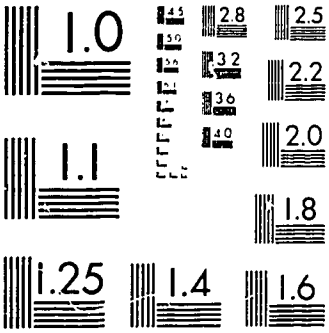


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ABSTRACT

The Outdoor Biology Instructional Strategies (OBIS) Trial Edition Set I contains 24 varied activities which make use of crafts, simulations, and basic investigative techniques to provide introductory learning experiences in outdoor biology for children aged 10 to 15. The individual water-resistant folio for each activity includes biological definitions and concepts, materials list, preparation, action, discussion, follow up, and suggested subsequent activities. Among the activities are studies of animal movement in water, leaves, natural recycling in soil and in water, seed dispersal, ponds, natural camouflage, and predator devices. Making sun prints, mapping a study site, plant hunts, and introductory census activities are also included. Set I includes 3 introductory folios. "What is OBIS?" explains the project's governing concepts and goals. The "Leader's Survival Kit" notes good activity sites, sample activity sequences, and safety information. An "OBIS Tool Box" contains Equipment and Technique Cards giving instructions for building and using various inexpensive equipment such as plankton nets and weed grapples. Instructions for each device are complete on one card. Finally, there are 2 booklets, a Pond Guide and a Lawn Guide, designed for quick and easy identification, via pictures, written descriptions, and size scales, of the most commonly encountered organisms in those locations. (SB)

# OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES TRIAL EDITION

SET I

## WHAT IS OBIS?

Outdoor Biology Instructional Strategies offers both independent and sequential activities to promote the understanding of ecological relationships by youngsters from ten to fifteen years of age. The major goal of OBIS is to design instructional strategies for learning experiences in outdoor biology that can be applied in diverse environments.

OBIS activities are primarily oriented toward community-sponsored youth organizations and nature centers. The activities introduce basic concepts of ecology in interest-catching ways. Youngsters investigate the interrelationships and interactions of plants, animals, and the physical environment, including man's role in the natural scheme. Such firsthand experience forms the basis for the understanding of basic biological relationships. This understanding is necessary to develop the public consciousness required to support appropriate management of man's environment.

## WHY OBIS?

The relationship between man and his environment has reached a crisis. Man for too long considered himself independent of nature, free to take what he wanted and change what did not suit his purposes. For centuries the environment withstood man's abuse; the planet was large and man's population, controlled by natural catastrophy, disease, famine, and conflict, was small. However, man prospered; his capacity to learn from experience and make changes in his environment insured continual "progress." Medicine and technology produced a greater chance of survival, and ever-increasing comfort and convenience. As man's population increased, the planet seemed to shrink, but often man remained indifferent to his long-term effects on plants, animals, soil, air, and water. We have reached the point where we can no longer ignore the ecosystem which supports us. We now realize that it is possible to exhaust the available supply of many natural resources.

We cannot continue to alter the face of the planet with wholesale disregard for the environment. Only by changing our way of life can we live compatibly with the other life forms in the environment. The general populace must have considerable environmental knowledge if basic attitudes and customs are to be changed to embrace new concepts of our relationship with nature.

## IT'S A BIOLOGICAL WORLD!

Man is a part of the life-sustaining system that includes the sun, plants and animals, soil, oceans, lakes and streams, and the atmosphere. Plants and animals interact with each other and with the soil and the atmosphere. The sun's energy sustains these interactions through **photosynthesis**, the process by which plants capture the sun's energy and manufacture food to support both the plants' and animals' life processes.

Animals, however, cannot make food; they must obtain their food by eating plants or other animals. The transfer of food from plants to plant eaters to animal eaters is called a **food chain**. The transfer and use of food made by plants does not end with animal eaters (predators). When organisms die, their bodies may be eaten by scavengers as diverse as worms and vultures.

### Food Chains

Plant and animal tissues not eaten by scavengers are consumed by fungi, 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 earth, water, and atmosphere, can then be used again by plants to produce food. This process is called **natural recycling**.

## Population, Community, Ecosystem

Each group of organisms of the same kind that lives and reproduces in a particular area is a **population**. Populations of plants, of plant eaters, of scavengers, and of molds and bacteria live together and depend on each other for food and protection. Such a combination of interdependent populations is called a **community**.

Communities differ depending on their locations. A pond community lives in a pond and consists of different kinds of plants and animals adapted for living in a pond. Oceans, tidepools, lakes, streams, prairies, deserts, and forests all represent communities that differ according to the physical surroundings **(environment)** in which they live, and the populations of plants and animals that make up the community. The lawn that surrounds your house is a community as is the city park or vacant lot. You do not have to travel long distances into the "wilds" to find natural communities.

The organisms that make up communities are dependent not only on each other, but also on the environment in which they live. While all organisims need water, oxygen, and food, plants need sunlight, carbon dioxide, and minerals to manufacture food. Temperature, humidity, and day lengths are also important. The interaction of the organisms of a community with the environment of light, soil, air, and water in which they live creates an interdependent unit of living and non-living elements called an **ecosystem**. The ecosystem is not something you can go out and touch or handle. You can see, touch and handle only the parts, such as the plants, animals, water, soil, etc. The ecosystem is the sum of these parts and their interaction.

## Adapting to a Habitat

Within the ecosystem there are other organizing concepts and interactions which are universal wherever there is life. **Adaptations** are special features or behaviors which improve an organism's chances of surviving and reproducing. Some animals display color adaptations which allow them to blend into their surroundings; hen ducks are the same mottled brown color as the dead rushes in which they nest. Other adaptations permit plants and animals to secure food, reproduce, move through their environment, and defend themselves. The sum of all of the adaptations displayed by an organism determines the habitat in which the organism lives. A **habitat** is the place where an organism normally lives and where you would ordinarily go to find it. An animal that is adapted to extract oxygen from water, has fins for maneuvering, and can tolerate relatively warm water, might be expected to live in a shallow pond habitat. A plant that can withstand high temperatures and low moisture might be found in a desert habitat.

If a habitat undergoes a radical change as a result of natural catastrophy (flood, fire, landslide, drought) or the intervention of man (land clearing, swamp draining, construction), the new life conditions may no longer support the varieties of life that were previously present. New plants and animals adapted to the new conditions will colonize the changed habitat. These first colonizers may not be adapted to compete with some of the organisms which follow later, and may fail and be replaced by still other organisms.

## Life Cycles

Every species must reproduce in order to perpetuate its kind. The process by which an organism comes into being, grows and matures, and produces eggs, seeds, or their equivalent, which in turn become young organisms to repeat the pattern, is called the **life cycle**. Some life cycles are simple; some complex. 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 may take years to mature sufficiently to reproduce.

## Man

One organism that lives in many ecosystems and influences countless communities is man. Man alone is able to survive in a wide range of environments. This range is due primarily to the advanced abilities of his brain, an adaptation which has allowed him to dominate all other life forms. Man's brain, and a second important adaptation, the opposing thumb, make it possible for man to manipulate any environment in order to provide himself a suitable habitat, and also to defend and feed himself using other tools created from materials in his environment. With these special abilities must come greater responsibility for the consequences of his actions. Take a simple example: a man goes into the woods to go camping. He catches a fish for dinner. If he were a bear or a raccoon, he would simply eat the fish. But man doesn't generally eat fish raw; he cooks it. So he gathers some wood and starts a fire. Carelessness can lead to the catastrophe of a forest fire. Even with care, the cover and food source for many organisms is often squandered cooking the fish. Gases and moisture are released into the atmosphere, but the minerals are displaced from the natural place and concentrated in an ash pile. The ashes are caustic, harboring no life until rain and wind dilute them and once again they are mineral nutrients for plants to use.

It is clear that the time has come for worldwide adoption of sensible management practices which can come only after an understanding of the processes of ecology. OBIS provides one avenue for young people to reach this understanding.

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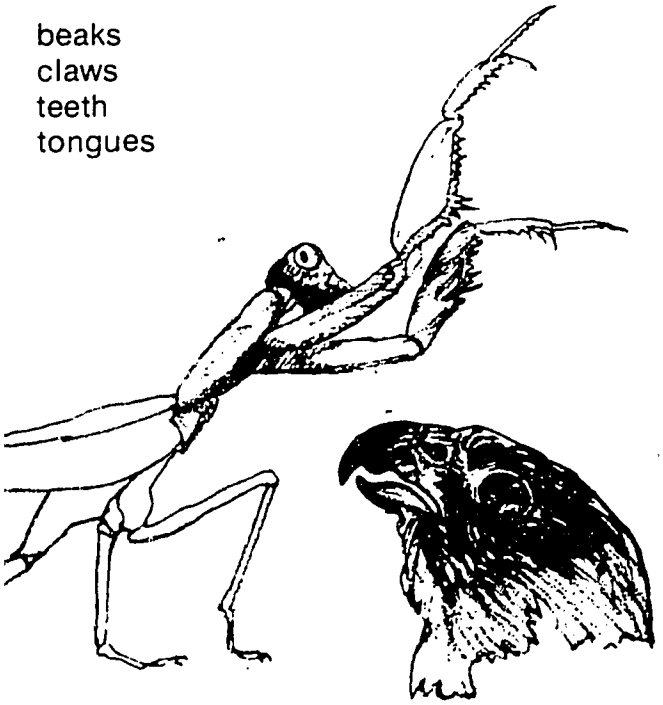
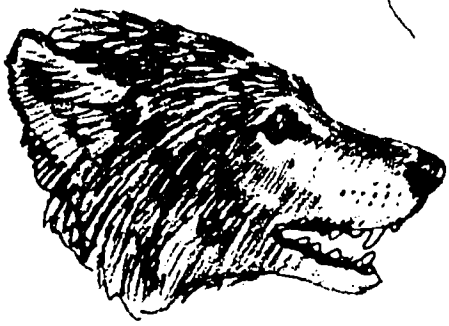
Predator Devices:

beaks
claws
teeth
tongues





Some plants and animals are adapted to attract attention. Plants must attract

## Action Card
## PREDATOR PREY

Outdoor Biology Instructional Strategies

Make a predator device for breaking nuts and eating the meats.

## Action Card
## PREDATOR PREY

Outdoor Biology Instructional Strategies

Make a predator device for getting at animals that live underground.

## Action Card
## PREDATOR PREY

Outdoor Biology Instructional Strategies

Make a predator device that could catch or pick up an egg.

## Action Card
## PREDATOR PREY

Outdoor Biology Instructional Strategies

Make a predator device that a meat eater would use.

## FOLLOW UP

Have everyone look for predators in the study site and decide what kind of prey they are adapted to eat.

## WHAT TO DO NEXT

*Invent an Animal*
*Animal Movement in Water*
*Who Goes There?*

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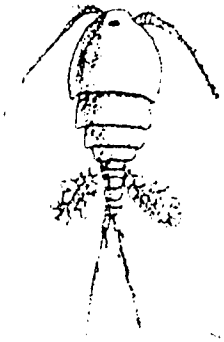

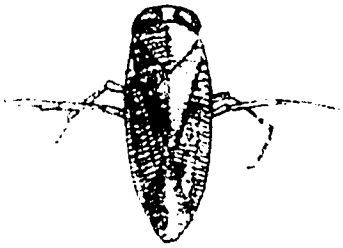

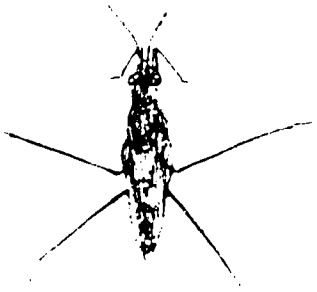

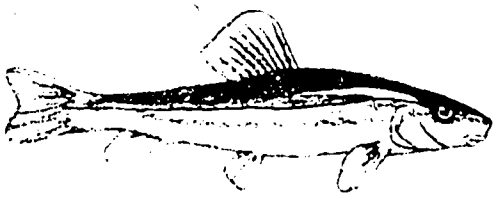

# WHAT TO DO NEXT

*Adaptation–Predator-Prey*
*Attention!*
*Seed Dispersal*
*Invent an Animal*
*Invent a Plant*

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# FOLLOW THROUGH

A. In order to observe animals that are not usually caught in sweepnets, set up some small pitfall traps. If you have the opportunity of meeting with your group again in a day or a week, present this second challenge: "How many additional animals can we find that we didn't find with our nets?"

**Follow Through Action:**

1. Introduce the challenge.
2. Prepare a map of the study area on your data board. Investigators can mark on this map exactly where they put their traps. This will enable them to relocate the traps.
3. Show the group how to make and place pitfall traps.
   a. Place your thumb in the center of a square of aluminum foil and wrap the foil around your thumb to make an extra-long thimble. Punch a small pencil hole in the bottom of the foil thimble to allow water to drain. (Small jars or tin cans can be substituted for the foil traps.)
   b. Tell the participants to dig holes in the lawn the same size as the traps and to press the traps into the holes. Flare or flatten the foil sticking out of the hole so little animals can easily walk into the traps from the surrounding grassland.
   c. Drop a piece of bait into the the trap.
4. Distribute trowels, vials, and bait and have students set up pitfall traps.
5. Have each student record the exact location of his or her pitfall trap on the map.
6. Leave the traps in the lawn for at least eight hours before making observations.
7. When you return, have each student record on the map the kinds and numbers of animals in his or her trap.
8. Review the "What Do You Think?" questions.

B. Conduct a night sweepnetting activity. Compare the results of a night sweep to the results of a day sweep.

C. Observe the animals attracted to a light that is left burning at night in your study site.

D. Sweepnet a lawn immediately after mowing or watering. Make comparisons.

# WHAT TO DO NEXT

*Invent an Animal*
*Sticklers*
*Bean Bugs*
*What Lives Here?*



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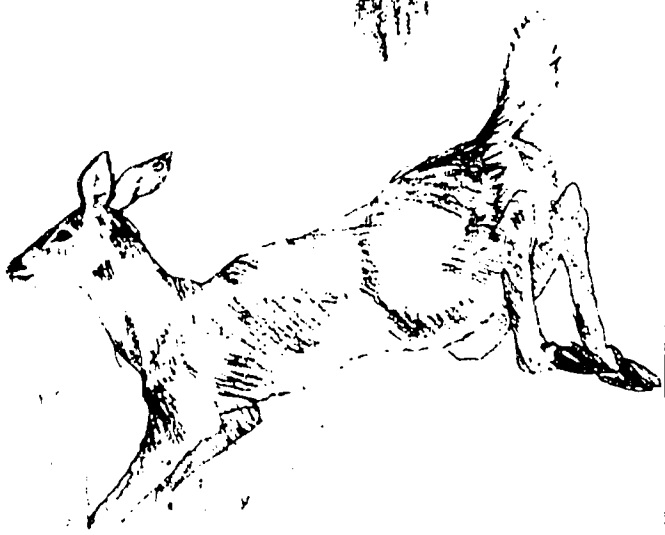

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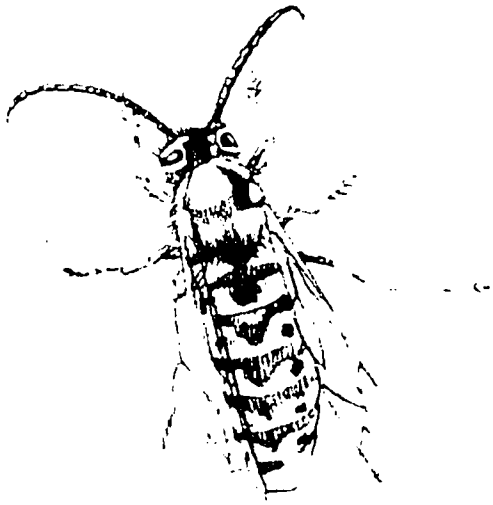

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## Action Card Side 1
## ATTENTION!

Outdoor Biology Instructional Strategies

Name _____

Your favorite color is _____

Pick one of these patterns:

_____ checkered
_____ stripes
_____ rectangles
_____ spots
_____ diamonds
_____ triangles

Choose a habitat:

_____ grassy
_____ leafy
_____ rocky
_____ other


## Action Card Side 1
## ATTENTION!

Outdoor Biology Instructional Strategies

Name _____

Your favorite color is _____

Pick one of these patterns:

_____ checkered
_____ stripes
_____ rectangles
_____ spots
_____ diamonds
_____ triangles

Choose a habitat:

_____ grassy
_____ leafy
_____ rocky
_____ other

## Action Card Side 1
## ATTENTION!

Outdoor Biology Instructional Strategies

Name _____

Your favorite color is _____

Pick one of these patterns:

_____ checkered
_____ stripes
_____ rectangles
_____ spots
_____ diamonds
_____ triangles

Choose a habitat:

_____ grassy
_____ leafy
_____ rocky
_____ other

## Action Card Side 1
## ATTENTION!

Outdoor Biology Instructional Strategies

Name _____

Your favorite color is _____

Pick one of these patterns:

_____ checkered
_____ stripes
_____ rectangles
_____ spots
_____ diamonds
_____ triangles

Choose a habitat:

_____ grassy
_____ leafy
_____ rocky
_____ other

## Action Card Side 2

## ATTENTION!

Outdoor Biology Instructional Strategies

Find a real plant or animal that attracted your attention by:

_____ smell

_____ sound

_____ sight

Do the features that caught your attention warn or attract?

## Action Card Side 2

## ATTENTION!

Outdoor Biology Instructional Strategies

Find a real plant or animal that attracted your attention by:

_____ smell

_____ sound

_____ sight

Do the features that caught your attention warn or attract?

## Action Card Side 2

## ATTENTION!

Outdoor Biology Instructional Strategies

Find a real plant or animal that attracted your attention by:

_____ smell

_____ sound

_____ sight

Do the features that caught your attention warn or attract?

## Action Card Side 2

## ATTENTION!

Outdoor Biology Instructional Strategies

Find a real plant or animal that attracted your attention by:

_____ smell

_____ sound

_____ sight

Do the features that caught your attention warn or attract?

## FOLLOW UP

Not all animals have the same quality of vision. Some, with limited color vision, view the world in varying shades of a single tone. Provide the group with colored cellophane masks. The masks can be made by taping colored cellophane (red is an effective color) to the forehead, covering the eyes.

Have everyone search for the designs again, and compare the results of the two searches.

**Note:** Colored cellophane or gel may be purchased from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

## WHAT TO DO NEXT

*Invent an Animal*
*Seed Dispersal*

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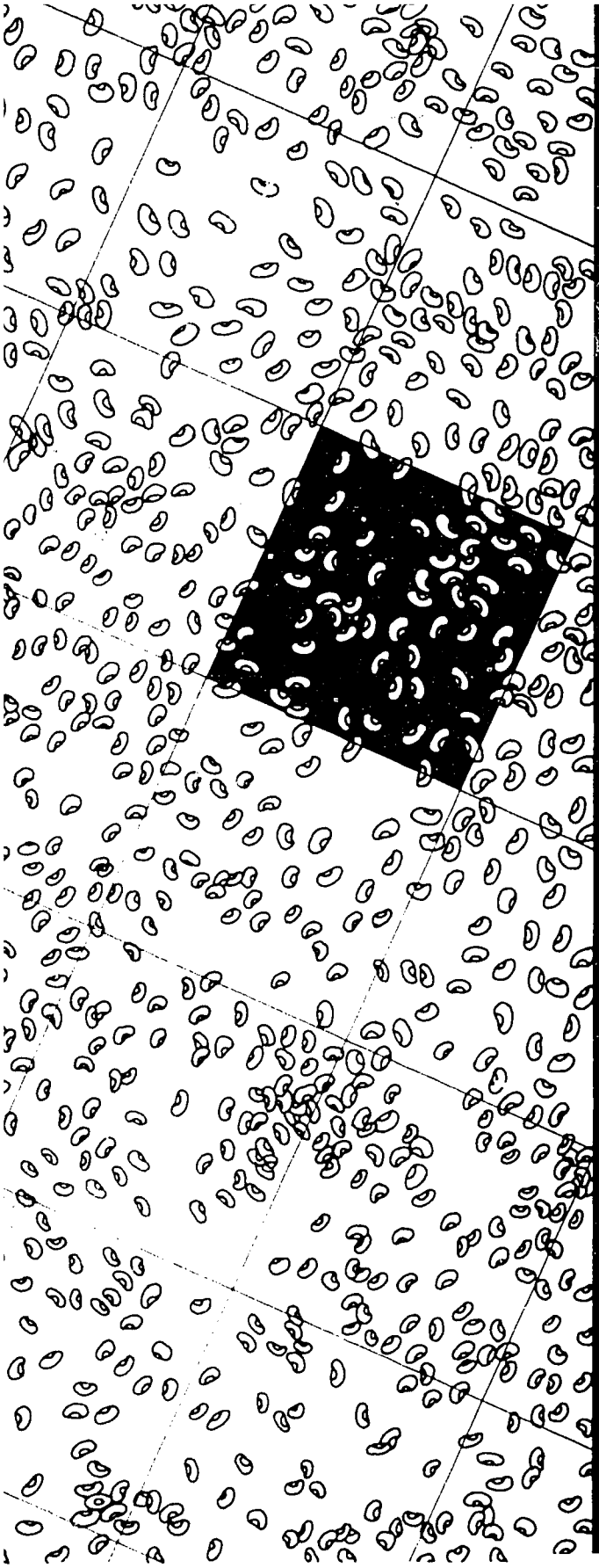

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## WHAT DO YOU THINK?

When everyone has completed an estimate, record the results on the data board. Reveal your "accurate" estimate at this point. Estimates can be expected to vary over a wide range. Discuss the range and ask them what might be responsible for the range. Some of these are:

samples not random

incomplete counts of bean bugs in the sample area; they can be hard to see

too few samples

arithmetic errors

non-uniform distribution of the bean bugs.

Ask one of the students to average all the estimates made by the investigators and compare that estimate with the estimate you determined in advance. Is it close? Closer than any of the individual estimates? Why?

## FOLLOW THROUGH

☐ Redo the activity to census some of the living organisms in your study site. Remember to calculate the area of your study area carefully.

☐ Are there worms on the lawn? Estimate the population of a species of worm.

☐ Here is an arithmetic problem: How big would a single leaf be that was equal to the total leaf area of the grass in the lawn? Compare this with the size of the leaf equal to the total broadleaf area on the lawn.

☐ Look at the soil in the lawn. Examine a cubic decimeter section. Count one type of soil organism, and estimate the population size of the organism in a 50 square meter/1 decimeter deep plot.

☐ Estimate the number of grass plants growing on a lawn.

☐ Estimate the number of trees in an orchard or woodlot (without counting them all).

