the commercial mix.

CHALLENGE: COMPARE THE ORGANIC-MATTER CONTENT OF A COMMERICAL SOIL MIX TO THAT OF OUR LOCAL SOIL.

MATERIALS

For each team of two:
1 14-dram plastic vial*
1 digging tool (spoon, stick, or trowel)

For the group:
1 large handful of any commercial gardening mix
2 kilograms of organic material (manure, compost, or leaf mold)
- water supply from bucket or faucet

1 small jar of alum (available at most drug stores)
- paper towels
- spare vials

Optional for the "Follow Through":
- vegetable seedlings or seeds
- half-gallon milk cartons

*Available from the Lawrence Hall of Science. See the "Equipment Order Form" in the *OBIS Toolbox* folio.

PREPARATION

Site. Areas with lots of bare, hard ground (such as vacant lots, school fields, or your back yard) are excellent sites for *Super Soil* because the soil in these places is usually low in organic matter. Do an "alum-profile" test on the soil at the potential site to make sure the soil is low in organic matter. (See the "Action" section, step 2.)

Materials. Mark a line one-fourth of the way from the bottom on each of the vials.

ACTION

COLLECTING SOI

1. Show the commercial so
youngsters, and tell them tha
excellent soil for growing veg
other plants.
2. Divide the group into tea
and give each team a clean
paper towel.
3. Challenge the teams to fi
site as similar to the commer
possible and to bring back a
paper towel.
4. When everyone returns, a
to compare the color, smell,
the commercial mix with the
samples.

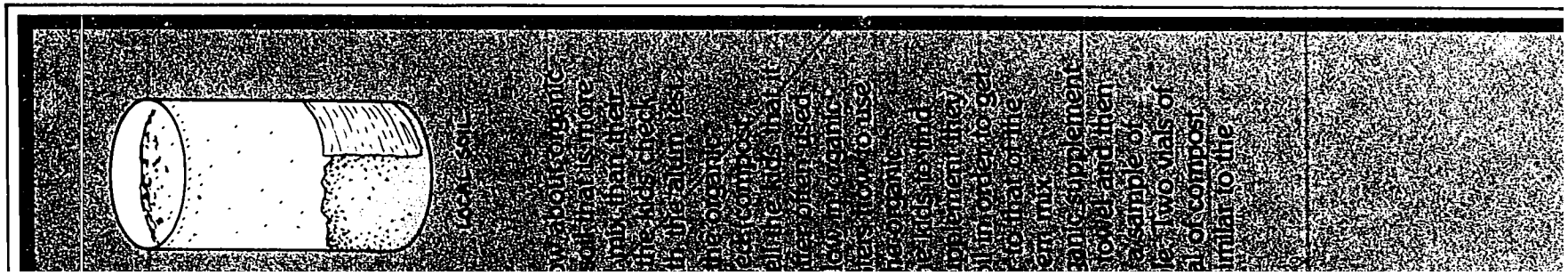
MAKING THE ALUM TES

1. Introduce the alum test as
way of comparing soil sample
commercial mix to demonstra
a. Fill a vial to the mark with
be tested. Add a large pi
b. Fill the vial with water, co
with your palm, and shak
vigorously.
c. Let the material in the vial
least one minute. Be caref
disturb the vial.
2. Distribute the vials, and as
to make "alum profiles" of th
samples they collected at the
3. Have the kids compare th
of their vials with the content
commercial-mix vial. Are the
similar? Are the same layers
visible in both vials? If the kid
notice, point out that the top
floating material in the vial of
mix is much larger than the
their soil-sample vials. Identify
layer as the organic matter, pr
soil. Tell the youngsters what
matter is, and explain its imp
the soil.

SUPER SOIL

Trial Editi

Set



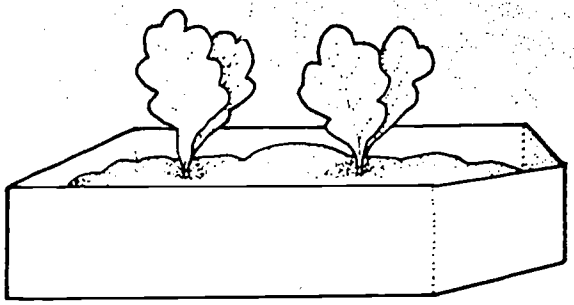
WHAT DO YOU THINK?