## WHAT TO DO NEXT

*Sticklers*
*How Many Organisms Live Here?*

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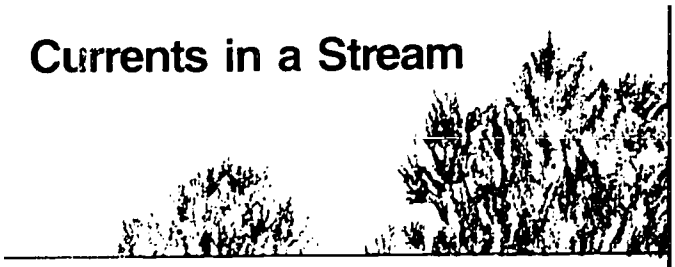
## Currents in a Stream



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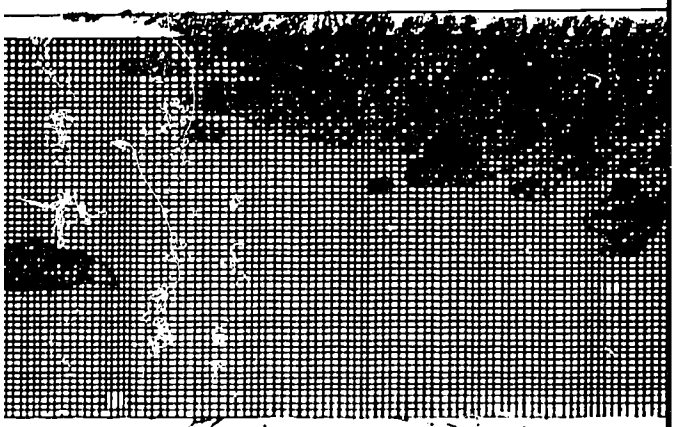

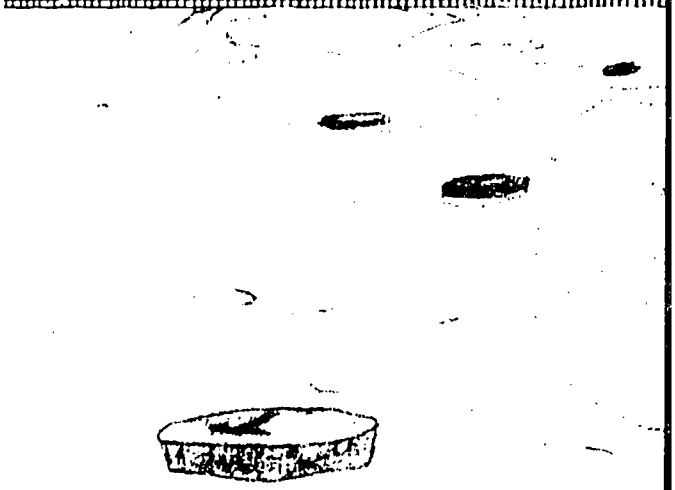

## SPEED CHECK

This post-race activity allows contestants to investigate the rate of flow in different parts of the stream.

1. Divide the participants into two-member teams: one will be a flow-meter operator and the other a timer.
2. Provide each team with a flow meter and a stopwatch or other timing device.
3. Have each team mark off an area of investigation (three or four meters of stream).
4. Give instructions for use of the flow meter: the operator stands near the section of stream or current to be measured. At the timer's signal, the cork is dropped into the water. When the string tightens, the operator yells "Stop!" and the timer records the time in seconds per meter. During each trial, the tied end of the stick should be held as close as possible to the point where the cork was first dropped.
6. Ask the participants to locate and record the fastest and slowest currents in their sections of the stream.
7. Have them identify the physical conditions associated with the swiftest and slowest current areas.
8. When the teams have finished, gather the group together and compare results.

## WHAT TO DO NEXT

*Aquatic Hi-Lo Hunt*
*Terrestrial Hi-Lo Hunt*

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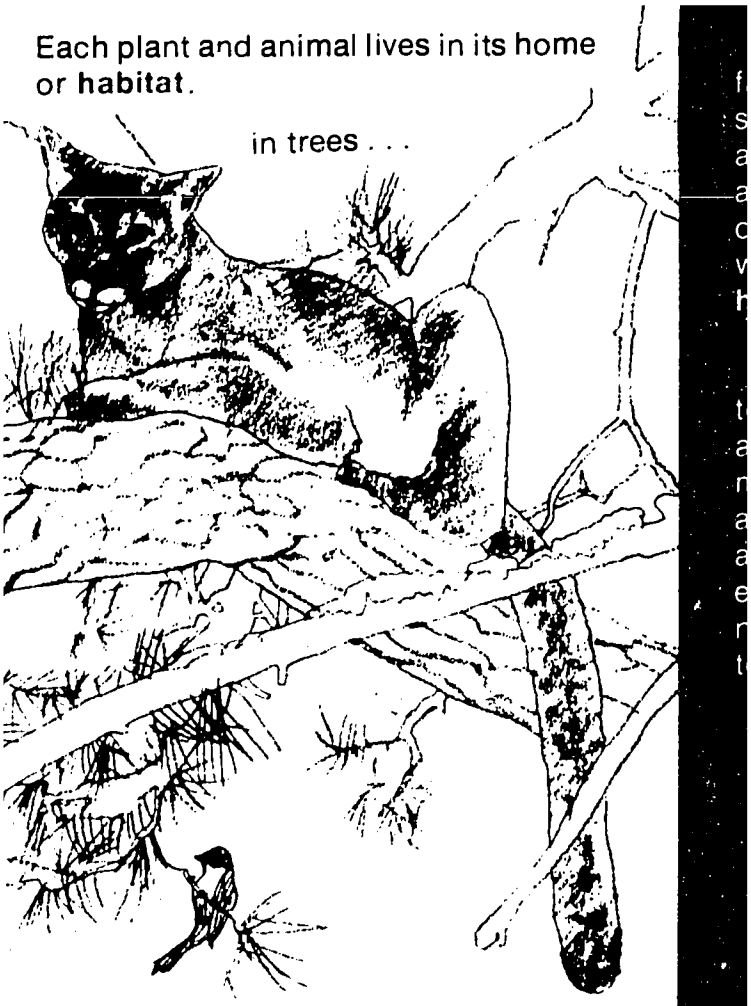
Each plant and animal lives in its home or **habitat**.




## Action Card
## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

Make a sun print of a tree habitat. Try to include at least 3 things — plants, animals, and non-living objects.

## Action Card
## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

Make a sun print of a water habitat. Try to include at least 3 things — plants, animals, and non-living objects.

## Action Card
## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

Make a sun print of an under-rock habitat. Try to include at least 3 things — plants, animals, and non-living objects.

## Action Card
## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

Make a sun print representing a shrub habitat. Try to include at least 3 things — plants, animals, and non-living objects.

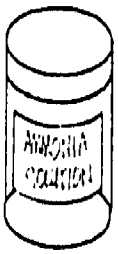
# Technique Card

## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

**How to use paper:**

1. Gather items for your sun print.
2. In your shadow (with your back to the sun), arrange items on the paper. Cover with clear plastic.
3. Step aside and let sun shine on the paper for 40-60 seconds.
4. Develop paper for 60 seconds in . . .

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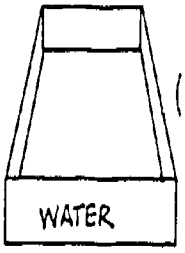



(For Blueprint paper)

5. Let paper dry in the shade.

# Technique Card

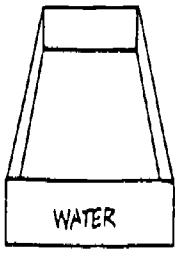
## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

**How to use paper:**

1. Gather items for your sun print.
2. In your shadow (with your back to the sun), arrange items on the paper. Cover with clear plastic.
3. Step aside and let sun shine on the paper for 40-60 seconds.
4. Develop paper for 60 seconds in . . .


(For Ozalid paper)




(For Blueprint paper)

5. Let paper dry in the shade.

# Technique Card

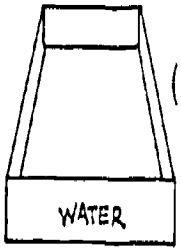
## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

**How to use paper:**

1. Gather items for your sun print.
2. In your shadow (with your back to the sun), arrange items on the paper. Cover with clear plastic.
3. Step aside and let sun shine on the paper for 40-60 seconds.
4. Develop paper for 60 seconds in . . .


(For Ozalid paper)




(For Blueprint paper)

5. Let paper dry in the shade.

# Technique Card

## HABITAT SUN PRINTS

Outdoor Biology Instructional Strategies

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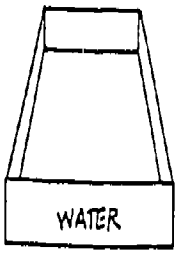
2. In your shadow (with your back to the sun), arrange items on the paper. Cover with clear plastic.
3. Step aside and let sun shine on the paper for 40-60 seconds.
4. Develop paper for 60 seconds in . . .


(For Ozalid paper)




(For Blueprint paper)

5. Let paper dry in the shade.

- ☐ Make a sun print of a water habitat. Try to include at least 3 things — plants, animals, and non-living objects.

3. Make a collage of the sun prints. Each student can then describe a habitat in terms of his or her sun print. The combination, or collage, of sun prints represents a series of habitats for this study area.

## WHAT DO YOU THINK?

- ☐ Were there parts of the habitat not represented by your sun print? If so, what are they?
- ☐ Does your collage include all of the habitats in your study area? If not, why are some of the habitats not represented?
- ☐ Think of ways to represent organisms in the study area that cannot be sun-printed.

## FOLLOW THROUGH

Individuals can produce other sun prints using only non-living objects. They then can try to predict the types of organisms (plants and animals) that would live in the habitat.

Make a sun print of a habitat for an imaginary organism — an **Okpok. Okpoks** require warm, moist, dark places to live and they eat plants.

## WHAT TO DO NEXT

*Habitats of the Pond*
*Invent an Animal*

**Outdoor Biology Instructional Strategies**
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

As the lad the afi oe Tha y S b p fi O a e S o la T a e th a T th a a w e T in w

## WHAT DO YOU THINK?

☐ Are there any plants or animals found in only one area?

☐ Are there any plants or animals that live in more than one area?

☐ After it becomes apparent that there are different organisms in different areas, tell the students that each area represents a particular habitat. Explain that the **habitat** for any organism (plant or animal) is the place where an organism normally lives and where you would ordinarily go to find it.

☐ Were there organisms you saw but were not able to collect? Add these to your map.

## FOLLOW THROUGH

☐ If microscopes or bioscopes are available, collect water and bottom mud and examine them.

☐ Teams can chart the number of organisms in each of the five habitats to see which supports the most life.

☐ Have each student or team investigate a different habitat, using the appropriate piece of equipment to find a plant and an animal not represented on the map.

## WHAT TO DO NEXT

*How Many Organisms Live Here?*
*Animal Movement in Water*
*Habitat Sun Prints*
*Animals in a Grassland*

**Outdoor Biology Instructional Strategies**
Lawrence Hall of Science
University of California
Berkeley California

Supported by a Grant from the National Science Foundation

# PREPARATION

Make a large version of the Census Chart that is inserted in this folder. Make small copies for each team.

Sample Census Chart

| | List the number of organisms found by each team. | Team 1 |
|---|---|---|
| ANIMALS | Tubifex Worms | |
| | Snails | |
| | Clams | |
| | Damselfly Nymphs | |
| | Scuds | |
| PLANTS | Elodea | |
| | Cattails | |
| | Pond Lilies | |

These organisms listed are examples of what you might find. For your chart list the organisms that you find at your site.

Provide a red marking pen for listing on the large chart the animal census results, and a green pen for the plant census results. Provide pencils for the teams to keep records on their team charts.

Cut pieces of discarded nylon pantyhose or stockings to be used as fine-mesh strainers. You may wish to make the bottom scrapers yourself, or make the construction part of the group activity.

# CENSUS CHART

## HOW MANY ORGANISMS LIVE HERE?

Outdoor Biology Instructional Strategies

| | List the number of organisms found by each team | Team 1 | Team 2 | Team 3 | Team 4 |
|---|---|---|---|---|---|
| ANIMALS | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| PLANTS | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Get the "Bottom Scraper" and "Aquatic Equipment" cards from *OBIS Toolbox* folio.

| Team 2 | Team 3 | Team 4 |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

3. After you are certain the teams understand the instructions, let them work on their own. Each team should make at least one census. If enough time is available, ask each team to make two censuses. All organisms should be returned to the pond after they have been counted. Let the teams work until fifteen minutes remain in the session.

## WHAT DO YOU THINK?

When all of the censuses have been recorded, ask which team found the greatest number of organisms, and which found the greatest number of different kinds of organisms. Write the term **populations** in large letters at the top of the chart. Explain that a population is a group of organisms of the same kind that lives and reproduces in a particular area.
Now compare the different censuses and ask why each team didn't find the same numbers and kinds of organisms. If they took two censuses, ask them if they can explain any discrepancies between their first and second census.
Some possible explanations are:
inconsistent counting techniques
inadequate equipment
uneven distribution of organisms over a habitat
differences in area sampled

## FOLLOW THROUGH

Using all the censuses taken, how might the group make an estimation of the number of organisms living on the entire pond bottom?
For reinforcement, ask the group to determine the population of highly visible surface organisms, e.g., shore plants, water striders, frogs, or ducks.

## WHAT TO DO NEXT

*Bean Bugs*
*Habitats of the Pond*
*Water Holes to Mini-Ponds*
*Sticklers*

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Lawrence Hall of Science
University of California
Berkeley California

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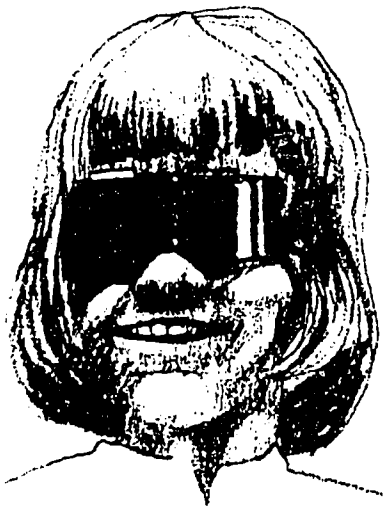
Abnormal Psychology

## FOLLOW UP

Not all animals have the same quality of vision. Some, with limited color vision, view the world in varying shades of a single tone. Provide colored cellophane masks. The masks can be made by taping colored cellophane (red is an effective color) to the forehead, covering the eyes with the cellophane. Have the group "hide and search" for some of the model animals again. Compare the results of the two different searches.



**Note:** Colored cellophane or gel may be purchased from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

## WHAT TO DO NEXT

*Attention!*
*Animals in a Grassland*
*Invent a Plant*
*Sticklers*

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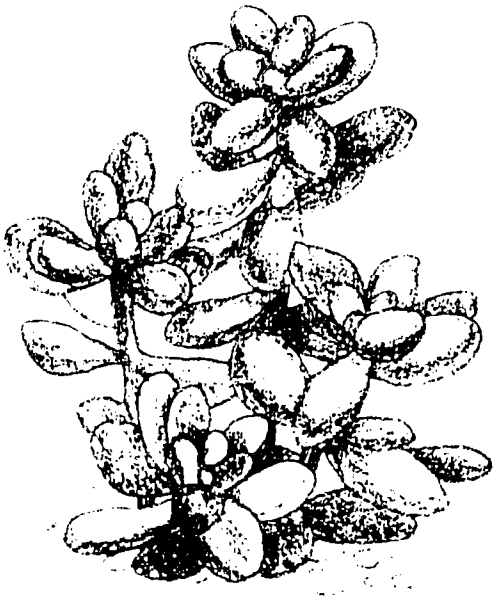


## Action Card
## INVENT A PLANT

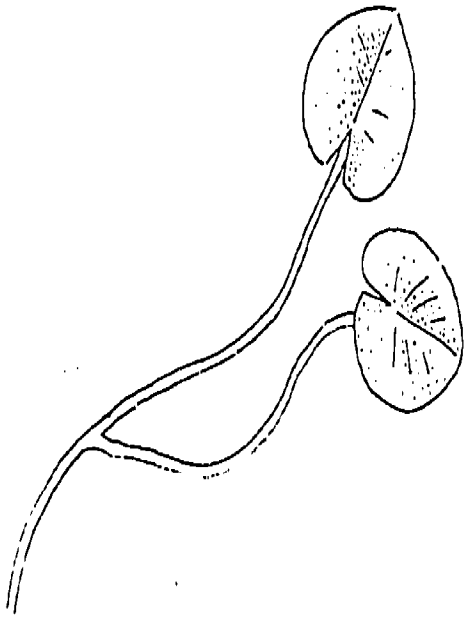
Outdoor Biology Instructional Strategies

Invent a plant which is lawnmower-proof.

## Action Card
## INVENT A PLANT

Outdoor Biology Instructional Strategies

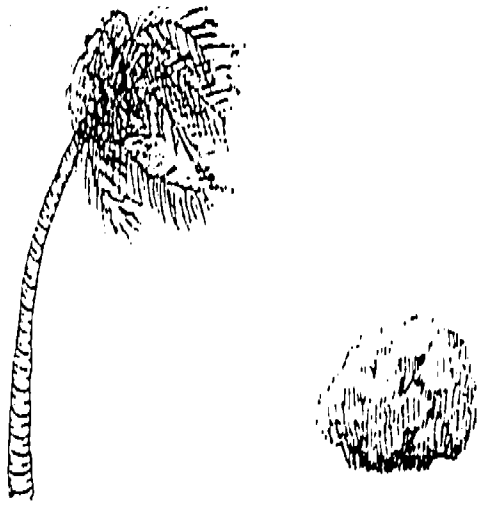
Invent a plant that can live on the surface of a pond.



## Action Card
## INVENT A PLANT

Outdoor Biology Instructional Strategies

Invent a plant so it can withstand high winds.



## Action Card
## INVENT A PLANT

Outdoor Biology Instructional Strategies

Invent a plant that grazing animals would not eat.

# Technique Card
# INVENT A PLANT

Outdoor Biology Instructional Strategies

**How to use plastic film:**

A. Form the wire into a basic petal or leaf shape and contour it as you desire.
B. Dip the shaped wire into the plastic film.
C. Stand wire in styrofoam or clay to dry.
D. Group petals together into flower or plant form.
E. Wrap stems with floral tape.
F. Add plastic leaves to stem as you wrap it.


# Technique Card
# INVENT A PLANT

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# Action Card
# INVENT A PLANT

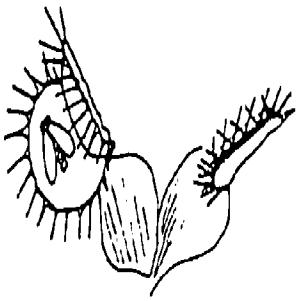
Outdoor Biology Instructional Strategies

Invent a plant that can hold on to rocks in swift rivers and streams.

# Action Card
# INVENT A PLANT

Outdoor Biology Instructional Strategies

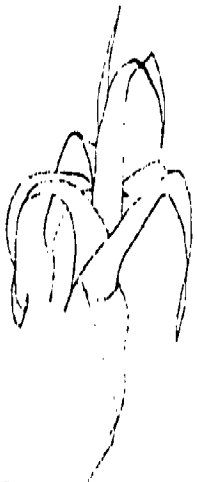
Invent a plant to catch insects.

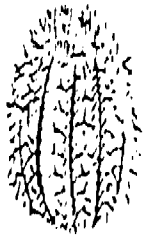


# Action Card
# INVENT A PLANT

Outdoor Biology Instructional Strategies

Invent a plant adapted to store water.



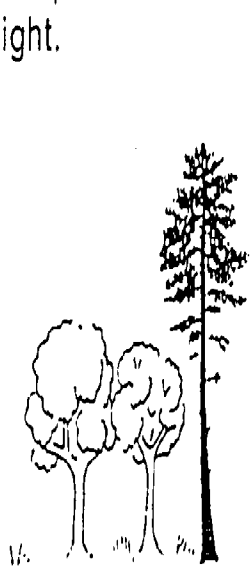


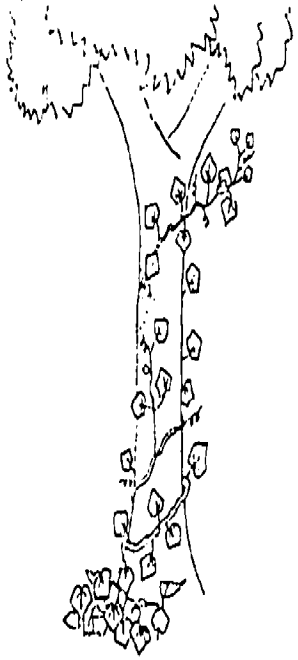


# Action Card
# INVENT A PLANT

Outdoor Biology Instructional Strategies

Invent a plant that can compete with other plants for sunlight.





# Technique Card
# INVENT A PLANT

Outdoor Biology Instructional Strategies

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E. Wrap stems with floral tape.
F. Add plastic leaves to stem as you wrap it.

## FOLLOW THROUGH

Find real plants that have the same adaptations that the models have.