1. Do soils from different areas of the site produce different alum-test results? Why?
2. How much organic supplement did you add to the local soil to get an alum test similar to that of the commercial mix?
3. Where do you think compost, leaf mold, and manure come from? What organic supplements could you make?

FOLLOW THROUGH

1. Let the kids take the equipment home to do an alum test in their own back yards.
2. Ask the kids to mix their own soil in which to plant seeds or seedlings.

a. Cut one side out of a half-gallon milk carton and staple the spout closed.
b. Poke two holes in the bottom of the carton for drainage.
c. Fill the carton nearly to the top with your handmade soil.
d. Plant seeds or seedlings and water them. Peas, beans, lettuce, and Swiss chard are easy to grow.



WHAT TO DO NEXT

Logs to Soil	Set IV
Mystery Marauders	Set III
Plant Patterns	Set II
Seed Dispersal	Set II
Natural Recycling in Soil	Set I

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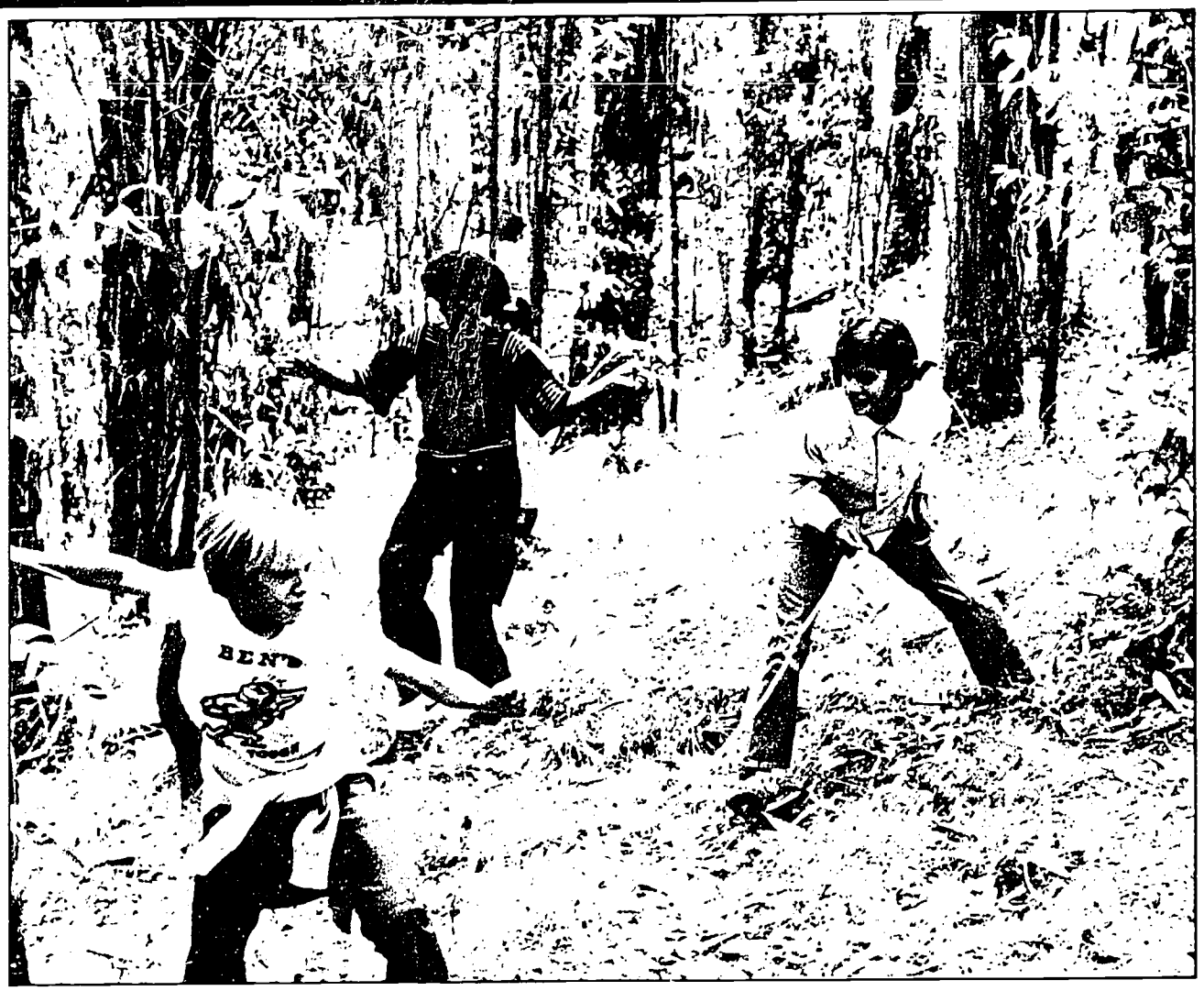


We often visit a forest and can't see the *trees* for the *forest*. However, if we look carefully, we can often find a wide variety of trees obscured by the rich blend of foliage.

The *line transect* is one sampling technique for sorting out the varieties and numbers of plants in an area. The procedure consists of counting the plants and the kinds of plants along a straight line.

In Part One of *Tree Tally*, the youngsters use a variation of the line-transect technique to investigate a forest site. They first set out lines in a zigzag pattern, and then take leaf samples from the trees along the lines. With their samples they make a simple graph or *histogram*, which organizes the leaves so that the youngsters can determine the number and varieties of trees in their site. In Part Two, the youngsters run a Forest Leap Frog race based on this information.

MATERIALS

For each team of two:

For Part One:

1 30-m length of string wound on cardboard*

1 paper or plastic bag

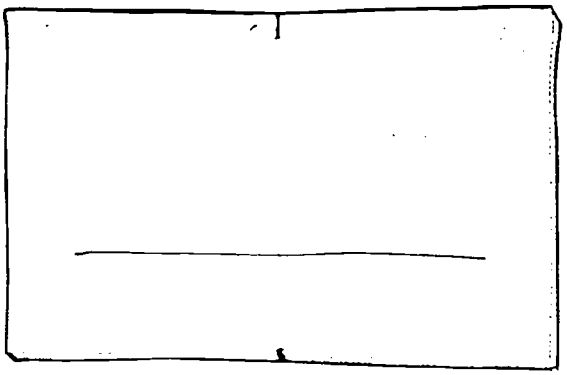
For Part Two:

1 4-m length of string wound on cardboard*

*See the "Preparation" Section.

For the group:

2 data boards (taped together) with a line drawn 10 cm from the bottom



1 marking pen

1 roll of clear adhesive tape

PREPARATION

Selecting a site. Choose a densely forested area with at least four different kinds of trees. The trees should be no more than 1.5 to 2 meters apart. If the trees in your area are farther apart, you can increase the length of the strings mentioned in the "Materials" section to 40 meters and 5 meters. (See Part One, step 2 and Part Two, step 2b in the "Action" section.)

ACTION

PART ONE CHALLENGE: FIND THE MOST COMMON TREE IN YOUR FOREST AREA.

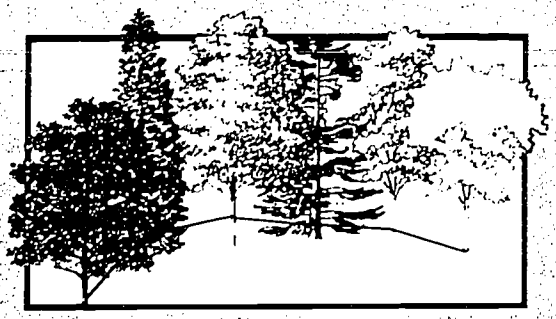
1. Ask the group to guess how many kinds of trees are in the area. Then tell the youngsters that they will use an OBIS transect to find out how many kinds of trees are in the area.

2. Demonstrate the following OBIS-transect procedure with one of the youngsters.

a. Tie one end of the 30-m string (or 40-m string) to a tree. The tree should be taller than the youngster.

b. Begin unwinding the string and move to the next tree, which must be only one step or leap away from the first tree. (If you had to increase the length of the string, the trees can be two paces apart.) Find a likely tree, jump to it, and pull the string taut. The string must touch the new tree. Wrap the string around the tree if necessary. Then move to the next tree that is a leap away.

c. Try to move in one general direction as you zigzag from tree to tree.



3. Divide the group into teams of two. Give each team one 30-m length of string and a paper or plastic bag. Assign each team a different starting tree. Each starting tree should be at least five meters from any other starting tree. Point the teams in the same direction to avoid tangled lines and let them set up their OBIS transects.