## WHAT TO DO NEXT

*Habitat Sun Prints*
*Seed Dispersal*
*Plants Around a Building*

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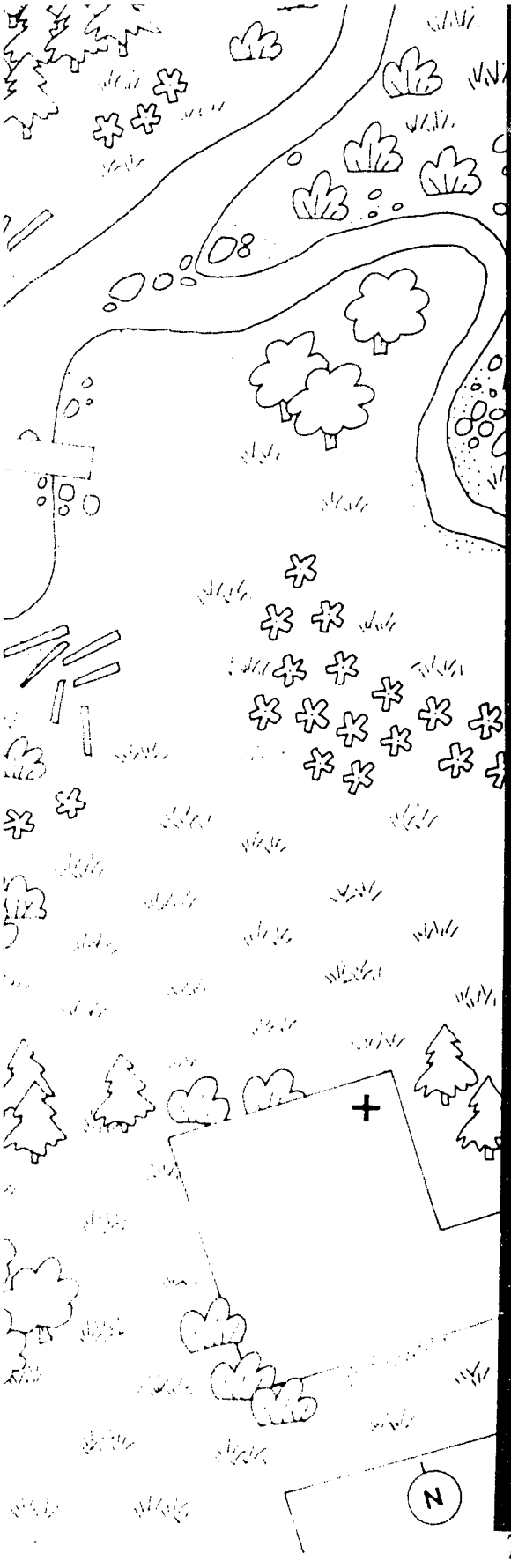


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# MAPPING A STUDY SITE

## WHAT DO YOU THINK?

1. What is the most common color on each map section and which features do these four colors represent?
2. What is the most common color on the overall map and which feature does it represent?
3. Which section contains the greatest number of different colors and which section the least? What might explain the differences in these two sections?
4. In which section do you suppose man's influence is most evident? In which section is it least evident?
5. In what ways do you think man may have affected the biological features of the activity site?
6. What do you think this site looked like fifty years ago?
7. What do you think this site will look like fifty years from now?

## WHAT TO DO NEXT

*What Lives Here?*
*Habitat Sun Prints*
*Plant Distribution Patterns*
*Sticklers*

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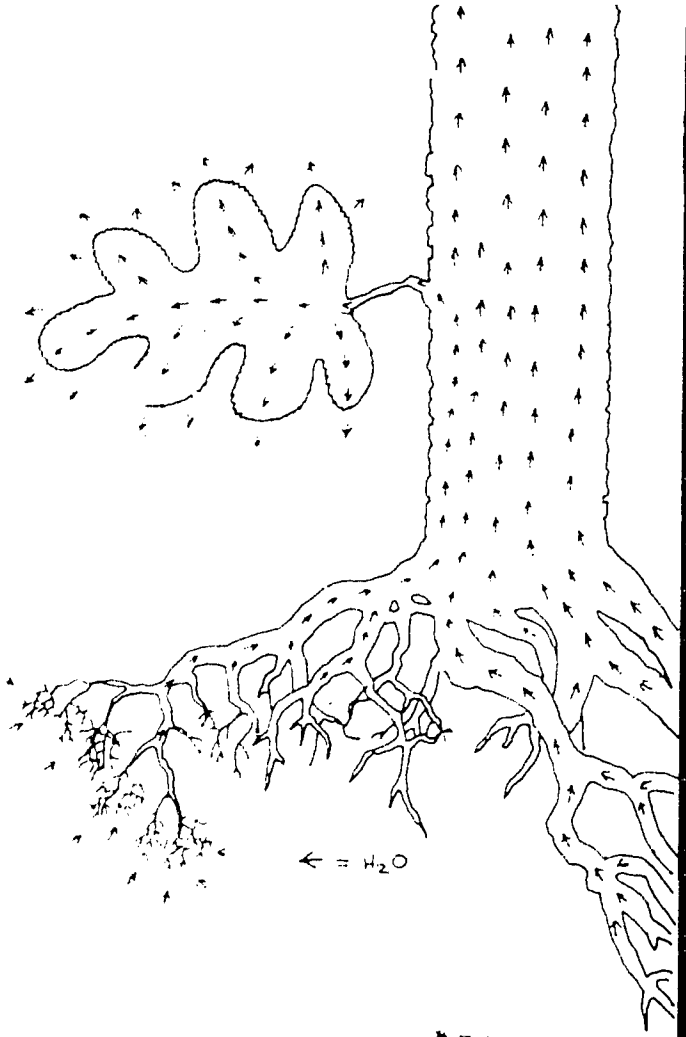


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**MEASURE THE MOIST**
**RELEASED FROM DIF**
**OF LEAVES BY OBSER**
**COLOR CHANGE OF C**
**CHLORIDE PAPER.**

## MATERIALS

Cobalt chloride paper*
OR Cobalt chloride crys
table salt
water and bowl
filter paper or some oth
paper (paper towels)
scotch tape
plastic bags
clothes pins
twist-ties
plastic food wrap
paper clips
hand lenses (optional) f
closely at leaves

*Cobalt chloride paper c
be obtained from junior
school science departm
supply houses, or the La
Science. See the order
*OBIS Toolbox* folio.

## Action Card
## MOISTURE MAKERS

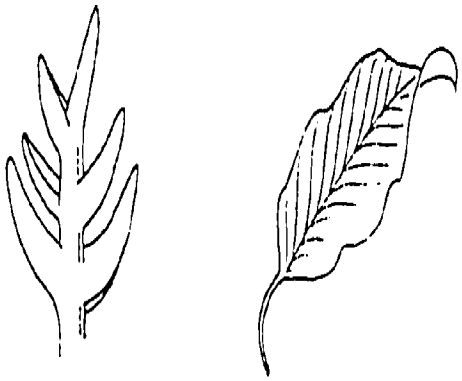
Outdoor Biology Instructional Strategies

Compare transpiration of a dead leaf with a live leaf attached to the same tree.

## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

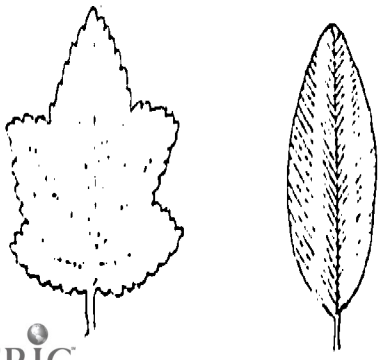
Compare transpiration of a thick juicy leaf (succulent) with a thin, flat leaf.



## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

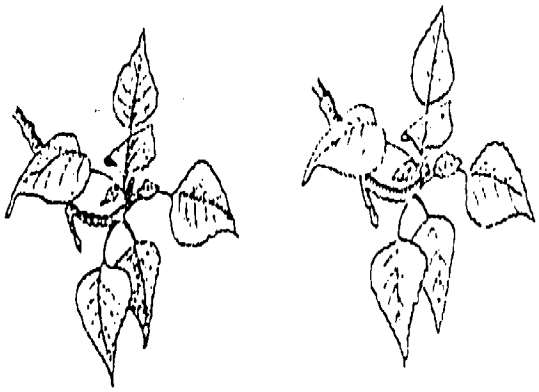
Compare transpiration of a hairy-surfaced leaf with a smooth-surfaced leaf.



## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

Compare transpiration of a leaf in the shade with a leaf of the same size and shape in the sun.



# Technique Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

**How to use cobalt chloride paper:**

To observe color change, place a piece of clear tape on both sides of one section of the paper. The taped area will remain blue and the uncovered area will turn pink when exposed to moisture.

Place dry cobalt chloride paper on living leaves that are attached to trees or bushes. Use paper clips to hold the paper in place. Enclose the paper and leaf in a plastic bag or plastic food wrap. Measure and compare the time it takes different leaves to turn the blue paper to pink.

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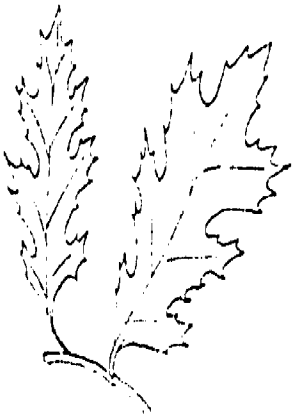
## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

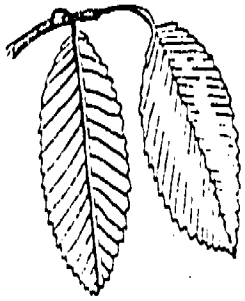
Compare transpiration of a small leaf and a large leaf on the same plant.



## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

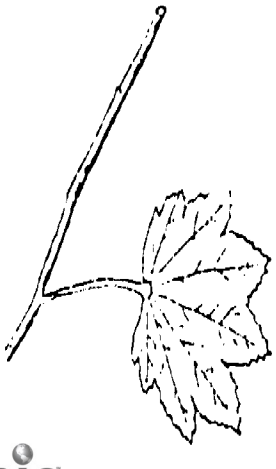
Compare transpiration of the upper side of one leaf with the lower side of another leaf. The two leaves should be the same kind and approximately the same size. (Place the cobalt chloride paper on top of one leaf and hold in place with a paper clip. Repeat the procedure on the bottom side of another leaf.)



## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

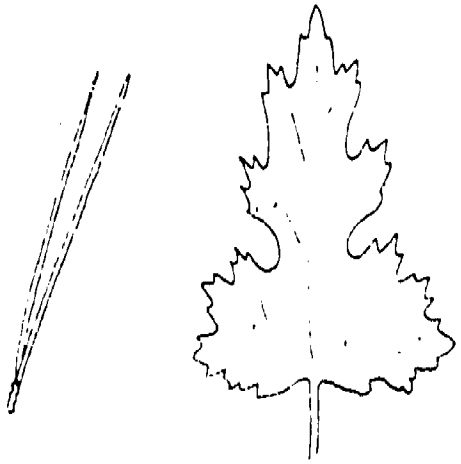
Compare transpiration of a stem with a leaf of the same plant.



## Action Card
## MOISTURE MAKERS

Outdoor Biology Instructional Strategies

Compare transpiration of a pine needle with a broad leaf.



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# MOISTURE MAKERS

Outdoor Biology Instructional Strategies

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## ACTION

1. Explain the method for us
cobalt chloride paper as a
moisture-measuring device.
(Instructions appear on the r
side of each **Action Card**.)
2. Distribute **Action Cards**.
☐ Compare transpiration of
leaf and a large leaf on the sa
☐ Compare transpiration of
with a leaf of the same plant.
☐ Compare transpiration of
needle with a broad leaf.
☐ Compare transpiration of a
th a live leaf attached to the
ree.
☐ Compare transpiration of
juicy leaf (succulent) with a th
leaf.
☐ Compare transpiration of
hairy-surfaced leaf with a
smooth-surfaced leaf.
☐ Compare transpiration of
the shade with a leaf of the sa
and shape in the sun.
☐ Compare transpiration of
side of one leaf with the lowe
another leaf. The two leaves s
the same kind and approxima
same size. (Place the cobalt
paper on top of one leaf and f
place with a paper clip. Repea
procedure on the bottom-sid
another leaf.)
3. Have each participant com
activity suggested on two or
the **Action Cards**.

## FOLLOW THROUGH

A. Effects of excessive watering on transpiration.

1. Choose two plants of the same type and approximately the same size.
2. Label plants A and B.
3. Water plant A the day before and just before measuring the rate of transpiration. Do not water plant B.
4. Measure the rate of transpiration and compare the results.

B. Compare the transpiration of one type of plant at different times of the day.

C. Transpiration of a potted plant:

1. Obtain several potted plants in metal, plastic, or styrofoam containers that have no drainage holes in the bottom.
2. Water the plants only once.
3. Cover the soil surface with foil, plastic food wrap, or paraffin to prevent evaporation of water from the soil. Weigh the entire set-up.
4. As a control, set up an identical pot. Add soil and water, but replace the plant with a wooden stick. Cover the soil surface as before, and weigh the entire set-up.
5. Continue to weigh the plants and control set-up every other day. The difference in weight loss between the control and experimental pots is the water lost through transpiration.

## WHAT TO DO NEXT

*Terrestrial Hi-Lo Hunt*
*Invent a Plant*
*Seed Dispersal*

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# DATA CHART

# NATURAL RECYCLING IN SOIL

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| container | weight | | | appearance of contents | |
|---|---|---|---|---|---|
| | before | after | differ-ence | before | after |
| Nylon Stocking | | | | | |
| Mesh Bag with large holes | | | | | |
| Plastic Bag | | | | | |

## FOLLOW UP

Place equal amounts of the same type of dead vegetation into several mesh bags. Weigh each and record the weight. Place one bag about 8 or 10 cm. above the soil (hanging from a stake), place one on top of the soil, and bury one about 8 cm. below the soil surface. A fourth bag can be buried deeper. Mark each site with a stake.

After 2-8 weeks recover the bags. Weigh them, and visually compare the contents.

## WHAT TO DO NEXT

*Natural Recycling in Water*
*Water Holes to Mini-Ponds*

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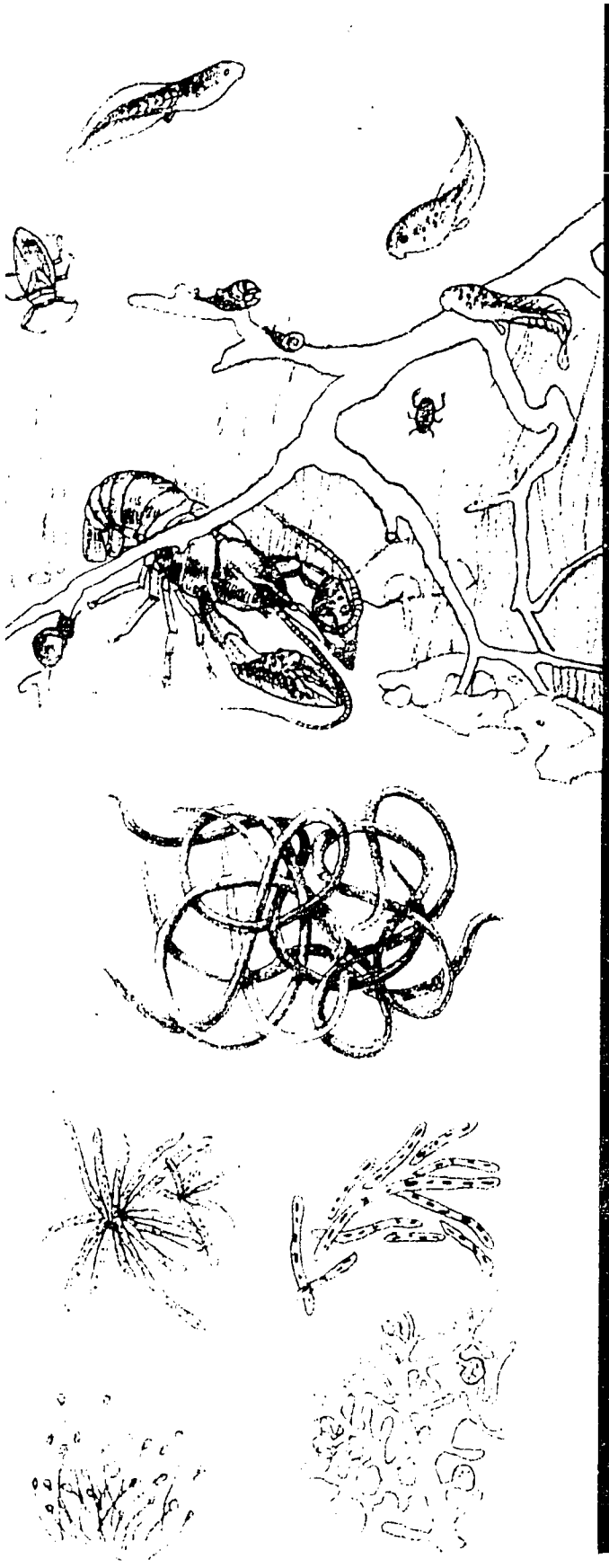

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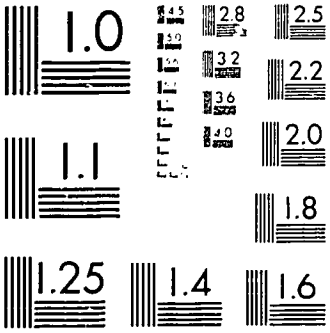


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

# DATA CHART
# NATURAL RECYCLING IN WATER

Outdoor Biology Instructional Strategies

| container | weight | | | appearance of bag & contents | |
|---|---|---|---|---|---|
| | before | after | differ-ence | before | after |
| Nylon stocking with dead vegetation | | | | | |
| Mesh bag with dead vegetation | | | | | |
| Plastic bag with dead vegetation | | | | | |

A. Put some of each type of vegetable material available into each bag.
B. Observe each vegetable type and record its appearance on your data card.
C. Close and tie each bag firmly with the string, leaving extra string to tie the bag to a stake.
D. Dip all the bags in water, remove them and allow to drip for one minute. Weigh the bags and record the weights on the data card.
E. Tie all three bags to a stake. Use the stake to firmly position the bags under water at some convenient place in an aquatic habitat (pond, stream, salt water marsh, etc.).

# NATURAL RECYCLING IN WATER

## FOLLOW UP

Using the same technique, compare natural recycling in running water with natural recycling in still water.

## WHAT TO DO NEXT

*What Lives Here?*
*Water Holes to Mini-Ponds*
*Natural Recycling in Soil*

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## FOLLOW THROUGH

☐ Do any of the suggested "WHAT TO DO NEXT" activities, comparing "control" and "out-of-control" areas.

☐ Make some charts on your data board and keep records of specific changes such as height of plants, number of weeds that appear, or number of lawn grasses which disappear.

## WHAT TO DO NEXT

*Water Holes to Mini-Ponds*
*Bean Bugs*
*Animals in a Grassland*
*Seed Dispersal*
*Terrestrial Hi-Lo Hunt*

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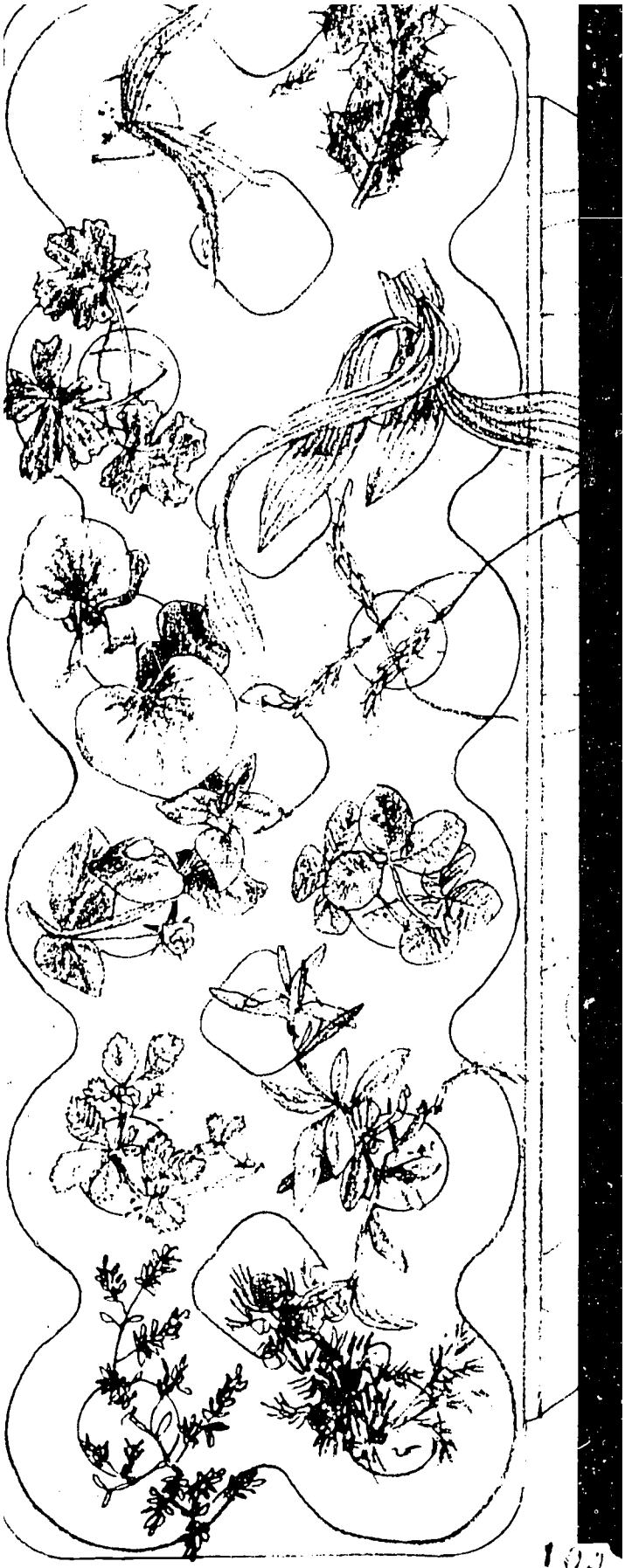

## FOLLOW THROUGH

1. Interested participants can further identify their collected plants by using standard biological keys and plant guides.
2. Compare the diversity of plants found at different times of the year or after a rainy or dry period.
3. Search for additional plants on the site. What was missed?
4. Conduct a plant hunt in two different environments such as a lawn and a meadow; compare results.

## WHAT TO DO NEXT

*Bean Bugs*
*Animals in a Grassland*
*Plant Distribution Patterns*
*Plants Around a Building*

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## Action Card

# PLANTS AROUND A BUILDING

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Find and mark on your map those places where plants seem to grow much larger than the same kind of plants in other places around the building. What do you think is causing this, in each case?

## Action Card

# PLANTS AROUND A BUILDING

Outdoor Biology Instructional Strategies

Find and mark on your map those places where plants seem to grow much smaller than the same kind of plants in other places around the building. What do you think is causing this, in each case?

## Action Card

# PLANTS AROUND A BUILDING

Outdoor Biology Instructional Strategies

Find and mark on your map those places where the number of plants in a small area is high. What do you think is causing this, in each case?

## Action Card

# PLANTS AROUND A BUILDING

Outdoor Biology Instructional Strategies

Find and mark on your map those places where the number of plants in a small area is very low. What do you think is causing this, in each case?

## Action Card

# PLANTS AROUND A BUILDING

Outdoor Biology Instructional Strategies

Find and mark on your map those places where no plants grow. What do you think is causing this, in each case?

## Action Card

# PLANTS AROUND A BUILDING

Outdoor Biology Instructional Strategies

Find and mark on your map the least common plant growing around the building. Are there any special conditions which permit it to grow in that place or places?