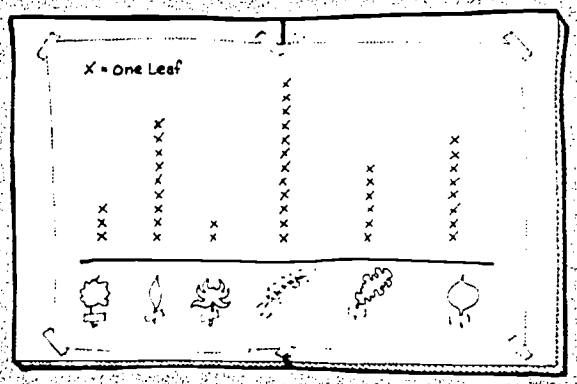
4. After all the teams have placed their lines, ask the youngsters to predict which kind of tree is the most common in the forest. Let the youngsters describe the kinds of trees any way they can.

5. Tell the youngsters that they will now count the trees included in their transects. Each team should go back along its line and pick *one* leaf from *each* tree touching the line. If they can't reach a leaf on a tree, the youngsters may have to shake the tree to loosen a leaf. They may also look carefully at the leaves on the tree and then find the same kind of leaf on the ground or on a smaller tree.

6. After the youngsters have finished collecting their leaves, call them together around the data boards. Tell the youngsters they can use the leaves they have collected to find out which kind of tree is the most common. Ask them how they can tell if one leaf is the same kind as another. Let the youngsters decide on their own criteria, but you might suggest looking at the leaves' shapes, edges (smooth or jagged), and surface textures (hairy, smooth, or sticky).

7. Instruct each team to put each type of leaf into a separate pile.

8. Ask each team to hold up one leaf that they think is from the most common tree. Tape that leaf under the line on the data boards and have all the teams report how many leaves like it they collected. In a vertical column above the leaf, make an X for each matching leaf collected. Make the X's the same size. Have the teams repeat the recording procedure for each kind of leaf they found.



9. After all the leaves have been counted and recorded on the data boards, tell the youngsters they have made a *histogram* of the trees in the area. Ask the youngsters to look at the histogram and tell you how many kinds of trees they found in the forest. Which tree is the most common? How do their original predictions compare with the results?

10. Have the teams rewind their 30-m strings onto the cardboard.

PART TWO CHALLENGE: SELECT ONE TYPE OF TREE AND RUN A FOREST LEAP FROG RACE BETWEEN TREES OF THAT TYPE.

1. Designate a starting point and a finish line about 50 meters apart. Use a 30-m string for the finish line.

2. Demonstrate the game with one of the youngsters.

a. Each team of two selects one kind of tree, e.g., red oak. Two or more

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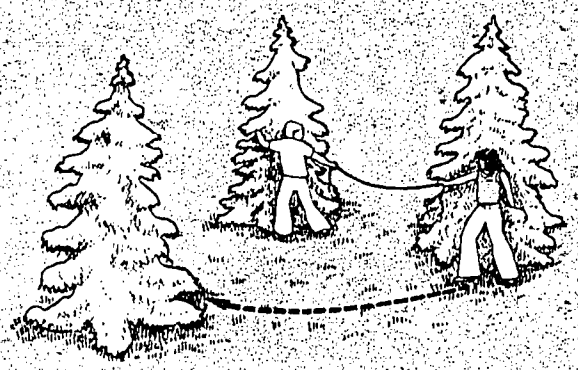
teams may choose the same kind.

b. Each member of the team holds onto the opposite ends of the 4-m (or 5-m) string *throughout the race.*

c. Both members of the team start at the same red oak. They should both be touching the tree.

d. At the signal "Go!", partner A moves to another red oak, while partner B remains touching the starting tree. As soon as partner A touches the second tree, partner B lets go of the starting tree and looks for a third red oak. Remember that the string limits how far the partners can "leap-frog" to the next tree.



e. The "leap frog" continues until all the teams reach the finish line.

3. Give each team a 4-m string and let them choose a starting tree. Make sure the starting trees are about the same distance from the finish line.

4. Run the race a number of times. Encourage the teams to use a different kind of tree for each race.

BRANCHING OUT

1. What kind of tree did the winning teams choose? According to the histogram, how common are the trees chosen by the winners?

2. Would a histogram for other parts of the forest look like our histogram? Why or why not?

3. If we came back in fifty years, how might our OBIS transect and histogram be different?

FOLLOW THROUGH

Go to another part of the forest. Give the teams a few minutes to look carefully at the trees and to choose one kind for another game of Forest Leap Frog. Run a few races and compare the results with the races run at the first site.