## Action Card

Outdoor Biology Instructional Strategies

## Action Card

Outdoor Biology Instructional Strategies

## FOLLOW UP

1. Reinforce the concept of environmental variable. Select a variable (temperature, moisture, light, etc.) and tour the site observing how plants respond to that variable. Challenge the participants to relate the results to the evidence you have acquired on plant growth around the building. (A more quantitative measurement of environmental variables is obtained in the *Terrestrial Hi-Lo Hunt* activity.)
2. Orient a building map according to the compass, and have participants hunt for evidence of differences in plant growth on the north, south, east, and west sides of the building. Can the youngsters relate these differences to environmental factors caused by the building's exposure? What about the effect of gardening or the lack of it?
3. Carry out the activity at a different season of the year, and compare the results in relation to each environmental factor.

## WHAT TO DO NEXT

*Terrestrial Hi-Lo Hunt*
*Plant Hunt*
*Invent a Plant*

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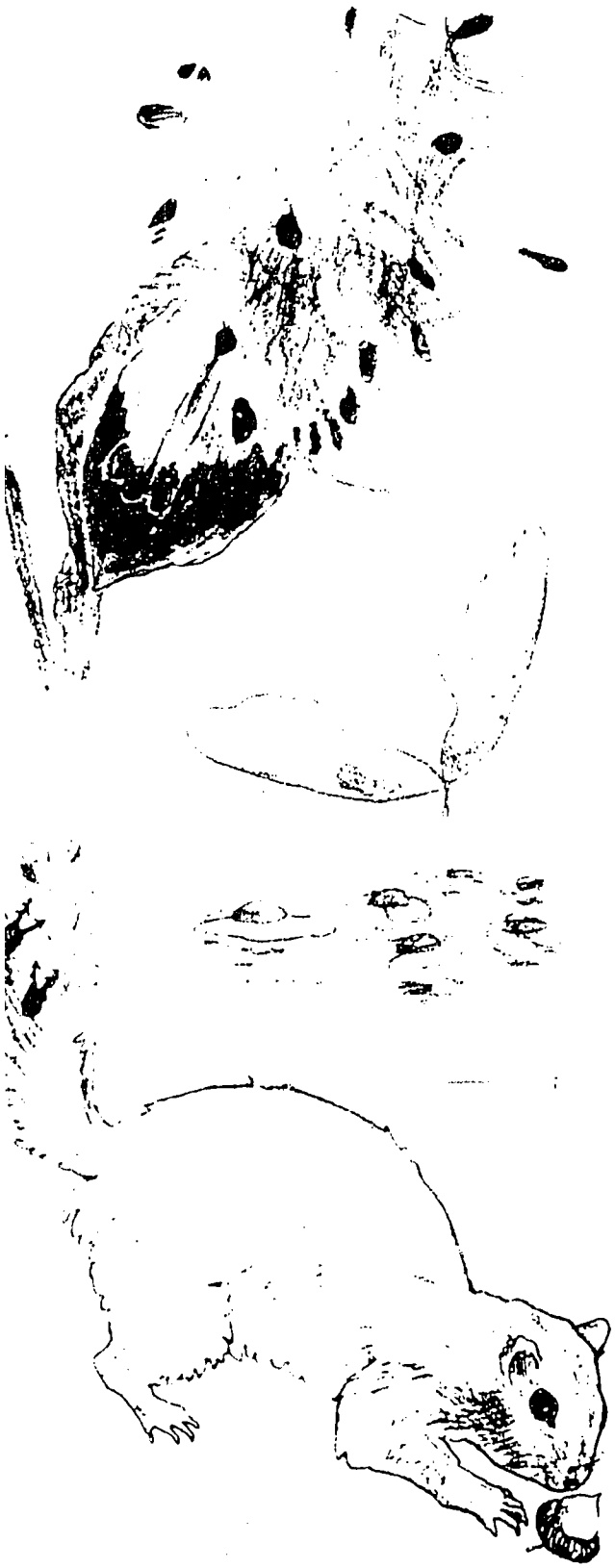
Seed dispersal is dependent on many agents:



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# SEED-GO

## SEED DISPERSAL

Look carefully at the plants in your surroundings. Decide how each plant disperses seeds and glue or tape a sample of its seed in the proper box. Some seeds may be dispersed in more than one way. The first person with five seeds in a row, in any direction, wins (same as Bingo).

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| | grass | trees | bushes | weeds | garden plants |
|---|---|---|---|---|---|
| wind | | | | | |
| water | | | | | |
| mechanical | | | | | |
| animals | | | | | |
| man | | | | | |

**REMEMBER:**
**In order to win, you may have to convince others that you are correct.**

# Action Card
## SEED DISPERSAL

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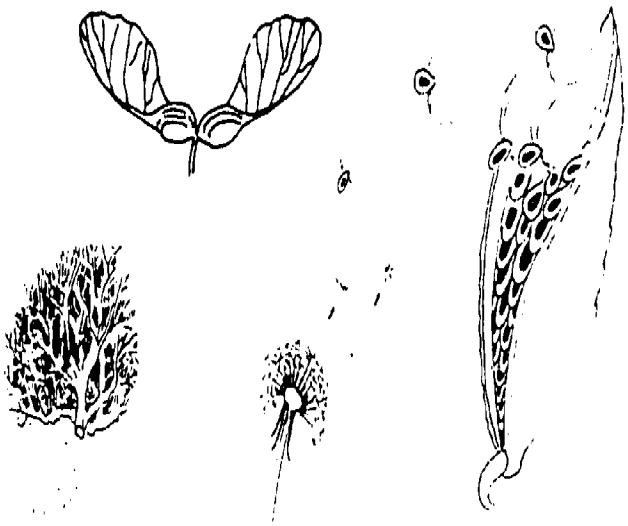
Modify your seed to fly at least three feet.



# Action Card

Outdoor Biology Instructional Strategies

# Action Card

Outdoor Biology Instructional Strategies

# Action Card

Outdoor Biology Instructional Strategies

# Technique Card
# MOISTURE MAKERS

Outdoor Biology Instructional Strategies

**How to use cobalt chloride paper:**

To observe color change, place a piece of clear tape on both sides of one section of the paper. The taped area will remain blue and the uncovered area will turn pink when exposed to moisture.

Place dry cobalt chloride paper on living leaves that are attached to trees or bushes. Use paper clips to hold the paper in place. Enclose the paper and leaf in a plastic bag or plastic food wrap. Measure and compare the time it takes different leaves to turn the blue paper to pink.


# Technique Card
# MOISTURE MAKERS

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# Technique Card
# MOISTURE MAKERS

Outdoor Biology Instructional Strategies

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Place dry cobalt chloride paper on living leaves that are attached to trees or bushes. Use paper clips to hold the paper in place. Enclose the paper and leaf in a plastic bag or plastic food wrap. Measure and compare the time it takes different leaves to turn the blue paper to pink.

## FOLLOW UP

Distribute duplicated **SEED-GO** cards and some glue or tape. **SEED-GO** is played like Bingo. When someone says he has won, encourage questions from the others so the winner can explain his reasoning.

## WHAT TO DO NEXT

*Adaptation–Predator-Prey*
*Invent an Animal*
*Invent a Plant*

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## FOLLOW THROUGH

Return to the study site and investigate the habitat and distribution of a real organism. This can be a free-wheeling investigation where each participant studies a plant or animal of his own choice. Or, if you can identify an organism that would provide a good habitat and distribution investigation, proceed exactly as in the stickler hunt. For instance, if there are ladybugs living on your lawn, catch one and say, "Here is another organism living in our study site. Let us see what we can find out about where it lives and how it is distributed." Proceed as before, but DON'T COLLECT organisms this time, because their removal might upset delicate ecological balances. Perhaps a plant would be an appropriate choice of organism for your study site.

☐ Walk to a new study site and investigate the habitat and distribution displayed by some other organisms.

☐ Play a game where some students search out an organism, determine its habitat and distribution, and describe that habitat and distribution to the group. Have the other students determine what the organisms are from the descriptions of habitats and distributions.

## WHAT TO DO NEXT

*Terrestrial Hi-Lo Hunt*
*Habitat Sun Prints*
*Habitats of the Pond*

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# Action Card
# TERRESTRIAL HI-LO

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**Temperature.** Use a thermometer to find the warmest and coolest spots in this site.

| Temp. °C | Location |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |

After you have finished taking temperature measurements, mark the warmest and coolest spots with your Hi-Lo markers.

# Action Card
# TERRESTRIAL HI-LO

Outdoor Biology Instructional Strategies

**Wind.** Use your wind station to find the windiest and calmest spots in this site.

| Wind Speed (rev/min) | Location |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |

After you have finished taking wind measurements, mark the windiest and calmest spots with your Hi-Lo markers.

# Action Card
# TERRESTRIAL HI-LO

Outdoor Biology Instructional Strategies

**Slope.** Use a slope-measuring device to find the steepest and flattest spots in this site.

| Slope (cm/meter) | Location |
|---|---|
| 1. | |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |

After you have finished taking slope measurements, mark the steepest and flattest spots with your Hi-Lo markers.

# Action Card
# TERRESTRIAL HI-LO

Outdoor Biology Instructional Strategies

**Light.** Use a light-measuring station to find the brightest and darkest spots in this site. (Remember: the darker the proof paper the brighter the spot.) Write the location of each exposure above each piece of proof paper.

After you have finished taking light measurements, mark the brightest and darkest spots with your Hi-Lo markers.

## FOLLOW THROUGH

1. For an interesting comparison, conduct the activity again at a different time of day, on another day, or during a different season.
2. Measure the changes which occur from early morning through late evening.
3. Select a site with different characteristics (ask the group to describe the differences) and compare the environmental variables of the two sites. If you have just studied a lawn, you might want to try a dense woody area, bare soil, pavement, or a meadow.

## WHAT TO DO NEXT

*Aquatic Hi-Lo Hunt*
*ESP–Environmental Sensory Perception*
*Plants Around a Building*

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Arrival

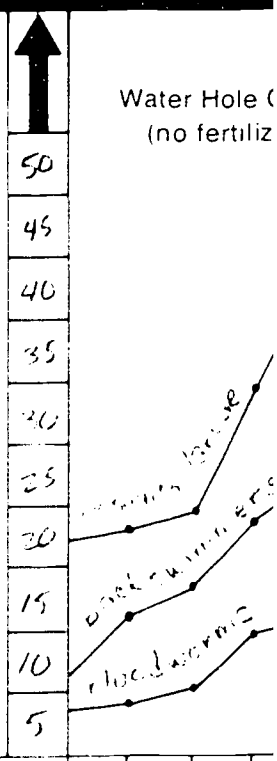
Survival

Population increase

Population decrease

## PARATION

ecting the site:
Look for a site preferabl
open and definitely not u
any plant exuding sap o
dropping lots of leaves.
Consider the problem of
and replenishing the hol
Obtain permission for di
holes.
ter hole charts
Make a large chart for eac
hole.

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or different organisms sh
ed in different colors.

Suggest the hands - and - knees approach for close observation. *Pond Guides* may be helpful for identifying new organisms.

5. End each meeting by asking the teams to compare the development of the two water holes. Use the information on the water hole charts to make this comparison.
6. After the group has observed the presence of a population of organisms in a water hole, introduce the term **colonization** and its definition. Reinforce understanding of the term by using it in the context of the water holes, i.e., were there any new colonizers this week?

## WHAT DO YOU THINK?

(Questions for discussion when you visit the water holes)

What changes can you see in each water hole?

Could there be any relationship between the biological changes and changes in physical conditions? (For example, could the appearance of organisms have anything to do with a change in light penetration in a water hole?)

What new animals have arrived?

What new plants have arrived?

What organisms have remained in the water hole over a period of time? Why?

What organisms have increased in numbers? How?

What organisms have decreased in numbers after a period of time? How?

What are the major differences between the two water holes? What are some explanations for these differences?

## FOLLOW THROUGH

Construct other water holes controlling different variables such as: amount of light, water, or adding detergents, nutrients, sugar, salt, etc. Observe and compare the changes in these water holes.

If you have a dissolved oxygen test kit available, you may want to monitor the changes in the dissolved-oxygen content of the water holes.

## WHAT TO DO NEXT

*Natural Recycling in Water*
*Out of Control*

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What lives in the water?

Plants?

Animals?

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## FOLLOW THROUGH

End the discussion by explaining that plants and animals are called organisms by scientists. Write **organism** and its definition so that everyone can see it. Ask the group how many different kinds of organisms they can name.

## WHAT TO DO NEXT

*Habitats of the Pond*
*Animals in a Grassland*
*Sticklers*
*Habitat Sun Prints*

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Wesneno

Aeaunco Inhlo

## FOLLOW UP

Place bait in two distinct vegetation areas (meadow or forest, shrub or grassy openings). Which area seems to have more mammal activity around the bait stations? What could be some of the reasons for a greater number of mammals in one area than another?

## WHAT TO DO NEXT

*Habitat Sun Prints*
*Natural Recycling in Soil*
*Sticklers*

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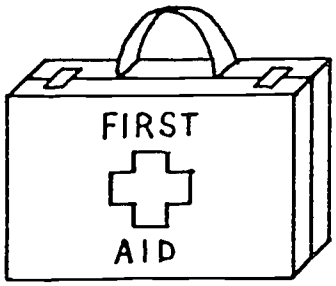


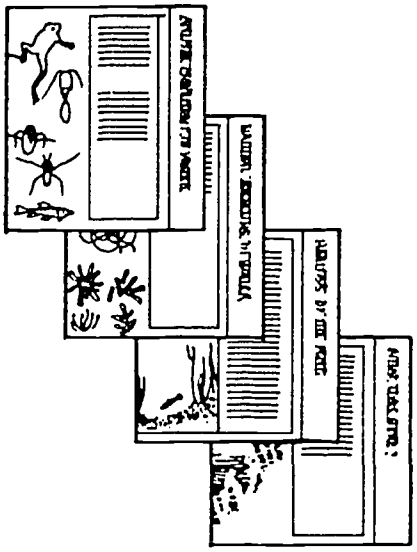

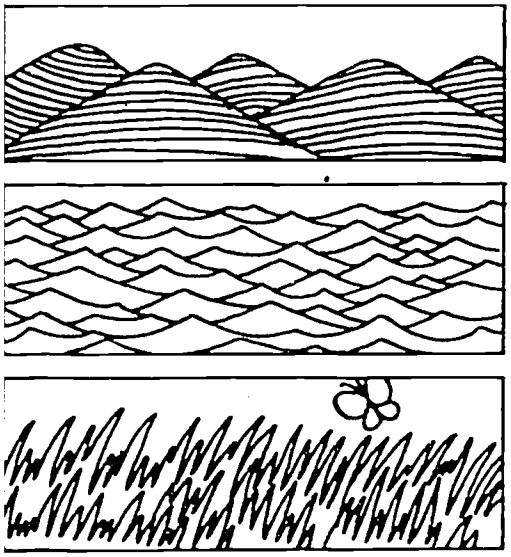

## USING THE OBIS FOLIOS

Each OBIS folio can provide an enjoyable and interesting outdoor activity. You can either select individual activity folios for inclusion in your existing environmental program or a group of folios to provide a comprehensive experience in outdoor biology. Flexibility and adaptability in selection and use of activities are major aspects of the design of the OBIS materials.

OBIS activities are intended primarily for boys and girls between the ages of ten and fifteen, but have been used successfully with both older and younger individuals. With some assistance, older participants can often take on a leadership role in guiding small groups using the folios.

In the "Currently Available OBIS Folios" section, you will find a list of the available folios. Also indicated is the habitat or habitats in which each activity has proved useful.

## CURRENTLY AVAILABLE OBIS FOLIOS

*Adaptation – Predator-Prey* (All habitats)
*Animal Movement in Water* (All aquatic habitats)
*Animals in a Grassland* (Lawns, meadows, and fields)
*Attention!* (All habitats)
*Bean Bugs* (All terrestrial habitats)
*Great Streamboat Race* (Streams)
*Habitat Sun Prints* (All habitats)
*Habitats of the Pond* (Ponds and lakes)
*How Many Organisms Live Here?* (Ponds and lakes)
*Invent a Plant* (All habitats)
*Invent an Animal* (All habitats)
*Mapping a Study Site* (All habitats)
*Moisture Makers* (All terrestrial habitats)
*Natural Recycling in Soil* (All terrestrial habitats)
*Natural Recycling in Water* (All aquatic habitats)
*Out of Control* (Lawn)
*Plant Hunt* (All terrestrial habitats)
*Plants Around a Building* (Building sites)
*Seed Dispersal* (All habitats)
*Sticklers* (All terrestrial habitats)
*Terrestrial Hi-Lo Hunt* (All terrestrial habitats)
*Water Holes to Mini-Ponds* (All habitats)
*What Lives Here?* (All aquatic habitats)
*Who Goes There?* (All terrestrial habitats)

## OBIS MODULES

The OBIS folios may be combined to produce concept packages, skill units, environment-oriented clusters, and many other schemes according to the needs of the children or the judgment of the leader. Any such grouping is often referred to as a **module**.

Combining several OBIS activities or folios into a module is best accomplished by the leader who knows the children, their ages, and their typical interest levels, as well as the available study sites, weather, time blocks, group size, and materials budget. Seashore activities obviously are not appropriate for a mountain camp site. Thus some selection is mandated by the physical site that is available. The leader is expected to match the level of the activities with the capability of the children. Many activities can be adapted to different age levels.

The OBIS development staff cannot foresee and provide for all possible variations in conditions. Therefore the individual leader is the most qualified individual to select and sequence the activities for his particular set of circumstances.

Some possible modules and the activities comprising the modules:

## ADAPTATION

*Adaptation – Predator-Prey*
*Invent a Plant*
*Invent an Animal*
*Seed Dispersal*
*Animal Movement in Water*
*Attention!*

## SAMPLING

*Animals in a Grassland*
*Habitat Sun Prints*
*How Many Organisms Live Here?*
*Habitats of the Pond*
*Plant Hunt*
*Bean Bugs*
*Sticklers*

## POND

*Mapping a Study Site*
*What Lives Here?*
*Habitats of the Pond*
*How Many Organisms Live Here?*
*Animal Movement in Water*
*Natural Recycling in Water*
*Water Holes to Mini-Ponds*

## 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 any aquatic or other potentially hazardous site.

The buddy safety system is designed so 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.

Avoid sites with obvious hazards such as steep banks and slide areas. Try to find 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 organisms should be permanently removed from their habitats. OBIS investigators collect organisms temporarily for observation and identification, but all should be returned to the exact place they were found (leaf samples are an occasional exception). The overall impact of your group on a study site should be minimal. Setting some rules of procedure would emphasize respect for the study 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. An area fifty meters square is ample for most activities, while some activities can take place in even smaller sites.

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



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**Outdoor Biology Instructional Strategies**
Lawrence Hall of Science
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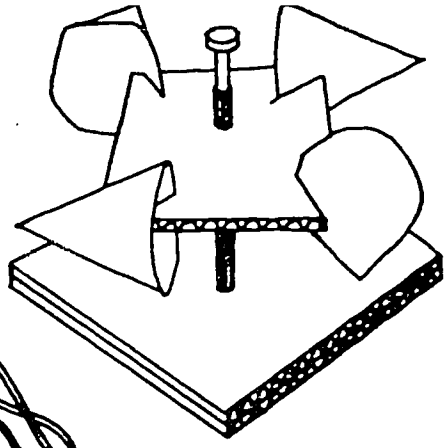
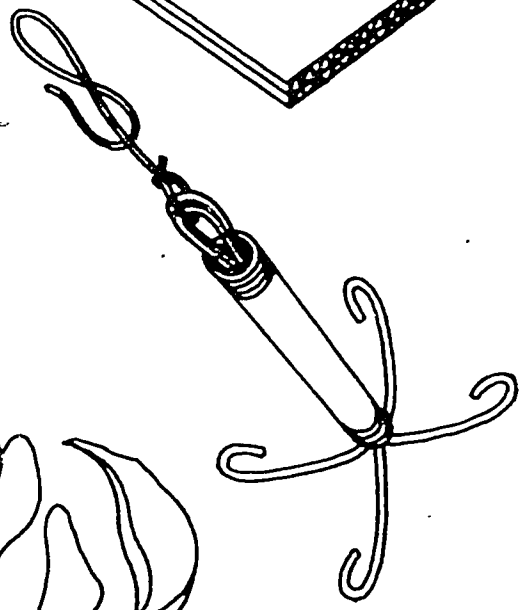
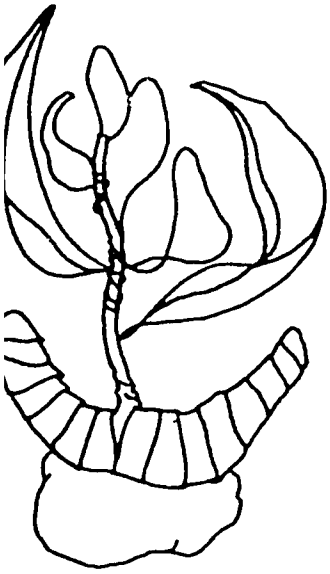
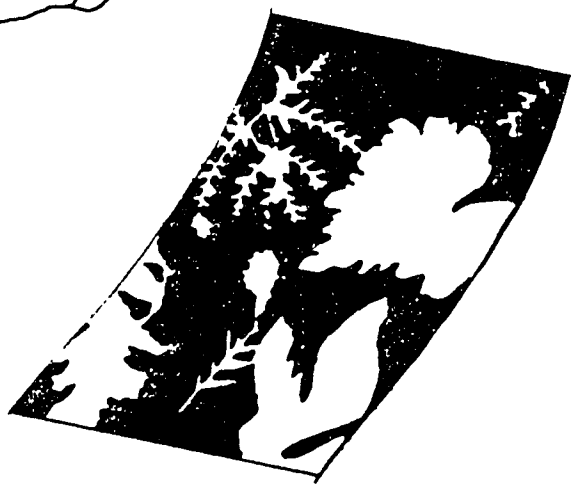








## EQUIPMENT AND TECHNIQUE CARDS

Inserted in this folio you will find an assortment of equipment and technique cards. These cards give you instructions for building and using various pieces of equipment required for certain activities. A few of these cards may be used in more than one activity. You may make additional copies of any of the cards. The following is a list of the activities that require these equipment or technique cards.

*Animal Movement in Water*
Basic Aquatic Equipment

*Animals in a Grassland*
Sweepnet

*Habitats of the Pond*
Bottom Scrapers I and II
Basic Aquatic Equipment
Plankton Net
Weed Grapple

*How Many Organisms Live Here?*
Bottom Scrapers I and II
Basic Aquatic Equipment

*Terrestrial Hi-Lo Hunt*
Measuring Light
Measuring Slope
Measuring Wind Direction and Speed

*Water Holes to Mini-Ponds*
Basic Aquatic Equipment
Measuring Light

*What Lives Here?*
Basic Aquatic Equipment

# BASIC EQUIPMENT, AIDS, GUIDES

## Data Board

Many OBIS activities call for the use of a data board. This board serves as a portable blackboard, 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 easily viewed by all group members, and field observations are conveniently displayed in one place for group consideration.

## Making a Data Board*

1. You will need a piece of thick cardboard, masonite, or fiberboard for a data board. A good size is 80 cm. x 60 cm.

2. Attach paper sheets (butcher or other) to the board.

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 blackboard.

## Comparison of Data

Some OBIS activities require comparisons of data collected on different occasions, but at the same study site. It is often convenient to record the data on plastic overlays on a data-board map of the site. A good source of overlay plastic is inexpensive plastic dropcloth material sold at paint stores and discount variety stores (wax paper also works well). Data can be recorded on one overlay during one investigation, and on others at subsequent investigations. For comparison of data, simply stack up the overlays.

## Lawn and Pond Organism Guides

These guides are designed for quick, easy identification of some of the most commonly encountered lawn and pond organisms. Only those organisms readily observed by the unaided eye or by means of a simple magnifying lens have been included.

To use the guides, simply flip through the pages until you come to a drawing that corresponds to the organism yo wish to identify. Use the size scales or scale-size drawings and the text to verify the organism's identity. Since the drawings are black and white and do not move, be sure to explain to your group that the organisms located will not exactly match the guide's drawings. The investigator should look for the drawing that most closely resembles his organism.

## Action Cards

Many folios contain activity cards which must be duplicated in order to provide sufficient copies for the youngsters. These cards, and in some cases the equipment cards, may be duplicated on any copying machine and the master sheet saved for future activities. We suggest you do the copying before the activity period and, in the case of summer camps or wilderness situations, before leaving the office machine behind.

Each sheet of action cards contains four cards; cut the copies apart and give one card to each participant. In some cases, we provide blank cards which allow you to create additional experiences that are suited to your particular environment.

# Equipment Card
# BASIC
# AQUATIC EQUIPMENT

Outdoor Biology Instructional Strategies

**Bug Boxes.** A bug box is a small, clear plastic box with a magnifying lens for a lid. To use, place an object or organism in the box and replace the lid to magnify the contents. A closed bug box heats up rapidly (especially when it is exposed to direct sunlight), so release organisms promptly after observing them.

**Hand or Dip Nets.** Hand nets can either be made or bought (aquarium nets work fine). You may want to extend the reach of an aquarium net by attaching some dowling or similar extension to the handle. A gradual, gentle scoop of the net is usually more successful and less damaging to organisms than a sudden, violent scooping motion. To prevent eye accidents, ask that the nets never be raised higher than shoulder level.

**Magnifying Lenses.** Magnifying lenses (5x to 10x, plastic or glass) must be purchased or brought by members of the group. To use, hold the lens close to one eye and move either your head or the object back and forth until you can see the object clearly.

**Meter Sticks.** A meter stick is useful for measuring water level variation in the water holes. Carry a meter stick each time you visit the water holes or fix a short ruler or other gauge in the water holes for direct readings.

**Spoons and Clear Plastic Cups.** These are useful for transporting tiny organisms and observing them at close range. Simply dip up tiny organisms with a spoon and place them in a cup partially filled with clear water.

**Team Site Boundary Markers.** Each investigating team will need two markers to indicate the boundaries of its study site. You can make these from 3" by 5" index cards. Staple, glue or tape the cards to sticks approximately 18" long to make a small flag. Make the boundary markers beforehand so trees and small shrubs need not serve as marker supports.

**Thermometers.** An ordinary thermometer can be used to monitor air and water temperatures. For safety and durability, choose an alcohol (red indicator) thermometer with a plastic or aluminum backing.

**White-Bottomed Containers.** These containers, which serve as observation pans, must be purchased or brought from home (white dishpans work well). The white bottom makes it easier to spot organisms living on the plants, and in the mud and debris of the pond bottom. You can also use these containers to temporarily hold an organism for observation. Merely dump dredged-up plants or mud and debris from the pond into the pan and examine the pieces one-by-one for eggs, animals, and other pond life.

**Note:** Certain hard-to-get materials are available from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

# Equipment Card
# BOTTOM SCRAPER I

Outdoor Biology Instructional Strategies

A **bottom scraper** is used to bring up a sample of bottom mud and debris for close examination. It can be used in shallow or deep water, provided a tow line of sufficient length is used to keep the scraper traveling along the bottom. This device allows you to closely observe organisms which you would otherwise completely overlook. To build your own bottom scraper you will need:

1 Empty can (any size will do)

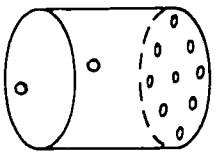
1 Piece of #18 or #20 wire 5 cm. longer than the diameter of the can

1 8 oz. fishing weight, or other convenient weight

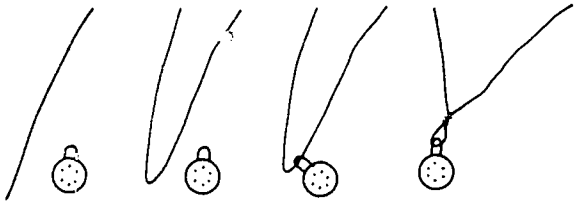
1 Nail and hammer to make holes on the bottom of the can

1 Tow line

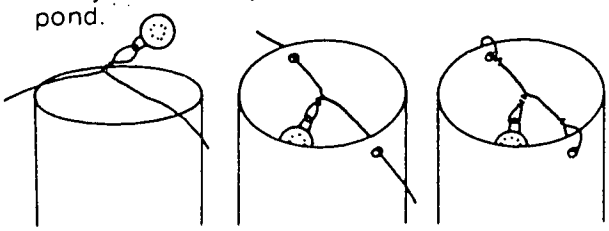
**1.** Punch holes in the can: several in the bottom, and two holes on the side of the can near the top, one directly across from the other.



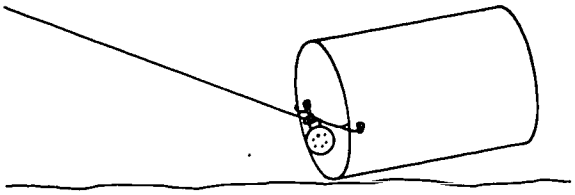
**2.** Now fasten the fishing weight (8 oz.) to the center of the wire with a few twists. If you twist the wire so that a big eye hole remains, you will have a convenient place to attach a tow line.



**3.** Now assemble the two parts by passing the two ends of the wire through the two holes you punched at the top, center the weight in the middle of the opening of the can, and twist the ends of the wire securely. Tie on the tow line and you are ready to sample the bottom of a pond.



**4.** To use the scraper, toss it underhand into the water and slowly pull it in. Filter the contents through a net or sieve to separate organisms.



# BOTTOM SCRAPER II

A **bottom scraper** that works well with firm or plant-covered bottoms can be made by bolting or nailing a fruit juice can (no. 10) to a wooden dowel or broomstick. The mouth of the can should point toward the user's end of the pole. Use the scraper as you would a rake to sample the bottom. To make this scraper you will need:

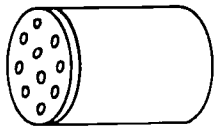
1 #10 empty can

1 Pole (a meter long)

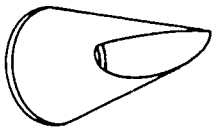
1 Hammer

Screws or bolts (or nails)

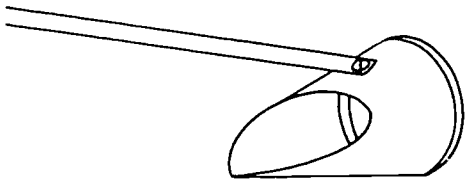
**1.** Punch several holes in the bottom of the can.



**2.** Flatten one side of the mouth of the can to make a broader scooping surface.



**3.** Bolt the stick to the upper half of the outside of the can at an angle to the long axis of the can (as illustrated). Your bottom scraper is now ready to scrape the pond bottom for samples.



# Equipment Card
# Measuring Light

Outdoor Biology Instructional Strategies

**MATERIALS FOR LIGHT MEASURING STATION**

1 package of proof paper (Studio Proof F, Kodak)
1 small jar of photographic hypo (fixing solution): mix 1 tablespoon of crystal for each cup of water.
1 small jar of plain water
1 pair of forceps or tweezers for transferring the pieces from the fixer into the water and onto the cardboard.
1 piece of cardboard (approximately 40 cm. square)
some pins or tapes
1 watch or kitchen timer

**Note:** Certain hard-to-get materials, such as the proof paper, are available from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

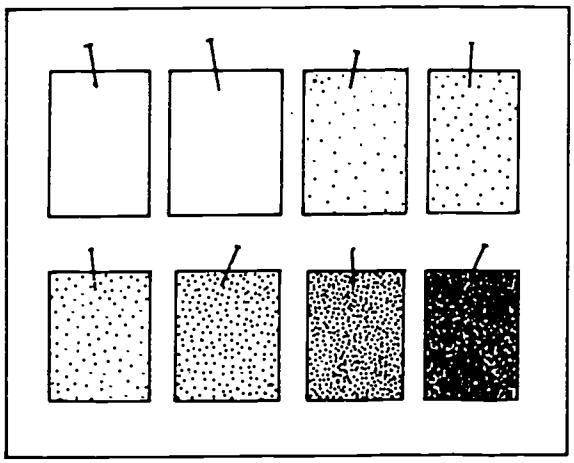
**How to use OBIS Proof Paper Light Meter:**

Print-out paper (Studio Proof F, Kodak) can be used to measure light intensity. A five minute exposure time will turn a piece of white proof paper dark brown when exposed to direct sunlight, light brown when exposed to filtered light (shade or overcast), and white to light tan when exposed to deep shade or artificial light. You can halt the color change by dipping the papers into photographic hypo (fixing solution) for a few seconds and then washing them in plain water for a few seconds. The fixed pieces can be dried by pinning them on a piece of cardboard.

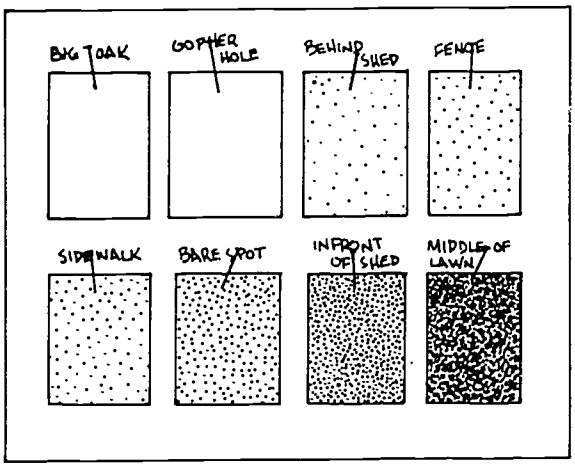
A standard sheet of proof paper will suffice for 16 field exposures; simply cut the sheet into 16 pieces. Cut the sheets indoors and keep them in light-proof packages until you are ready to use them. To use proof paper, simply remove a piece, write the location of exposure on the back of the piece, expose it for five minutes, fix and wash it, and pin it up to dry. Proof paper is insensitive enough to allow for small time delays and exposure errors.

To use proof paper underwater, you will have to use a transparent, waterproof housing like a glass jar with a waxed lid, or several plastic bags placed one within the other and sealed with rubber bands. Attach the proof paper to a small piece of cardboard and weight the jar or bags so that the proof paper faces the surface when it's submerged.

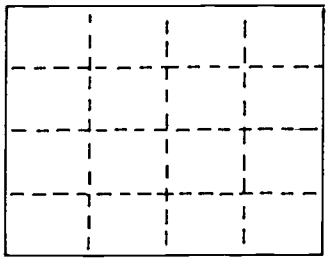
For *Water Holes to Mini-Ponds*



For *Terrestrial Hi-Lo Hunt*




Write the location of the exposure above each piece of paper after pinning it on the drying board.



# Equipment Card

# Measuring Slope

Outdoor Biology Instructional Strategies

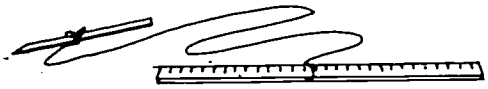
## MATERIALS FOR SLOPE-MEASURING DEVICE

1 meter stick
1 125 cm. piece of strong cord
1 25 cm. sharpened stick
1 level tube (test tube and cork)*
household ammonia
water
tape

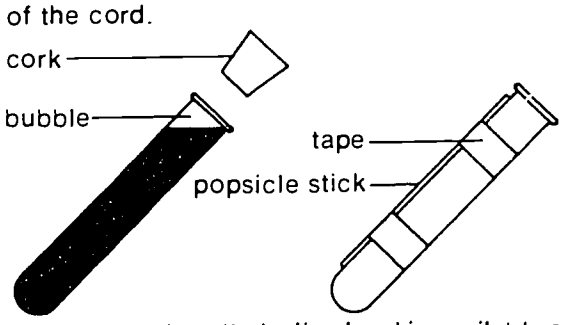
**Slope** can be determined by fixing an anchor point at the upper part of the slope, drawing the one meter cord taut, sliding it up or down until the cord is level, and reading slope directly in cm/meter. Assemble the apparatus like this:

**1.** Sharpen the 25 cm. stick and fasten the cord to it with a knot which can slide up and down the stick.

**2.** Attach the free end of the cord to the meter stick so that the distance between the two sticks is one meter, and the cord can slide on the meter stick. You can mark off centimeters on any stick if you do not have a meter stick.

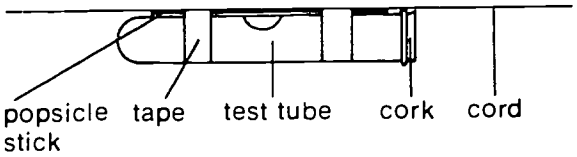


**3.** Make your level. Fill the test tube almost full of water and add a drop of ammonia. Cork the tube so that a small bubble remains. Trim off top of cork. If your test tube has a flared lip at the top, tape a popsicle stick to the side of the tube before taping the level tube to the center of the cord.

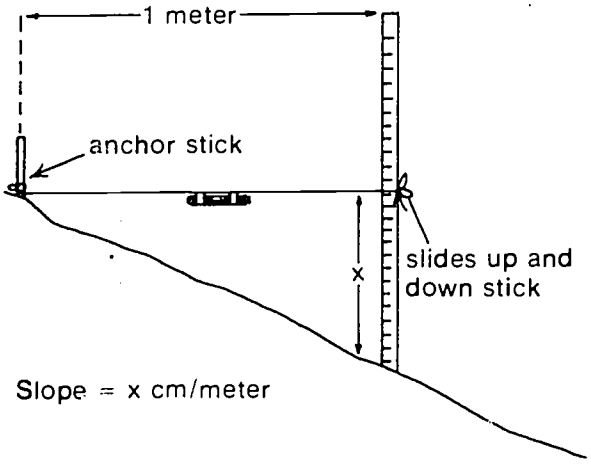



*A little bubble called a line level is available at hardware stores or may be purchased from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

Your level should look like this:




**4.** Assemble all pieces and use like this:




Slope = x cm/meter

# Equipment Card
# PLANKTON NET

Outdoor Biology Instructional Strategies

A **plankton net** is a device for concentrating minute aquatic organisms for close observation. These organisms are easily overlooked in water samples and pass through standard dip nets. The plankton net is essentially a cloth funnel which allows water to pass through but retains small organisms. The small organisms collected in the funnel are washed down into the clear vial at the bottom of the funnel. To make a plankton net you will need:

1 Metal embroidery hoop (about 15 cm. in diameter)

1 Piece of old bed sheet

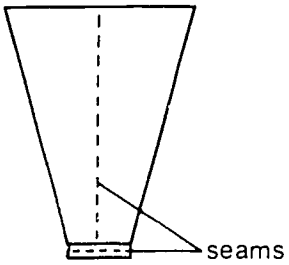
1 7 dram (approximate size) vial (old pill vials are fine)

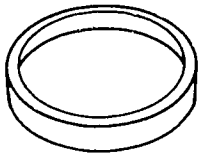
2 Pieces of #20 wire, each 10 cm. longer than the diameter of your hoop

1 Tow line (about 6 meters long)

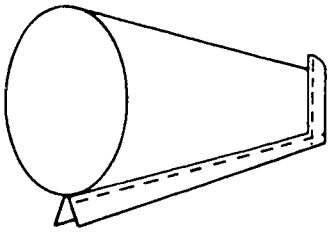
1 Rubber band

**1. Sew the cloth cone.**
The net is a cone of old bed sheet material as wide at the top as your embroidery hoop, and as narrow at the bottom as your vial. A couple of measurements and a trial or two should be sufficient to give a suitable pattern from which any number of nets can be made. Two seams are needed: one at the vial end to keep the material from unraveling, and one up the side to make a cone.

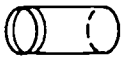


embroidery hoop

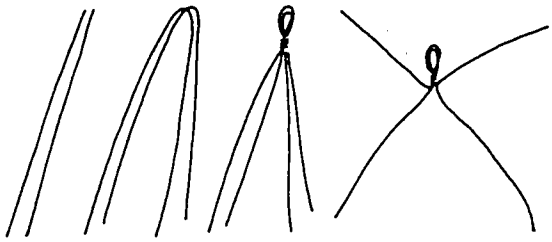


cloth cone



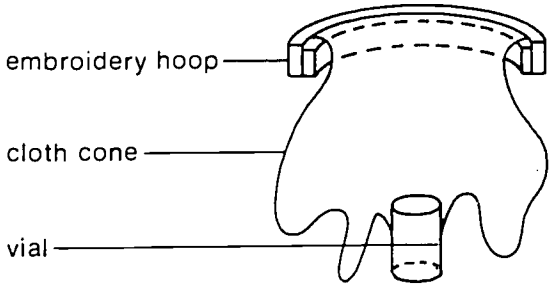
vial

**2. Prepare the wire yoke**
Using a pair of pliers, if necessary, twist the two wires together as shown. Be sure to leave an eye at the center to attach your tow line.

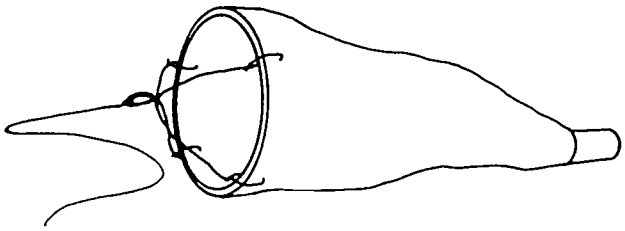


**3. Assemble your net.**
Fix the net in the embroidery hoop. Any way that will work is good, but this way is the best:

**Cross-section of Plankton Net**




Attach the wire yoke to the hoop-net combination by pushing the wire through the cloth and twisting each wire around the hoop.



Drop the vial in from the open end and secure it with a rubber band. Attach a tow line to the eye of the yoke, and your net is ready.

**4.** To use a plankton net, toss it underhand into the water and either pull it in hand-over-hand, or pull it out by moving away from the pond. Make five or more passes to concentrate the surface life before examining the plastic holding vial.

# Equipment Card SWEEPNET

*Animals in a Grassland*

Outdoor Biology Instructional Strategies

**MATERIALS:**

1 wire coat hanger

1 stick (approximately 1 meter long) for your net handle

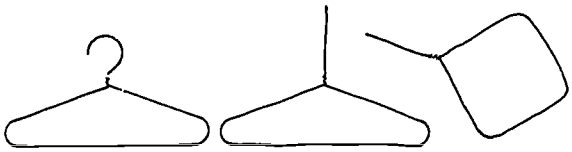
1 piece of cheese cloth or netting for the net bag (1 square meter)

1 needle and thread for sewing (or a sewing machine)

1 piece of tape or wire to attach net to handle

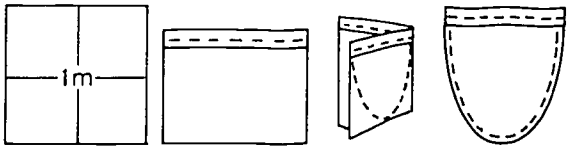
**1. Preparing the hoop.**

Take a wire coat hanger, straighten the hook, and pull the hanger into a square:



**2. Preparing the bag.**

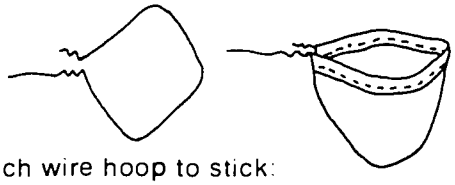
Your net should be approximately one meter in circumference at the top, tapering down to a point. A sewing machine speeds up construction, but older kids can hand sew the nets if sufficient time is provided. Sew like this:



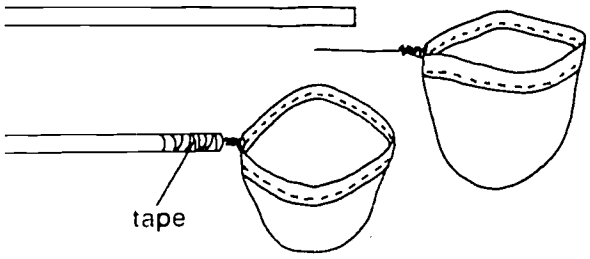

Fold one edge down and sew | Fold square in half and sew | Cut off excess

**3. Assembling the net.**

Open the wire square and thread on the net:



Attach wire hoop to stick:

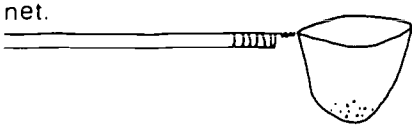



**4. Using a sweepnet.**

While a sweepnet can be used to pursue and capture an animal that has caught your eye, this is not the most efficient method of use. A sweepnet is best used as a random sampling tool. You walk at moderate speed across the grassy area, sweeping the net back and forth, in pendulum fashion, in front of you. The net should just brush across the top of the grass. The idea is to sweep any animals that are buzzing around in front of you into the nets, so you must turn the net in your hand to capture animals on both right and left swings of the net. After you have made fifteen to thirty swings of the net, make a quick swing around your head to concentrate the animals at the bottom of the net, and grab the end of the net in your hand to keep the catch from escaping.