WHAT TO DO NEXT

Leaf Living	Set IV
Fly a Leaf	Set III
Pigment Puzzles	Set III
Plant Patterns	Set II
Bean Bugs	Set I

As spring approaches and the frequenc
of warm, sunny days increases, the wir
snow layer under which plants are buri
actually helps create favorable growing
conditions. Some plants may be up an
ready to flower within days after the
snow around them melts, indicating tha
a great deal of growth has taken place
beneath the snow.

In Part One of *Wintergreen*, the youngsters use photo proof paper to investigate the light conditions for plants living under the snow. When the air temperature is cold enough, the youngsters can measure the insulation effect of the snow cover (Part Two).

MATERIALS

FOR PART ONE:

For each team of two:

1 piece of cardboard, 40 cm x 40 cm
1 packet of photo proof paper (See the "Making a Light Reading" Technique Card.)
1 small jar of fixing solution (See the technique card.)
1 small jar of water
1 pair of forceps or tweezers
1 pencil
1 ruler
1 watch with a second hand

For the group:

1 large data board
• felt-tip markers
2 rolls of transparent tape
1 extra packet of proof paper
1 "Making a Light Reading" Technique Card

FOR PART TWO:

For each team of two:

1 thermometer dip-stick (See the "Thermometer Dip-Stick" Equipment Card.)

For the group:

1 "Thermometer Dip-Stick" Equipment Card

PREPARATION

Site. Choose a snow-covered site in which you can find green plants under the snow. The site must have been covered with snow for several months. The snow layer should vary in depth, but should be less than one meter deep and soft enough so that the kids can dig to the ground with their hands.

Time. This activity works best on a sunny day in late winter or early spring. If the air temperature is above −4° C (25° F.), postpone Part Two for a colder day.

Materials for Part One

Light Reading Materials. Prepare one small jar of fixing solution and a packet containing two envelopes of proof paper for each team. (See the technique card.)

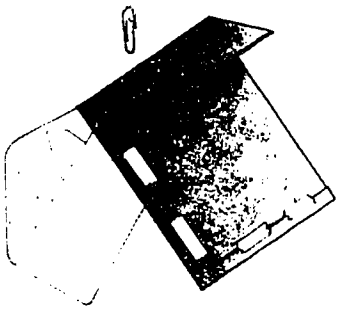
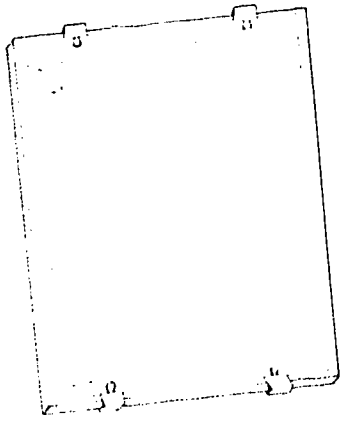


Chart. Draw the illustrated chart on the data board.



Materials for Part Two

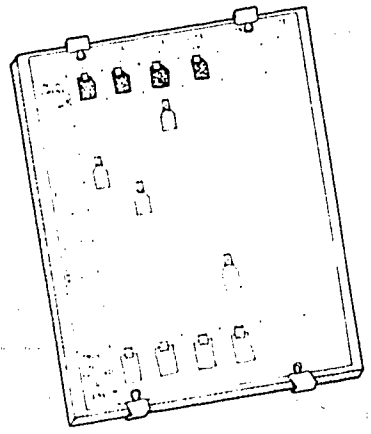
Thermometer Dip-Stick. Make a thermometer dip-stick for each team of two. (See the equipment card.)

Practicing the Light-Reading Technique. Before conducting the activity, take a light reading on top of and below the snow with the photo proof paper to acquaint yourself with the procedure and to determine the exposure time. In addition, take a couple of readings fairly deep in the snow to determine the maximum depth to which light can penetrate. (See the technique card.)

ACTION

PART ONE CHALLENGE: FIND GREEN PLANTS UNDER THE SNOW, AND FIND OUT HOW MUCH LIGHT REACHES THOSE PLANTS.