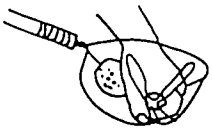
**How to transfer animals from net to observation bag:**

A. Concentrate animals in the bottom of the net.

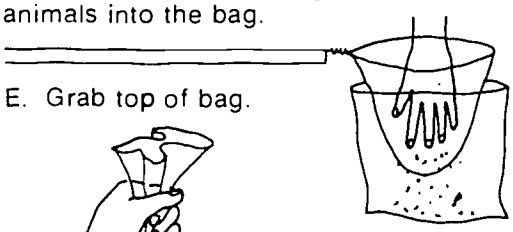


B. Pinch the net closed, keeping the animals in the bottom of the net.

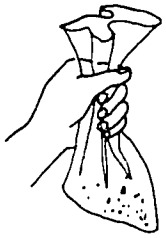
C. Turn net inside out while holding animals.



D. Place net in plastic bag, release and shake animals into the bag.



E. Grab top of bag.



F. Twist the top a couple of times and tuck the top under your belt or into an open pocket while you continue to sweep.

# Equipment Card
# WEED GRAPPLE

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Submerged plants and other debris not easily reached from shore can be collected by using a **weed grapple** fashioned from a short piece of pipe, coat hangers, and a long line. When using the weed grapple, be careful to use a low, underhand toss to avoid hitting another person. Always remember to hold on to the free end of the tow line when you toss the weed grapple, so that it will not be lost. To make a weed grapple, you will need:

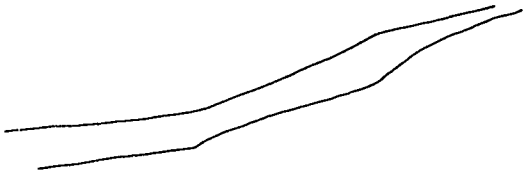
1 6 to 8 cm. length of pipe, 1 to 2 cm. in diameter

2 Coat hangers

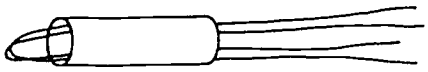
1 Tow line

1 Pair of pliers for bending the coat hangers into shape

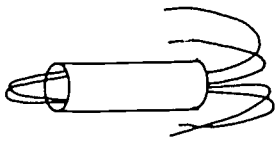
**1.** Separate or bend the two coat hangers into two long pieces of equal length.



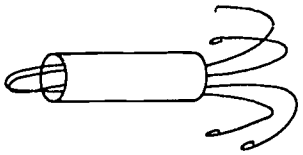
**2.** Bend the wires in half and insert both of them into the pipe so that the bent ends stick out a little from one end of the pipe. The tow line will be attached to these loops.



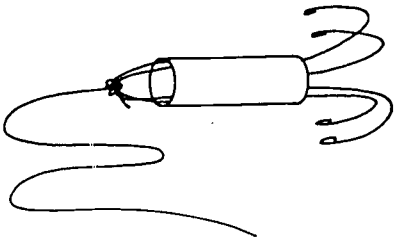
**3.** Bend the unlooped ends of the coat hanger lengths to form a four-pronged hook at the other end.



**4.** Bend the end of each hook back, so there will be no sharp ends exposed.



**5.** Attach the tow line to the bent hanger loops, and your weed grapple is finished.



# Equipment Card
# MEASURING WIND DIRECTION AND SPEED

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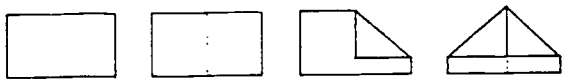
### MATERIALS FOR ONE WIND STATION:

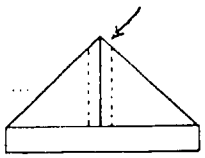
2 nails (16 penny)
1 or 2 cardboard bases (three thicknesses of cardboard glued together, at least 10 cm. by 10 cm.)
2 pieces of plastic soda straw (6 cm. long)
1 piece of heavy duty aluminum foil (15 cm. by 2 cm.)
1 roll scotch tape
1 magnetic compass
1 pair of scissors
1 marking pen
1 tube of glue
1 watch with second hand
4 3" x 5" index cards
1 stapler
1 square of cardboard (6 cm. by 6 cm.)

### CONSTRUCTION OF WIND SPEED MEASURER

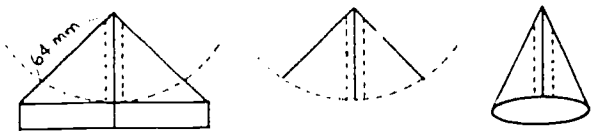
1. Make 4 cones as follows:
   Take a 3" x 5" card and fold it like this:



Tape it here with scotch tape:

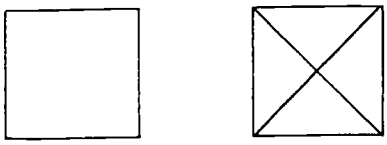


Cut on a curve like this:

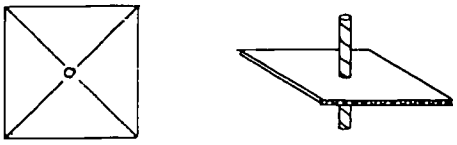



Open the cone, and make three more.

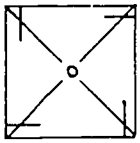
2. Construct your cone holder as follows:
   Cut 6 cm. cardboard square and draw two diagonal lines.



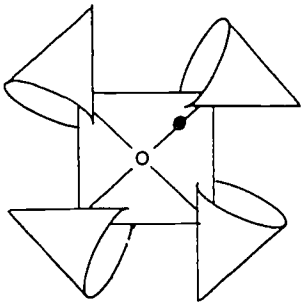
Where the two diagonals intersect, poke a hole with your nail and enlarge it until your straw segment fits snugly in the hole.



Cut four slots in the cone holder like this (cut in 1-2 centimeters):



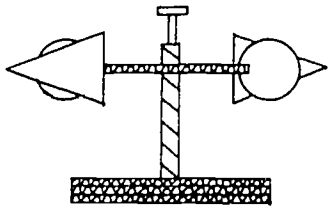
3. Assemble the apparatus:
   Slide a cone into each slot. Be sure they all face the same direction (clockwise or counterclockwise).



Put a reference mark on the cone holder near one of the cones to help you count revolutions.

Make your base by gluing three thicknesses of cardboard together.

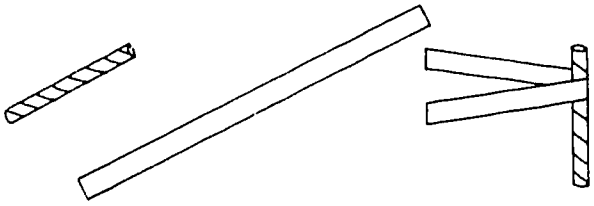
Run a nail through the straw and stab it into the cardboard base.



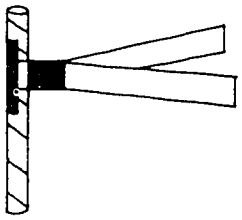
You may want to put a small washer here if you have one.

**CONSTRUCTION OF WIND VANE**
(for measuring wind direction)

1. Cut a piece of heavy-duty aluminum foil 15 cm. by 2 cm. Bend this around the second 6 cm. piece of straw.

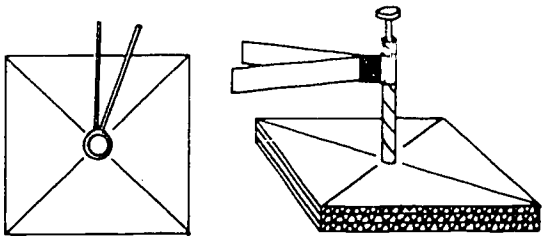


2. Fold the pieces of aluminum foil tightly together and tape them near the straw.



Slap a little piece of tape here to keep the aluminum foil from sliding up and down the straw.

3. Put a nail (small enough to allow the straw to rotate) through the straw and push it into a cardboard base (same as the wind speed measurer or a different base). Spread the two pieces of aluminum foil slightly, and you are ready.



top view side view

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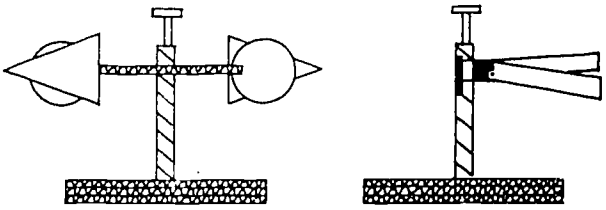
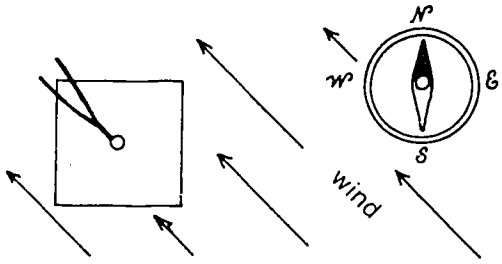
**USING YOUR WIND STATION**

With these two pieces of equipment you can measure direction and speed of wind.



**Wind direction** is measured with your wind vane. Place it in the wind and note the direction the aluminum foil swings. Winds are named for the direction they come *from*. A wind blowing *from* the north is a north wind. You will want to use a compass if you have one to help you determine directions. This is a south-east wind:




**Wind speed** is determined using an anemometer (the gadget with the four paper cones). The faster the wind blows, the faster the device turns. Wind speeds should be reported in revolutions per minute. (You will need a watch with a sweep second hand.) Set the wind speed meter in the location that you want to measure wind speed, get the watch ready, and holler "Go!"). One person watches the second hand while the other counts how many times the colored cone goes by. After a minute (or fraction of a minute), the clock watcher hollers "Stop!" and the other reports how many times the colored cone went by. Wind speed in a calm area might be 6 or 7 revolutions per minute (rpm) while fast wind might be in excess of 100 rpm's.

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**Outdoor Biology**
**Instructional Strategies**
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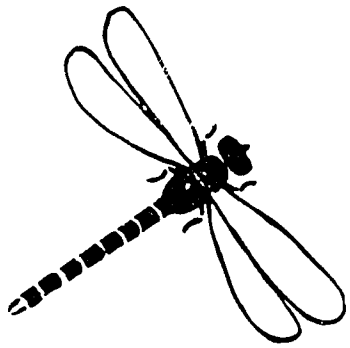

# POND GUIDE

# POND GUIDE

A guide for identifying organisms
found in and around the pond.

Trial Edition August 1978

Outdoor Biology Instructional Strategies
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# PREFACE

OBIS is an NSF-supported project that is currently developing outdoor biology instructional activities for familiar, man-managed communities such as lawns, ponds, streams, farms, and gardens. These activities are being designed for young people 10 to 15 years of age.

This guide was written as part of the OBIS activities for the pond. It is designed for quick, easy identification of some of the most commonly encountered pond organisms. Only those organisms readily observed by the unaided eye, or by means of a simple magnifying lens, have been included.

References are listed at the end of the guide. Both the artist and the author express their gratitude to the authors of the consulted works. Those desiring more information about pond organisms would do well to refer to these publications.

Note: This guide was produced as an aid to the study and appreciation of pond life. We ask the users of this guide to leave the ponds and other freshwater systems they study as they found them so that others who follow may find the same pleasure in the sites.

## WHERE TO USE THIS GUIDE

This is a guide to common aquatic organisms in ponds. If you do not have a pond nearby, try a forgotten bucket of water, a puddle, a quiet stream, or an edge of a lake or reservoir. While you may not be able to find the exact plant or animal described in the guide, you may find the general type.

When plants and animals can't be easily observed, a net or plastic bag on a pole will help you locate and catch them. Try to observe organisms in their natural settings; if you have to take the organism out to look at it, be sure to replace it when you've finished your examination. Placing animals in a plastic bag filled with water is a good way to observe them. A hand lens is also useful in your work.

## HOW TO USE THIS GUIDE

The animal section has been organized by major groups or phyla. In some cases (Arthropods, for instance), groups have been broken down further.

The plant section has been organized by growing zones (i.e., shore, emergent, floating leaved and submerged plants).

The small size of the guide lends itself to page flipping until the desired illustration is located. The brief text can then be checked to verify the identification.

Size scales have been included with some animals as an aid to identification. The size scales represent the minimum and maximum body lengths of all the members of a particular order (leeches) or family (damselflies) of animals. Antennae and tail parts have not been included in these scales. For most of the smaller animals a scale size drawing has been included along with the illustrations.

## ACTIVITIES TO DO WITH THIS GUIDE

You can identify many plants and animals in the pond with this guide, and you can do much more...

Find and identify a plant or an animal in the pond.

Can you find an animal or plant similar to the one you just identified?

Can you find the same animal or plant in another color?

Can you find the same animals active throughout the day?

Are there animals that are active only early in the morning or only in the evening?

How do the plants change during the day? (Pick out one plant and make hourly observations of it.) Is the flower open or closed? Which way do the leaves face? Is the plant wilted? Are there insects on it?

Wait three months. Can you find the same plants and animals you found before? Are there any new plants or animals?

Can you find a larva? What does it turn into? (Hint: leave the larva where you found it and make periodic observations until it hatches. Did you guess right?)

Can you find animals that have immature forms that do not look like the adult forms? Can you find ones where both adult and immature forms are similar? Do the immature forms eat the same things that the adult forms eat?

Find a plant. Identify it in the guide. Is it found all over the area or in one certain spot? What are some of the conditions under which the plant seems to grow best?

Which plants and animals are the most numerous?

Which animals and plants can always be found in ponds?

What is one of the biggest changes that happens to your pond during a day? a week? a year?

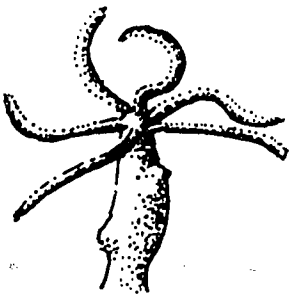
These are just a few of the many observations and studies you can carry out in ponds. Try these activities, try some of your own, and have fun discovering the busy world of the pond.

# Invertebrates

are animals without backbones. They comprise 95% of the animal kingdom as far as numbers of species are concerned. Includes coelenterates (i.e., jelly fish), worms and leeches, mollusks (i.e., clams), arthropods (crustaceans, arachnids, insects), echinoderms (i.e., starfish), and other miscellaneous animals.

## COELENTERATA

means hollow gut and refers to the fact that the main cavity of the body is the digestive cavity. Includes hydras, jelly fish, sea anemones, and corals. Most coelenterates are marine.



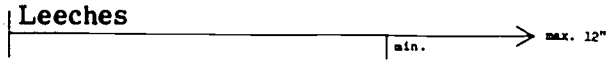
### hydras

have a stalk-like body with tentacles encircling the mouth. They look like a half-inch of string with the unattached end frayed out into several strands.

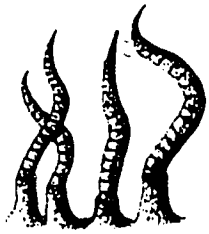
## EARTHWORM GROUP

includes worms with segments. Segmented (divided into parts) worms appear to be ringed. The earthworms, leeches, and tubifex worms belong in this group.

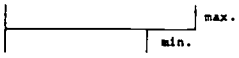
### Leeches




are flattened, ringed worms that have both a tail and mouth sucker. They feed on the blood of vertebrates and other invertebrates. Some species may reach over a foot in length.



### Tubifex Worms




are slender, reddish worms that live in the soft bottom mud. They construct dirt tubes out of which only the hind part of their bodies is extended.

8 FLATWORMS

includes flattened, unsegmented (unringed) worms such as the familiar Planaria. Many flatworms appear cross-eyed.

MOLLUSKS

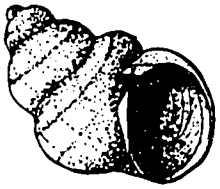
possess soft bodies and usually a shell. The mollusks contain mussles, clams, snails, slugs, squids, and the octopus.

clams and mussels

are distinguished by their bi-valved (clam-like) shells hinged at the back.

snails

usually have a single-coiled shell.

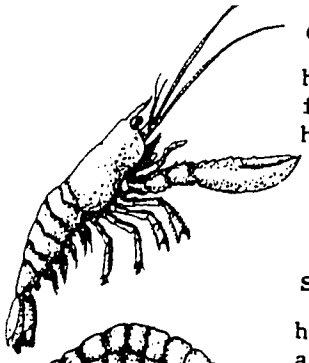


ARTHROPODS

are animals with jointed legs and segmented bodies. Includes crustaceans, arachnids, and insects.

Crustaceans

are primarily aquatic. They have an outer shell, or exoskeleton, and nearly all crustaceans breathe by means of gills.

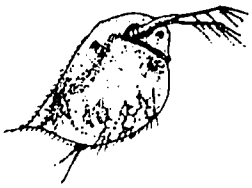


crayfish

have five pairs of legs. The first pair is armed with claws. They look and behave like miniature lobsters.

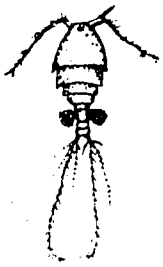
scuds 

have arched backs and narrow bodies and are shaped like fleas.



water fleas 

are tiny crustaceans covered by a transparent shell. Their internal structure shows up very clearly under magnification. Their gut appears as a dark tube (j-shaped in Daphnia) running through the body length.



copepods 

appear as little white specks darting through the water. They move in a jerky manner. Magnification shows them to be pear-shaped.

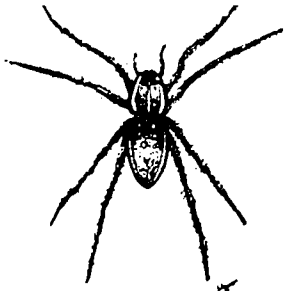
seed shrimp 

are small crustaeans with bi-valved shells. They move by sticking their slender legs and antennae from between the shells and kicking them rapidly backward.

## Arachnids

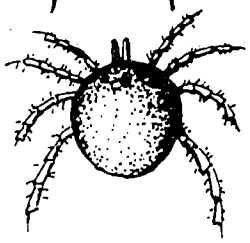
are members of the arthropod group with eight legs. Includes ticks, scorpions, spiders, and water mites.

**10 spiders**



have bodies divided into two segments: a head and an abdomen. The fisher spider is one of the few spiders that spends its life in or near water.

water mites 



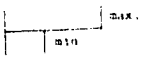
are usually no more than 0.2 inch long. Their bodies appear to be of one segment. They commonly appear as brightly colored spots swimming or walking about in the water.

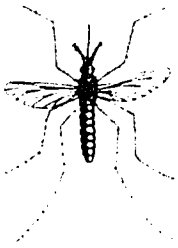
## Insects

are the most successful group of animals both in terms of numbers of species and total numbers. Adults have three body regions: head, thorax, and abdomen. The middle region (thorax) bears three pairs of jointed legs and the majority are equipped with one or two pairs of wings.

### Trueflies

have only one pair of wings and include the mosquitoes, midges, craneflies, and houseflies.

mosquitoes 

have one pair of transparent wings and most are equipped with a long piercing and sucking tube for obtaining their food. A hand lens reveals that mosquito wings are fringed with tiny, colorful scales and hairs. Only females suck blood.

mosquito larvae 


are commonly called wrigglers because of their wriggling motion as they swim. Mosquito larvae appear hairier than midge or cranefly larvae. Wrigglers hang downward from the surface film and breathe by means of gills and an air tube.

**mosquito pupae** max. min.

look like large commas and move about using their flaplike tail parts. They usually last only a few days before the adult mosquito emerges.

**midgeflies** max.

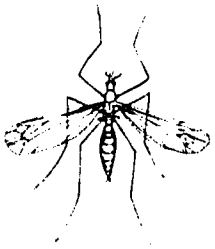
resemble mosquitoes but are usually smaller and more delicate. A hand lens shows their wings are bare and not covered with scales like the wings of mosquitoes.

**midgfly larvae** max. min.

are slender and wormlike and many construct soft dirt cases around their bodies. Many midgeflies have larvae which are blood-red in color and are commonly called blood worms.

**midgefly pupae** max.

are also slender with a slightly enlarged head region. Midgefly pupae don't appear as hunched up as mosquito pupae.



**craneflies** max. min.

look like giant mosquitoes. They are long and slender and their extremely long legs mark them as the "daddy-long legs" among flies.

**cranefly larvae** max. min.

are larger than either mosquito or midgefly larvae. They are brownish to whitish and often appear quite transparent. True cranefly larvae have a breathing disk at the end of their tail.

12 cranefly pupae

are pale colored, sluggish, and do not eat. Most craneflies go to shore to pupate in soft, damp soil.

## Water Bugs

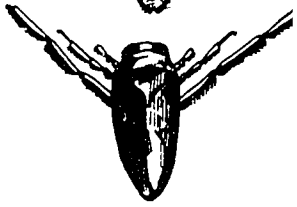
have jointed mouth parts for piercing and sucking. Most have two pairs of wings. The young water bug nymphs look like smaller models of the adults with shorter wings.

backswimmers

are unique among aquatic bugs in the respect that they always swim on their backs. Their backs are shaped like the bottom of a boat and they use their long, hind legs to propel themselves through the water. Their bite is painful.

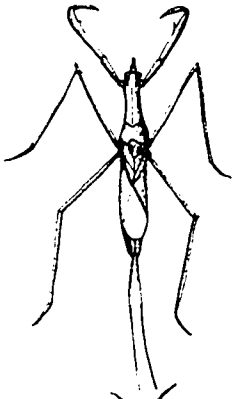
water boatmen

resemble backswimmers in shape but differ in that they swim on their stomachs and do not h[illegible] keeled underside. They propel t[illegible]lves through the water with their long middle and hind legs.



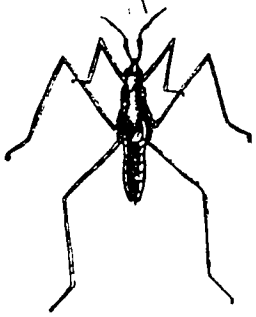
water scorpions

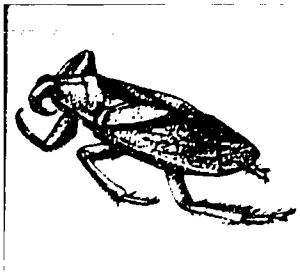
have a breathing tube that is formed when they press their two, long, grooved tail filaments together. The water scorpion illustrated looks like an aquatic walking stick. The other type of water scorpion has a stout, oval-shaped body. Both types use their first pair of legs for seizing prey.



water striders

are named after their ability to rapidly skim or skate on their spiderlike legs over the surface of the water. They prefer quiet or gently flowing water. They range in size from the tiny broad-shouldered water striders with bodies about 1/8 inch long, to the large water striders with 3/4 inch long bodies.





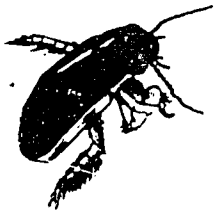
giant water bugs

may reach 3 inches in length, making them the largest true bugs. They have wide, flat, oval bodies and can inflict a very painful bite. Their strong front legs are similar in form and action to the front legs of the water scorpions.

Beetles

make up one of the largest insect groups. They generally have four wings, but the thick, heavy, front pair serve as wing covers for the hind wings and as a protective back armor. Only a few species live in the water. Their larvae have three pairs of legs.

predaceous diving beetles max. min.

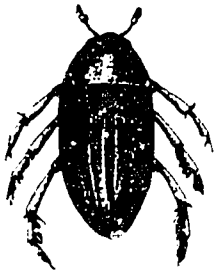


make up the major group of water beetles. They are usually observed with the tip of their abdomen at the water's surface and their head below the surface. They have an oval, flattened shape and their shiny compact bodies are generally colored black to brownish-black. Diving beetles have slender, thread-like antennae. Their larvae are commonly called water tigers.

whirligig beetles max. min.

are easily recognized from their whirling, circling motion on the surface. The smooth form of their oval, flattened bodies is broken only by their front legs which project from the sides of the body just behind the head. Their eyes are divided into two parts which allow them to see both above and below the water at the same time. They are blue-black or bronze in color.

scavenger beetles max. min.



resemble diving beetles but can be easily distinguished by their short, club-shaped antennae. They also differ from diving beetles in that they rest in a heads-up position when they are at the surface rather than head down.

## 14 Miscellaneous Insects

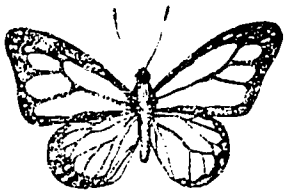
comprise those insects that do not fit in the three preceding categories.

### butterflies and moths

have four wings that are covered with tiny, overlapping scales. The powder-like scales easily rub off when the wings are touched or handled.

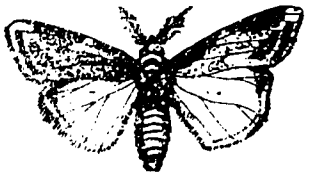
### butterflies

are generally slender-bodied, brightly colored insects. They have antennae that are swollen at the tips into lumps or knobs.



### moths

are usually heavy bodied and dull colored. The easiest way to distinguish a moth from a butterfly is to look at its antennae. Moth antennae are variously shaped, but not clubbed.



### butterfly and moth larvae

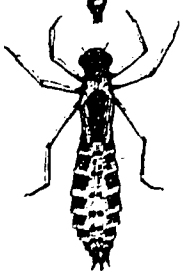
are commonly called caterpillars. They are wormlike but possess three pairs of legs near the head region and five pairs of leglike structures from the middle to the end of their bodies. Caterpillars have tremendous appetites and moult several times before changing into pupae.

### butterfly and moth pupae

are usually compact, immobile structures that take no food. The pupa is a resting stage during which the insect reorganizes internally to form the adult.

**dragonflies** (max. / min.)

resemble short crayons with four large wings which are finely laced with veins. Dragonflies hold their wings in a horizontal position when resting.

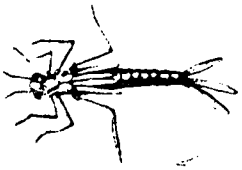


**dragonfly nymphs** (max. / min.)

are usually dull-colored, slow-moving organisms that use a scooplike lip to capture their food. The dragonfly nymphs are generally large and chunky in comparison to the damselfly.

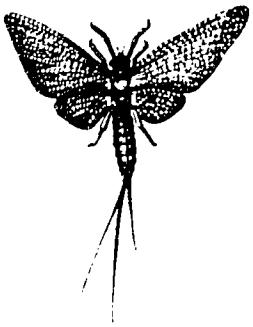
**damselflies** (max. / min.)

resemble matchsticks with four membranous wings. They are slimmer and more delicate-looking than dragonflies. Damselflies hold their wings close together and pointing backwards when resting.



**damselfly nymphs** (max. / min.)

are slimmer and more delicate looking than the dragonfly nymphs. These nymphs have three leaf-shaped gills at the tips of their abdomen.



**mayflies** (max. / min.)

are delicate-looking insects that possess two or three long, threadlike strands projecting from the tip of their abdomen and four nearly transparent wings. When resting, the wings are held close together and pointing vertically.

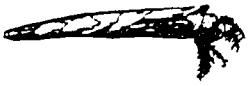
**mayfly nymphs** (max. / min.)

are similar to damselfly nymphs but they appear stouter and their tail flaps are usually longer and featherlike. Mayfly nymphs also have smaller heads and lack a scooplike lip for capturing food.

caddisflies

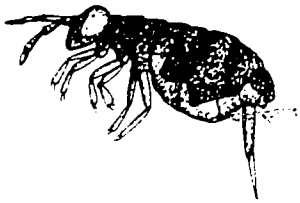
are mothlike insects with four, soft, hairy wings and long slender antennae.

caddisfly larvae



live in little cases or tubes which they construct from pieces of wood, leaves, sand, and silk. Most caddisfly larvae build portable cases which they drag about whenever they travel. During travel only the front end of the body and the legs stick out from the case.

springtails

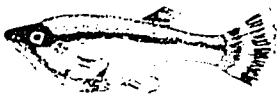


are tiny, wingless insects commonly found on the water's surface near shore. They are named after their unique forked tails that they keep folded beneath their body. When disturbed, the tail piece suddenly springs downward to lift the springtail up into the air.

## Vertebrates

are animals with backbones. They comprise 5% of the animal kingdom. Includes fishes, amphibians, reptiles, birds, and mammals.

### FISH



spend their lives entirely in water. Fish breathe by means of gills. They have fins and their streamlined bodies are usually covered with scales.

### AMPHIBIANS

begin life in water with gills and later develop lungs. Their skin is thin, scaleless, smooth or warty, usually moist, and not waterproof. Frogs, toads, and salamanders belong in this group.

frogs

are smooth-skinned with long, powerful hind legs. Tree frogs have toes with enlarged tips.

toads

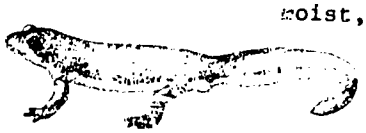
possess a warty skin, large neck glands, and are rarely found moving about during the day. Toads have shorter back legs than frogs.

tadpoles

are the well-known larval stage of frogs and toads. They are completely aquatic and do not possess external gills like salamander larvae.

salamanders

also include newts. They have a lizard-like body but lack claws. They have a moist, scale-less skin.



salamander larvae

are completely aquatic and possess external gills.

REPTILES

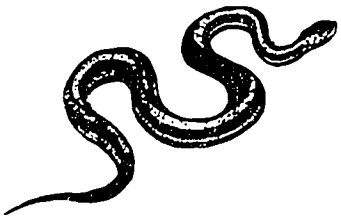
breathe by means of lungs. Their skin is dry, scaly, waterproof, and thick. Snakes, lizards, and turtles are familiar reptiles.

lizards

have movable eyelids and usually have limbs with clawed toes.

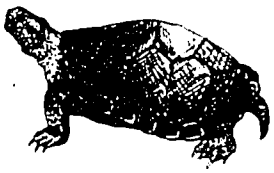
snakes

have no limbs and non-moving eyelids.



turtles

have a body shell into which they can draw their heads and limbs.



MAMMALS

have milk glands for nursing their young and at some time in their lives possess hair or fur. Most mammals are more active at night (nocturnal) than during the day (diurnal).

raccoons

are easily identified by his black mask and black-ringed tail. Look for his handlike tracks along muddy shores and stream banks.

deer

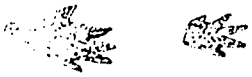
are large, browsing mammals. Males start to grow antlers in the spring and shed them each year in late winter.

mice

are small, gnawing mammals. Usually one obtains just a glimpse of these small animals as they dart away. The house mouse came to America from Europe as a stowaway on early ships.

muskrats

are ratlike but chunkier with a thick, naked tail. They are good swimmers.



shrews

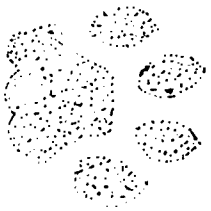
are the smallest, living mammals. The pygmy shrew may weigh less than a tenth of an ounce when full grown. Mouse size or smaller, shrews are distinguished by a pointed snout, pinpoint eyes, and tiny ears.

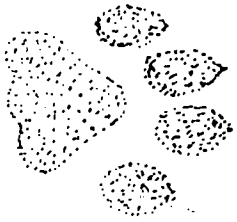
bats

are familiar as the only true flying mammals. They possess great maneuvering ability and are often seen flying above lakes, ponds, rivers, and streams at dusk.

"tracks"

of dogs and cats may commonly be found around the edges of ponds and lakes.





# 20 Plants

## SHORE

### willows

prefer wet or moist soils and often grow near bodies of fresh water. They vary in size from small shrubs to large trees. Willows are easily identified by their narrow, pointed leaves.

### horsetails

are fernlike plants that often grow near the edge of ponds and streams and in other moist areas. The successive whorls of side stems around the main stem gives the plant a shaggy, taillike appearance. Horsetails feel rough and abrasive because of their high silicon content.

### sedges

are grasslike or rushlike plants. They often appear as spikes with grasslike leaves. Their stems are three-sided and appear triangular in cross section. They generally grow from 1 to 3 feet tall.

## EMERGENT

### cattails

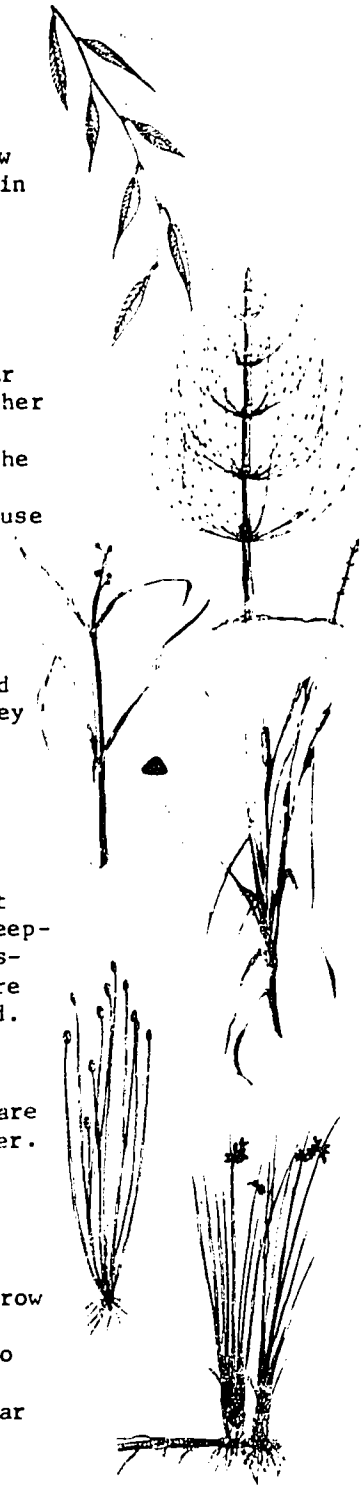
are among the most familiar marsh and waterside plants. They grow 4 to 8 feet tall and new plants arise from their creeping root-stocks and seed. The seed clusters form the most characteristic feature of cattails, the dark brown cattail head.

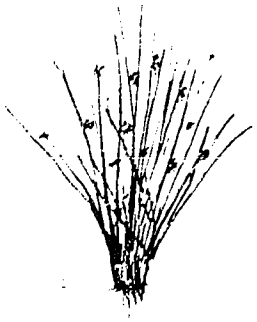
### spike rushes

are characterized by naked stems which are topped by a single flower or seed cluster. They usually grow in tight bunches and average from 2 to 5 feet in height.

### bulrushes

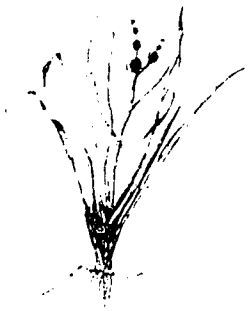
include the familiar Tules. They may grow in water up to 9 feet deep; the Tule or great bulrush grows to a height of 15 to 20 feet. They usually appear as great spikes with a flower or seed cluster near their tips.





rushes

are similar to bulrushes but lack their size. Rushes average about 1 foot in height and usually have hollow stems. There are two forms; one is essentially a naked stem with a sheath at the base, the other bears flattened leaves along its stem. Like the bulrushes, the flowers and seed clusters are found near the top of the stem.



bur-reeds

are named after their closely packed seed clusters which resemble large burs. They are close relatives of cattails and are often found growing with them. Bur-reeds have long, slender flattened leaves like cattails and vary in height from 1 to 6 feet.

water plantain

grows close to pond edges and in other shallow, wet places. The pointed, oval leaves all arise from the base of the plant. The flower spray is supported on a long slender stem. The tiny flowers have three petals. Water plantain normally reaches 1 to 3 feet in height.

arrowheads

are named after their arrow-shaped leaves. Their three-petaled flowers are arranged in whorls of three on a long, slender stem. Arrowheads bear edible tubers or thickened roots which have given rise to such names as duck potato and delta potato. Arrowheads grow to 2 feet high.

water cress

is a sprawling herb that grows in moist to aquatic places. It was introduced from Europe and is often used in salads. Rooting occurs at the stem nodes or joints and in this manner water cress may spread to form dense stands in cold, spring-fed ponds and streams. It has compound leaves (two or more leaflets to a leaf) and white flowers which are borne on the stem tips.

165185

mare's tail

belongs to the Milfoil family. It has hollow stems that may be partially or completely submerged. The narrow, short leaves are arranged on the stem in whorls of six to twelve leaves each. The stem varies from 10 to 18 inches in height and a line of stems often arise from a single, rope-like rootstock.

## FLOATING

duckweed

is known as the smallest flowering plant. Duckweed has a tiny leaflike body which may or may not bear rootlets. The leaf-like plants float at the surface and often grow so densely they appear as a green carpet covering the surface of small ponds and ditches. Duckweed reproduces by breaking apart in addition to bearing seeds.

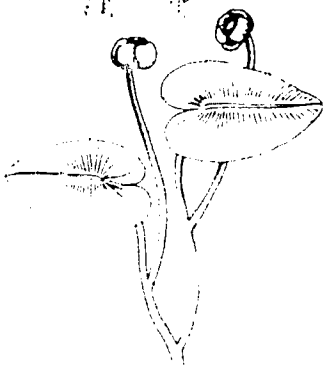
water ferns

are tiny floating ferns with scalelike, lobed leaves, and hanging roots. They often form dense reddish-green mats that can cover the entire surface of small ponds and ditches and shade out water plants beneath the surface. They reproduce by breaking apart; the broken fragments then grow into new plants.

water shamrocks

are amphibious ferns that are often found in shallow water of seasonally fluctuating depth. They are named after their clover-like leaflets. These leaflets are usually found floating on the water surface and are attached by long, slender stalks to a creeping stem rooted in the mud.

yellow pond lily



is one of the familiar water lilies. It is characterized by large floating heart-shaped leaves that are attached by long stems to the base of the plant rooted in the mud. The large, yellow flower is tuliplike and bears six to twelve petals. The stems vary from 4 to 15 inches long.

### water shield

is similar to the pond lily with its long-stemmed floating leaf blades. The leaf blades are oval rather than heart-shaped, however, and the reddish-purple flower is far from tuliplike and appears only briefly. The stems range from 1 to 4 feet in length.

### water milfoils

have stout stems that vary from 1-1/2 to 3 feet long and bear leaves in whorls of three to six. The milfoils may be partially or completely submerged. The submerged leaves differ in size and shape from the leaves that are above the water. The milfoils' tiny flowers grow near the stem tips.

### aquatic buttercup

bears the characteristic yellow or white buttercup flower with five petals. Submerged leaves are finely divided as opposed to the three-lobed floating leaves. The submerged plant stems appear whitish.

## SUBMERGED

### bladderworts

have long slender stems that may be submerged or floating. The stems bear leaves that are so finely branched they look like a capillary system. To the finely branched leaf segments are attached the bladder-like traps that give the plants their name. The tiny bladders are effective in trapping minute water animals.

### filamentous algae

belong to the green algae group which is more abundant in ponds and lakes than all the alga groups combined. Filamentous algae appear as very thin green strands that often form dense submerged mats.

elodea

or Anacharis grows entirely submerged as a loosely rooted or free-floating plant. The branched stems are crowded with green, translucent, narrow leaves arranged in whorls of three or more. Elodea spreads with amazing speed and may literally fill up a pond or slow stream and crowd out other plants.

hornwort

is also known as coon tail because of the dense whorls of leaves arranged about the stems. The narrow, forked leaves bear small teeth or horns along their margin. Hornwort has no true roots and its tiny flowers are fertilized underwater.

pondweeds

make up the largest group of truly aquatic seed plants. All of them grow rooted to the bottom and most grow completely submerged except for their flowers. The group shows a wide variation in leaf shape and size. Many pondweeds have long underground stems and tubers that give rise to new plants. The pondweed illustrated is one of about forty species.

water nymphs

appear as slender, many-branched plants that grow completely submerged. They have leaves that bear a characteristic serrated or toothed margin. The leaves broaden abruptly at their base. The flowers and seeds are found inside the leaf bases.

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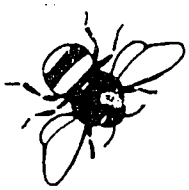
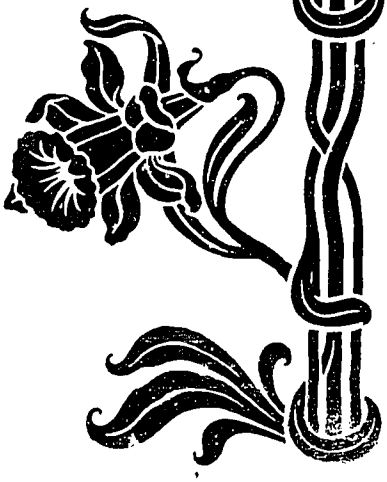
# LAWN GUIDE





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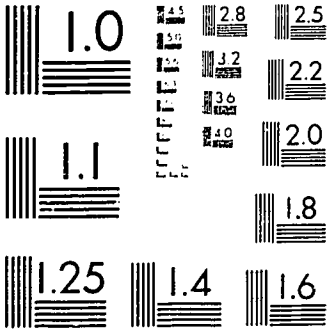


MICROCOPY RESOLUTION TEST CHART
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# LAWN GUIDE

A guide for identifying organisms
found in and around the lawn.

Trial Edition August 1978

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Lawrence Hall of Science
University of California
Berkeley, California 94720

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# PREFACE

OBIS is an NSF-supported project that is currently developing outdoor biology instructional activities for familiar, man-managed communities such as lawns, ponds, streams, farms and gardens. These activities are being designed for young people 10 to 15 years of age.

This guide was written as part of the OBIS activities for the lawn. It is designed for quick, easy identification of some of the most commonly encountered lawn organisms. Only those organisms readily observed by the unaided eye, or by means of a simple magnifying lens, have been included.

References are listed at the end of the guide. Both the artist and the author express their gratitude to the authors of the consulted works. Those desiring more information about lawn organisms would do well to refer to these publications.

## WHERE TO USE THIS GUIDE

This is a guide to common plants and animals that can be found in and around lawns, pastures, vegetable or flower gardens, and vacant lots. You may not be able to find the exact plant or animal in this guide, but you may determine the general type.

Plants are easy to locate and closely examine because they do not run away. When you try to catch and observe any of the small animals in a lawn or garden, you may need to use a small net or plastic bag. A hand lens will help you in your observations. Do not collect the plants and animals; try to observe them in their original locations. If you must pick up the organisms, return them to the spot where you found them when you've finished looking at them.

## HOW TO USE THIS GUIDE

The Lawn Guide is intended to be an easy reference for identifying organisms on the lawn. The organisms have been grouped according to general type.

There are two plant sections: Grass and Non-Grass. All the grasses have been shown with flowers, a situation rarely seen in regular lawn grasses. Except for weedy grasses which flower, it would be much too difficult to identify most of the lawn grasses. The Non-Grass plants are easy to identify, and many of the more common ones have been included in this guide.

For convenience, animals have been grouped in three sections. Small Flying Animals include those flying insects you will most often catch on or near the lawn. Small Non-Flying Animals include insects and other animals such as spiders, snails, and pill bugs. Big Animals include those most familair to you, such as birds, reptiles, and mammals.

Each organism is identified by a picture and a short description. Key descriptive words are underlined. In some cases, the picture of an animal is accompanied by a small drawing showing its actual size. The food habits for each animal are listed, and the length of each plant's life cycle is given. Less common terms are listed in the Glossary.

The small size of the guide lends itself to page-flipping until the right picture is found. The brief descriptions, particularly the underlined key words, can be checked to verify the identification and to find out about food habits or life cycle.

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## ACTIVITIES TO DO WITH THIS GUIDE

You can identify many plants and animals in the lawn with this guide, and you can do much more...

Can you find an animal or plant on the lawn near your house that can also be found on the lawn of your school?

Can you find the same animal or plant in another color?

Can you find the same animals active throughout the day?

Are there animals that are active only early in the morning or only in the evening?

How do the plants change during the day? (Pick out one plant and make hourly observations of it.) Is the flower open or closed? Which way do the leaves face? Is the plant wilted? Are there insects on it?

Wait three months. Can you find the same plants and animals you found before? Are there any new plants or animals?

Can you find a larva? What does it turn into? (Hint: leave the larva where you found it and make periodic observations until it hatches. Did you guess right?)

Can you find animals that have immature forms that do not look like the adult forms? Can you find ones where both adult and immature forms are similar? Do the immature forms eat the same things that the adult forms eat?

Find a plant. Identify it in the guide. Is it found all over the area or in one certain spot? What are some of the conditions under which the plant seems to grow best?

Which plants and animals are the most numerous?

Which animals and plants can always be found in lawn areas?

What is one of the biggest changes that happens to your lawn during a day? a week? a year?

These are just a few of the many observations and studies you can carry out on lawn areas. Try these activities, try some of your own, and have fun discovering the busy world of the lawn.

# Non-Grass Plants

## Chickweed

Slender, much-branched stems with a line of white hairs along one side. Leaves smooth and pointed. Likes it cool. Annual.

## Scarlet Pimpernel

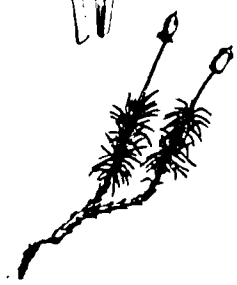
Low growing. Stems branched. Most identifiable feature: under a clear sky salmon-colored small flowers are easily seen. Annual.

## Dandelion

Almost stemless, with jagged leaves growing in a circle around the base of the plant. Flower stalks rise from the base. Easy-to-see yellow flowers turning into familiar puff-ball seed head. Annual, biennial, or perennial.