1. Tell the youngsters that they are going to look for green plants living under the snow. Define the boundaries of your site, divide the group into teams of two, and send them off.
2. After about fifteen minutes, gather the youngsters and let them describe the plants they found. Tell the kids that green plants can produce food and grow when conditions are right. Ask the kids if they know what factors a plant must have in order to grow (enough light, moisture, good soil or nutrients, and adequate temperature). Tell the youngsters that they are going to investigate ***light.***
3. Ask the kids if they think any sunlight is reaching the plants they have found. Tell the youngsters that you have materials for measuring the amounts of light.
4. Gather the youngsters around one of the green plants. Show the kids the proof paper, and explain that its shiny side turns brown when exposed to sunlight.
5. Show the youngsters how to place the paper strips in the snow and how to record the data. (See the technique card.)
6. Distribute the light-reading materials to each team. If the temperature is below freezing, ask the youngsters to keep the jars of water and fixing solution in their pockets. Send the teams out to gather light and snow-depth data around their plants.
7. Circulate among the teams. Remind them to write the location, snow depth, and exposure time on the envelopes. (Make sure at least one team takes a reading on a plant buried so deep that light does not reach it.) Call the teams together after twenty to twenty-five minutes.
8. Show the teams the chart and how to position the strips. In a column for each location, tape the unexposed (control) strip in the proper box on the chart, the strip from the snow surface above the "Snow Surface" line (zero centimeters), and the strip from under the snow at the appropriate snow depth.



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Outdoor Biology Instructional Strategies

Seeing the Light

1. Ask the youngsters to discuss what they learned about the light conditions around their plants.
2. To what depth must the snow melt before light can reach the buried plants?
3. How do you suppose the amount of light would be affected if your site were covered by a large tree?

PART TWO CHALLENGE: FIND OUT HOW THE SNOW LAYER AFFECTS THE TEMPERATURES AROUND PLANTS UNDER THE SNOW.

1. If the air temperature is −4° C (25° F.) or lower, the youngsters can investigate the insulating effect of the snow layer.
2. Tell the youngsters that plants usually don't freeze until temperatures are well below 0° C. Tell the group that they are now going to investigate the ***temperature*** under the snow.
3. Divide the group into teams of two, and give each team one thermometer dip-stick. Ask the teams to measure the air temperature.
4. Ask the teams how cold the air is. Ask them to predict whether the temperature under the snow is warmer, colder, or the same as the air temperature.
5. Demonstrate the dip-stick technique for measuring the temperature under the snow. (See the equipment card.) Assign each team a different snow depth at which to take their temperature readings.
6. After about fifteen to twenty minutes, bring the group together to share results.

CHILLING THOUGHTS

1. Was the temperature under the snow warmer or colder than that on the surface?
2. What do you think the temperature would be one meter under the snow if the air temperature were −40° C? What do you think would happen to plants living at this depth?

FOLLOW THROUGH

1. Your youngsters can obtain further evidence of the insulating ability of the snow layer by comparing the freezing times of a juicy fruit when left on the snow's surface and when buried in the snow. Choose a time when the air temperature is −10° C (15° F.) or less. Bury half the fruit samples (cherry tomatoes or grapes) in the snow and leave the other half on the surface. When the surface samples feel somewhat frozen, collect all the fruit. Cut them open and compare the numbers of frozen sections found in the fruit that were left above and below the surface.
2. The youngsters can observe how the snow layer insulates plants from cold temperatures by removing the snow from a small area of green plants. Have the youngsters keep the snow off the area and observe the plants over a period of time. Then have the youngsters compare the plants with other plants in an area covered with snow.

WHAT TO DO NEXT

Super Soil	Set IV
Animal Anti-Freeze	Set II
Sensory Hi-Lo Hunt	Set II
Terrestrial Hi-Lo Hunt	Set I

Jan. 1979 OBIS Equipment Order Form

***About June. 1979. Delta Education. Box M. Nashua NH 03061 will distribute these and other OBIS materials. Contact them for prices and ordering information.**

Shipping Address (Please print):

Name: _____ **Date:** _____

Address: _____

City: _____ **State:** _____ **Zip:** _____

Please send me the following items in the quantities indicated:

QUANTITY	ITEM — DESCRIPTION		UNIT SHIPPING WT. (Kg.)	TOTAL WT. (Kg.)	UNIT PRICE	TOTAL PRICE
	Blacklight bulb for safari lamp	each	.05		$8.97	
	Blacklight fluorescent tracing powder	20 gr. pkg.	.10		.95	
	Blueprint paper (22 cm x 30 cm sheet)	25 sh. pkg.	.20		1.75	
	Bug box	each	.01		.35	
	Colbat chloride crystals	110 gr pkg.	.15		3.75	
	Colbalt chloride test paper (1 cm x 15 m roll)	each	.025		3.50	
	Colored cellophane (25 cm x 30 cm sheet)	red, each	.025		1.25	
		green, each	.025		1.25	
		blue, each	.025		1.25	
	Confectioners dye (10 grams in vial)	each	.020		1.00	
	Kodak Studio Proof F paper (20 cm x 25 cm sheet)	10 sh. pkg.	.15		2.75	
	Line level	each	.025		1.40	
	Litter Critter Wheels thermofax transparencies	1 set of 4 wheels	.050		.35	
	Magnifying lens (3 lenses 3x, 5x, 8x, plastic frame)	each	.025		1.00	
	Meter tape	each	.025		.50	
	Ozalid paper (21.5 cm x 28 cm sheet)	25 sh. pkg	.15		1.00	
	Plastic measuring cup (250 ml)	each	.020		.30	
	Plastic vials with lid (14 dram)	pkg of 10	.150		1.30	
	Spring scale (2000 gram)	each	.070		3.00	
	Thermometer, calibrated in °C	each	025		1.25	
	Tweezers	each	.10		.40	
	Water Breathers dropper	each	010		.20	
	OBIS Lawn Guide	each	05		.60	
	OBIS Pond Guide	each	.05		.60	
	OBIS Trial Edition, Set I	each	1.20		8.50	
	OBIS Trial Edition, Set II	each	1.20		9.50	
	OBIS Trial Edition, Set III	each	1.20		10.50	
	OBIS Trial Edition, Set IV	each	1.20		11.50	
	The OBIS Trail Module	each	05		2.00	

	Subtotal Wt. (Kg.)	**Subtotal**
	California sales tax for California residents only (6% California residents) (6½% Bart County residents)	
	Shipping fee (see reverse)	
	TOTAL DUE	

☐ Check or money order enclosed
Make check payable to
Regents of the University of California

☐ Please bill me (Minimum order $10.00)

SEND YOUR ORDER TO: Discovery Corner — OBIS
Lawrence Hall of Science
University of California
Berkeley, California 94720

☐ Please check here if you desire air mail shipment
OTHERWISE ALLOW FOUR WEEKS FOR DELIVERY.
(Air mail takes approximately one week.)

127 **PLEASE RECHECK YOUR COMPUTATIONS AND BE SURE THAT THE SHIPPING FEE IS CORRECT.**

Rec'd on _____ By _____ Shipped on _____ By _____

To Determine Your Shipping Fee:

1. Total the weight of merchandise.
2. Use Table A to find your shipping zone.
3. If you desire surface shipment, find the shipping charge in Table B. Allow at least four weeks for delivery.
4. If you prefer faster (1 week or less) airmail shipment, check the box on the front of this form, and find the shipping fee in Table C.
5. Enter the shipping fee in the appropriate box on the front of this form.

Table A — Shipping Zone

Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone	Zip Code Prefixes	Zone
006-008	8	580-584	8	674-679	6	770-787	7	850-859	5	955	3
		585-586	7	680-681	7	788	6	860-864	4	956-959	2
100-199	8	591-593	8	683-693	6	789	7	865-880	5	960-961	3
		594-597	7			790-797	6	881-882	6	962-966	1
200-299	8	570-577	6	700-704	8	798-799	5	883	5	967-969	8
		580-582	7	705-706	7			884	6	970-974	4
300-379	8	583-588	6	707-708	8	800-826	5	893-893	4	975-976	3
380-381	7	590-591	6	710-729	7	827	6	894-897	3	977-979	4
382-385	8	592-593	6	730-739	6	828-832	5	898-899	4	980-986	5
386-387	7	594-599	6	740-745	7	833	4			986	4
388-499	8			746	6	834-835	5	900-928	4	987-992	5
		600-609	8	747	7	836-837	4	930-935	3	993	4
500-509	8	610-617	7	748	6	838	5	936-939	2	994	5
		618-619	8	749-762	7	840-844	4	940-951	1	995-997	8
600-608	7	620-667	7	763-764	6	845	5	952-953	2	998	7
610-611	6	668-672	6	765-767	7	846-847	4	954	1	999	6
612-628	7	673	7	768-769	6						

Table B — Surface Shipment

WEIGHT UP TO:		.5 Kg.	1 Kg.	2 Kg.	4 Kg.	6 Kg.	8 Kg.	10 Kg.	12 Kg.	14 Kg.
YOUR ZONE	1-3	1.50	1.50	1.50	1.75	2.00	2.25	2.50	2.75	3.00
	4-6	1.50	1.50	1.75	2.25	2.75	3.25	4.00	4.50	4.75
	7-8	1.75	2.00	2.50	3.25	4.50	5.50	6.50	7.75	8.75
WEIGHT UP TO:		**16 Kg.**	**18 Kg.**	**20 Kg.**	**22 Kg.**	**24 Kg.**	**26 Kg.**	**28 Kg.**	**30 Kg.**	
YOUR ZONE	1-3	3.25	3.50	4.00	4.25	4.50	5.00	5.50	6.00	
	4-6	5.50	6.00	6.50	7.25	7.25	8.00	8.50	8.75	
	7-8	10.00	11.00	12.00	13.00	14.00	15.00	16.50	17.25	

Table C — Air Mail Shipment

WEIGHT UP TO:		.5 Kg.	1 Kg.	2 Kg.	3 Kg.	4 Kg.	6 Kg.	8 Kg.	10 Kg.	12 Kg.
	1-3	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	11.00
Z	4	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	11.00
O	5	2.25	2.50	3.25	4.00	5.00	6.50	8.00	10.25	12.00
N	6	2.50	3.00	3.75	4.50	5.75	7.75	10.75	11.75	14.00
E	7	2.50	3.00	3.75	4.50	5.75	7.75	10.75	13.00	15.00
	8	2.75	3.25	4.25	5.25	7.25	9.00	12.00	14.25	17.00
WEIGHT UP TO:		**14 Kg.**	**16 Kg.**	**18 Kg.**	**20 Kg.**	**22 Kg.**	**24 Kg.**	**26 Kg.**	**28 Kg.**	**30 Kg.**
	1-3	13.25	15.25	17.00	19.00	21.00	21.00	25.00	27.00	29.00
Z	4	13.25	15.25	17.00	19.00	21.00	22.00	27.00	27.00	29.00
O	5	13.25	15.25	19.00	20.00	22.00	24.00	29.00	30.00	31.00
N	6	16.00	19.00	22.00	22.00	25.00	27.00	30.00	32.00	34.00
E	7	16.00	20.00	24.00	25.00	28.00	30.00	33.00	35.00	38.00
	8	20.00	22.00	26.00	27.00	31.00	33.00	37.00	43.00	44.00

OBIS ABSTRACT

What is OBIS?

Start with a group of young people in the out-of-doors and a biological concept or process as the basic ingredients. Add a large measure of fun; stir in the discovery approach; and season with a simulation, a game, a craft, or an interesting investigation. Mix thoroughly and you have one of the 100 activities that have been developed by the Outdoor Biology Instructional Strategies (OBIS) Project.

OBIS provides community-sponsored youth organizations and schools with learning activities for use at common outdoor sites such as lawns, local parks, city lots, neighborhood streams and ponds, and the seashore. Although the activities are intended primarily for ten- to fifteen-year-old youngsters, both younger and older people (including family groups) have enjoyed OBIS activites. Their easy-to-follow format, simple preparation and equipment, and short duration (usually one hour) make OBIS activities suitable for both the experienced outdoor-education leader and the first timer with no previous experience in biology. The activities may be used independently or sequenced to create a program to suit your needs. Scouts, Park and Recreation districts, religious groups, service groups, nature centers, summer camps, and schools are a few of the groups that have used OBIS activites in their outdoor-education programs. OBIS activities help youngsters and adults to better understand and appreciate the ecological relationships in their local environment.

How Were OBIS Activities Developed and Trial Tested?

The OBIS materials were developed at the Lawrence Hall of Science, University of California, Berkeley, and supported by a grant from the National Science Foundation. The materials were developed over a six-year period ending in 1978. Unlike many development projects, OBIS considered the testing of activities with youngsters to be an integral part of the development process. The OBIS activity development procedure is one of devising a strategy, trying it out numerous times with youngsters, making modifications and then retrying the revised activity. This testing,

revision, and retesting process was repeated on a local level and, in many cases, on a national level for each OBIS activity. To help gather national feedback on the trial edition activities, OBIS established a network of OBIS Resource Centers across the country. Over the past five years, OBIS has received thousands of feedback comments from OBIS users throughout the United States. This feedback is being used to revise the existing OBIS trial editions.

The OBIS Trial Editions are available through the Lawrence Hall of Science, University of California, Berkeley, California 94720.