## Sedge

Very narrow and stiff-leaved plant. Without its flower it looks very grass-like. Unmistakable flower stalk: little clusters of green flowers growing at the base of six spike-like leaves. Triangular stem, usually taller than lawn. Grows in very wet areas.



## Moss

Small, short, soft stemmed plants. Many plants to a patch. No flowers. Found in over-watered lawns. Annual.

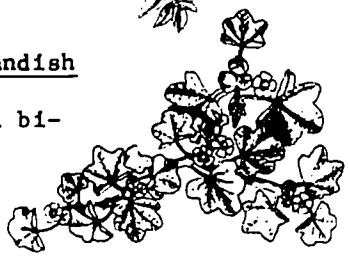
## Oxalis/Sourgrass

Looks like clover, but not related. Prefers shade. Grows low with runners. Flowers yellow, small. Stems taste sour. Perennial.

## Knotweed/Knotgrass

Very low growing; forms circular mat. Found in areas with lots of foot traffic. Slender, wiry, non-rooting stems. Leaves bluish-green and smooth. Very small white flowers.

## Mallow/Cheese Weed

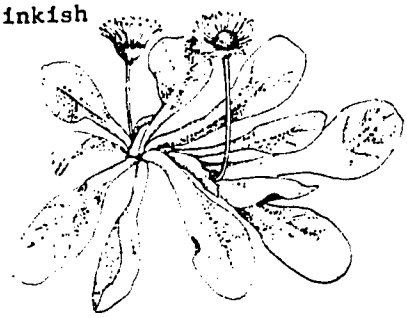


Stems low and spreading. Leaves roundish and broad. Fruit looks like little rounds of cheese. Annual or often a biennial.

## Spurge

Very low growing, stems form circular mats from single root. Stems and leaves are green or often reddish. Positive identification--pinched leaves yield a milky sap (poisonous). Annual.

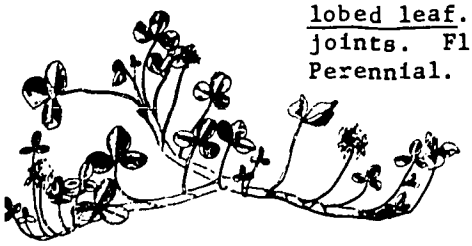
## English Daisy



Low growing with oval leaves. Flowers stick up. Easy-to-see white or pinkish daisy-like flowers. Perennial.

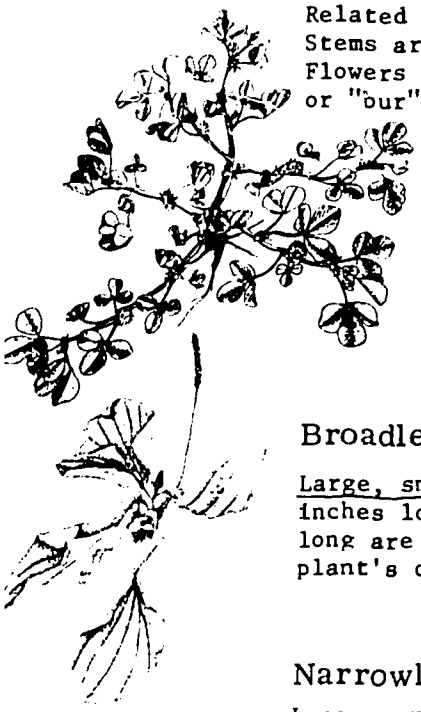
## Clover

Common, non-grassy lawn plant. Three-lobed leaf. Low growing, roots at joints. Flowers white, red, or pink. Perennial.



## Burclover

Related to clover. Clover-like leaf. Stems are low growing and spreading. Flowers are small and yellow. Seed pod or "bur" is spiraled and spiny. Annual.

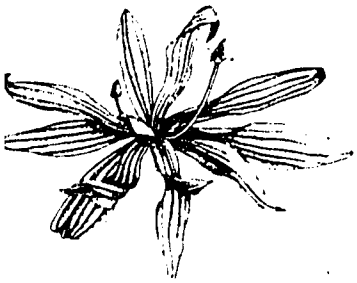


## Broadleaf Plantain

Large, smooth, roundish leaves, 3 to 6 inches long. Flower stalks 3 to 6 inches long are easily seen sticking up from the plant's center. Perennial.

## Narrowleaf Plantain/Buckhorn

Long, narrow leaves with parallel veins, 3 to 12 inches in length. Long flower stalks stick up above leaves. Perennial.



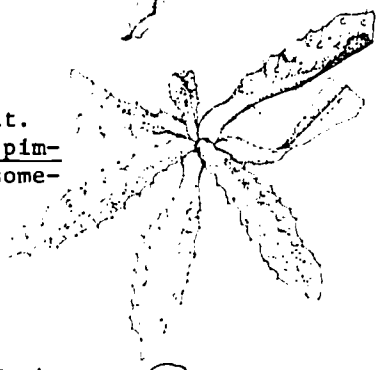
## Thistle

Almost stemless, with leaves notched with long spines that hurt if touched at edges. Leaves are spiny and have short hairs and "pimples." Flowers, when present, are purplish. Perennial.

## Curly Dock

Almost stemless, with large, reddish-green leaves that are curly and wavy along the edges, growing in a circle around the base of the plant. Flower stalks appear in the center of the plant and are green or reddish-brown in color. Perennial.

## Bristly Cxtongue



Tallish. Coarse, rough-looking plant. Leaves covered with rough hairs and pimples. Flowers are yellow and look somewhat like small dandelion flowers. Biennial.

## Dichondra

Low, creeping stems, root frequently at nodes. Can form dense mats, or even "lawns." Leaves lily-pad shaped; 1/4 to 1-1/2 inches in width. Flowers rarely seen. Perennial.

## Cutleaf Geranium

Low growing, many branches per plant. Leaves are divided into narrow fingers. Easily seen small purple flowers. Annual.

# Grass Plants

Since grasses are easy to identify when they are in flower, and only weedy grasses usually flower in a regularly mowed lawn, most of the grasses listed are weedy species. Flowers are usually green, brown or beige.

## Crabgrass

Fat leaves, yellowish-green in color, often hairy. Best way to tell is to look at flower. Spreads by seed and runners. Annual.

## Bermuda Grass

Thick, coarse grass. Stems are smooth and wiry. Runners have many jointed parts with roots at each joint. Flower somewhat similar to crabgrass. Perennial.

## Goosegrass

Low, thick mat-forming grass, growing from central point. Appears as a silvery, pale green clump. Will flower even under constant mowing. Distinctive flower. Annual or short-lived perennial.

## Ryegrass

Long, narrow leaf, hard to tell from regular lawn grass unless flowering; somewhat glossier than most grasses. Forms clumps. Annual or short-lived perennial.

## Kentucky Bluegrass

Very common and desirable lawn grass. Can be identified in cut stage by looking with a hand lens at veins on upper side of leaf--look like railroad tracks running down the middle. Will flower along uncut edges of lawn; very tall, from one to two feet high. Perennial.

## Annual Bluegrass

Short, soft, light-green grass. Will continue to form flowers and seeds even under frequent mowing. Usually found in cool, frequently watered areas. Look for light-colored flowers growing on short grass plants in lawn. Annual.

## Foxtail/Wild Barley

Occurs as clumps, often in new or infrequently mowed lawns. The leaves are smooth, dull green. The mature seed heads look like a squirrel or fox tail, often sticking in socks or shoes.

# Fungi

## Mushrooms

Many kinds of fungi appear on lawns. Most are in the familiar toadstool shape. Others are button-like. They are usually white or light brown, but can range from bright red, blue, yellow to black. Many are poisonous. Mushrooms do not manufacture their own food, but live off decaying plant material.

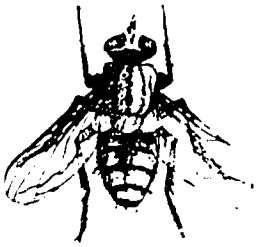
# Small Flying Animals

## Dragonflies

Brightly-colored, fast-flying insects. Hard to catch. They have four large wings, which are held out when at rest, and a large head. Food: small flying insects.

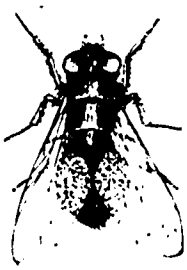
## Damselflies

Look like skinny dragonflies. Wings are held close together and point backwards when at rest. They are usually very brightly colored. Food: small flying insects.



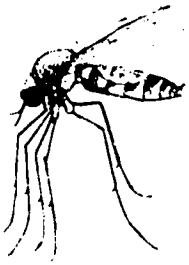
## Frit Flies

Small black flies. Usually very numerous. Hover near lawn surface. Food: larvae feed on grass stems.



## Houseflies

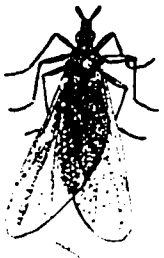
Several species of medium-large flies, all of which look something like the common housefly. The location of your lawn will determine the exact species. Stout-bodied, very active; single pair of wings. Food: scavengers on all sorts of decaying vegetable and animal waste matter.



## Fungus Gnats

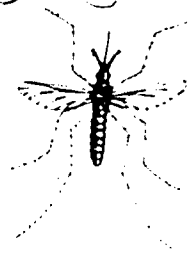
Small, dark, mosquito-like, long-legged flies. With a hand lens you can see that the first segment of their legs is very long. Food: larvae feed on decaying vegetable matter and mushrooms; adults feed on the ooze from decomposing plant material.

## Marchflies



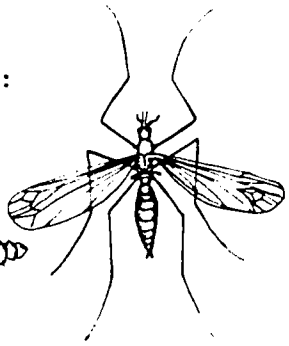
Small to medium-sized, clumsy, black flies can be very abundant in early spring and summer. Food: larvae feed on decaying vegetable matter and on the roots of plants.

## Mosquitoes



Skinny, long-legged small flies. Only one pair of wings, which are fringed with tiny scales and hairs (a hand lens is needed to see these). Most have long, piercing, sucking mouth parts. Food: females suck blood, males feed on nectar and plant juices.

## Craneflies



Large mosquito-like fly, often orangish. Very clumsy and relatively common. Food: adults may feed on plant nectar or dew; larvae are scavengers or may feed on grass roots.

larva

## Bees

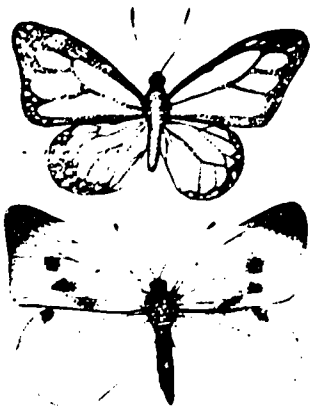
Familiar honey bee with hairy, yellow and black striped abdomen. Usually found near or on clover, dandelion flowers, or other showy non-grass plant flowers. Food: pollen and nectar from flowers, nectar converted into honey back at hive.

## Yellow Jackets

Very showy insects with bright black and yellow markings on its non-hairy abdomen. These wasps are pesty and will sting if disturbed. Food: scavengers, very noticeable during picnics.

## Small Wasps

Any of a number of species of small, black, narrow-waisted wasps. Common in small numbers at all times of the year. Food: most are parasitic, laying their eggs into a host insect; the larvae feed on that host from the inside, eventually killing the host.



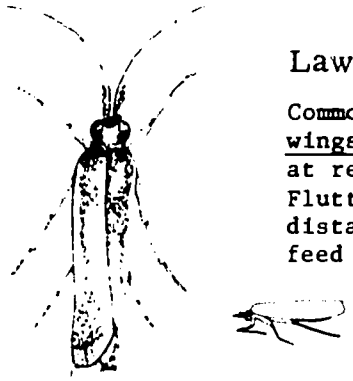
## Butterflies

Slender-bodied insects with large, often brightly-colored wings. Wings are covered with tiny scales. Antennae are slender with a swollen knob at the end. Food: adults often don't feed--if they do, usually on flower nectars; larvae feed constantly on plant material.

Pictured here:

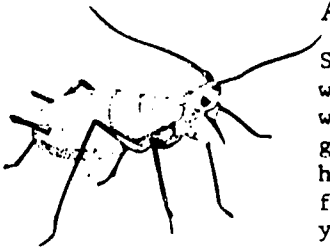
Monarch - black and orange
Cabbage - white and black

Typical larvae or caterpillar



## Lawn Moth

Common slender moth. Long and narrow, wings usually folded against body when at rest. Very distinctive "snout." Flutter about at dawn; will fly short distance when disturbed. Food: larvae feed on stems or roots of grass.

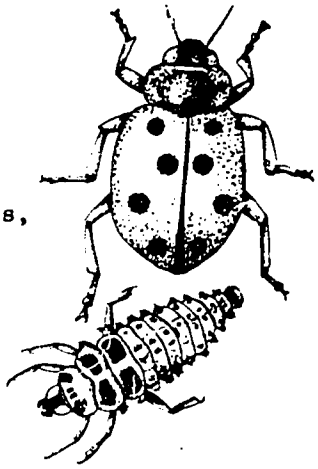


## Aphids

Small, round, soft-bodied insects. With wings at certain times of year, without wings the rest of the year. Usually green, can be black or brown. With a hand lens, can see tiny pegs sticking up from rear of abdomen. Food: adults and young suck plant juices.

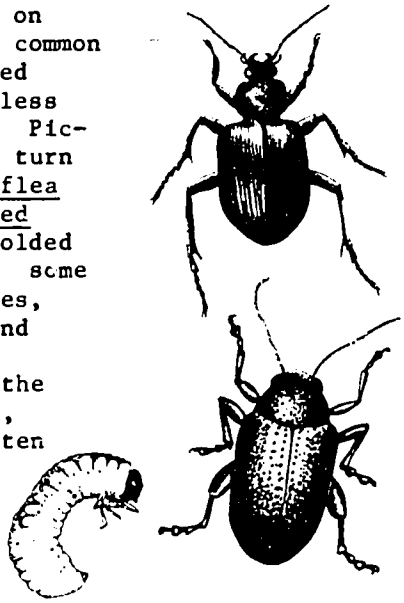
# Small Non-Flying Animals

## Ladybug/Ladybird Beetles




Medium-sized, round, reddish-orange beetles with black spots (or reverse coloring). Often very common. Can be seen crawling to top of a blade of grass, flying a short distance, and repeating the action. Food: both adults and larvae are predators; favorite food is aphids.

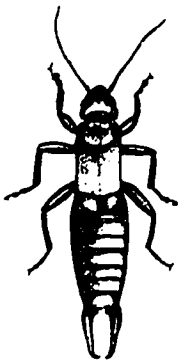
## Beetles




Many types of beetles can be found on lawns; only the ladybird beetle is common enough to be specifically identified here. Beetles range in size from less than 1/8 inch long to 1 inch long. Pictured here are two kinds likely to turn up. A ground beetle and a little flea beetle. Beetles are all hard-bodied and rarely fly. Their wings are folded under their hardened backs. Food: some are predators, others are herbivores, still others are scavengers. Ground beetles are mostly predators, flea beetle adults feed on leaves, and the larvae feed on the roots of plants, particularly dichondra. Larvae often eat different food than adults.

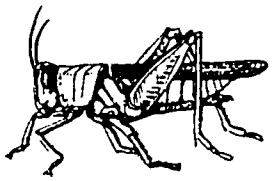
## Weevils/Snout Beetles

As their name implies, these are beetle-like in appearance, with the head more or less elongated into a snout. Weevils, like beetles, prefer to run rather than fly. Food: almost all feed on plant material.



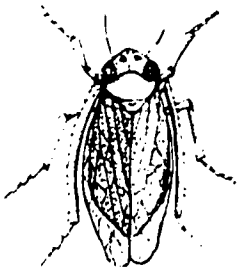
## Earwigs

Slender, medium-sized insects with large pincers on the end of the abdomen. Earwigs are largely active at night and hide during the day in cracks, crevices, and under objects. Food: mainly scavengers, but also eat live plants.



## Grasshoppers

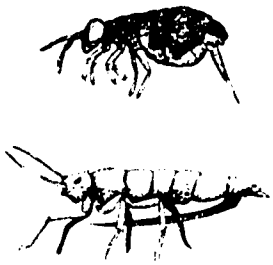
Long-legged, jumping insects. Usually green or brown, they range in size from 1/4 inch to over 3 inches. Very large hind legs to aid in hopping, they also fly. Males sing by rubbing the inside of the hind leg against the lower edge of the front wing. Food: plant feeders



## Leaf Hoppers

Small bugs, very numerous at certain times of year. Oval-shaped body, segments not well separated. Will move sideways, hop, or fly. Often interesting coloration: black, brown and white, or all green, some with red markings. Food: suck plant leaf juices.

## Springtails



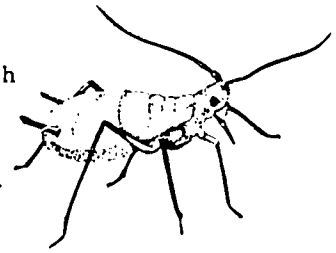
Tiny wingless insects that are very plentiful. They are named after their unique forked tails that they keep folded beneath their body. When disturbed, the tail springs downward, catapulting the insect into the air. May be dark-colored, yellowish, or colorless. Not likely to be caught with nets, but very likely found in traps. Very numerous in the soil. Hand lens is really needed to see them well. Food: scavengers, some feed on microscopic plants.

## Ants

Small, black (sometimes red), narrow-waisted, ground-dwelling insects (rarely, winged ones can be found). Often found in large numbers, in swarms or lines. Antennae are usually elbowed. Familiar insect, lives in large colonies. Food: varied; some ants are predators, some herbivores, others scavengers.

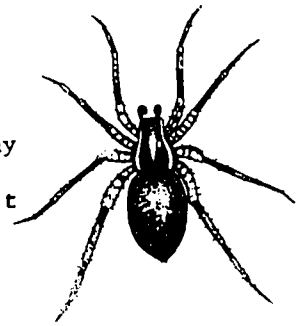
## Aphids

Small, round, soft-bodied insects. With wings at certain times of year, without wings the rest. Usually green, can be black or brown. With a hand lens, one can see tiny pegs sticking up from rear of abdomen. Food: adults and young suck plant juices.



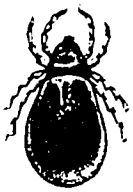
## Spiders

Many kinds of spiders can be found on lawns. All have eight legs, two body segments, and piercing mouth parts. Many spin webs to catch their prey; others, like the wolf spider pictured here, don't have webs but pounce on their victims. Food: all are predators.



## Mites

Tiny spider-like animals; all adults have eight legs. Mites look like fast-moving dots. Colors vary; red, orange, brown, and black are most common. Food: varies; some are predators, others herbivores or scavengers.



## Millipedes

Medium-sized, elongated, wormlike animals with many legs. Most millipedes have 30 or more pairs of legs, usually two pairs per segemnt. Often millipedes can be found rolled up into a ball. Food: most are scavengers.

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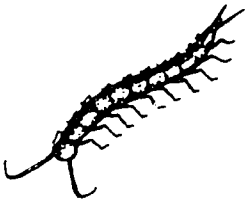
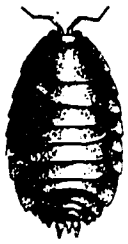
## Centipedes



Medium-sized, elongated, flattened, worm-like animals with 15 or more pairs of legs. Each body segment has a single pair of legs. Very active and fast-running, unlike millipedes. Usually orange in color. Some will bite or sting if held in the hand. Food: predators.

## Isopods/Pill Bugs/Sow Bugs



Medium-sized, oval-shaped, armored animals. Brown, black, or grey in color with yellow spots. Legs originate underneath the armored back and often can't be seen from the top. When alarmed, pill bugs roll up into a tight ball, or "pill. They live in cracks, crevices, or even out in the middle of the lawn. Mainly active at night. Food: mainly scavengers, but will eat fresh plant material

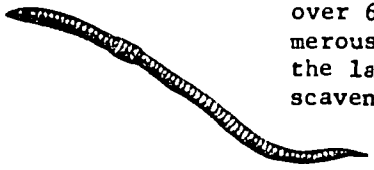
## Snails

Soft-bodied animals with a hard, coiled shell. Very small snails can be quite plentiful in lawns, especially ones around 1/16 inch. Food: fresh and decaying plant material.

## Slugs

Look like snails without shells. Both snails and slugs travel on a slippery substance that they secrete; they thus leave a track where they have been. Food: fresh and decaying plant material.

## Earthworms



Segmented worms with a large band around the body about 1/3 of the distance from the head. Size varies from 1 inch to over 6 inches. Earthworms are very numerous in lawns, frequently come up after the lawn is watered or at night. Food: scavenger; eating material in soil.

# Big Animals

## AMPHIBIANS

Almost all begin life in water with gills; later they develop lungs and come on land. Their skin is usually moist, either smooth or warty. Toads, frogs, and salamanders belong in this group. All of these animals may be found on lawns, but they are not regular visitors. Food: all are predators as adults.

Salamanders

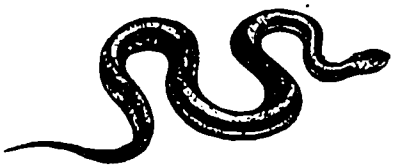
Frogs

Toads

## REPTILES

Have dry, scaly skin which they periodically shed. Snakes and lizards are common reptiles. Snakes are commonly found on lawns--lizards less often. Food: all snakes and most lizards are predators.

Snakes



Lizards

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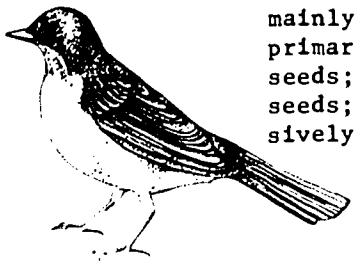
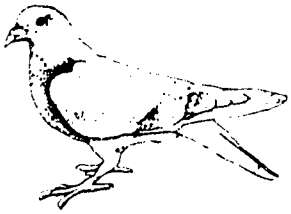
## BIRDS

Have wings and feathers; nearly all fly. Many birds are common and important visitors to lawns. Robins, blackbirds, sparrows, and pigeons are pictured here. Food: robins are predators, feeding mainly on earthworms; blackbirds feed primarily on insects and spiders and on seeds; sparrows feed on insects and seeds; pigeons eat seeds almost exclusively.





## MAMMALS

Have fur or hair and nurse their young on milk. Most mammals are more active at night than during the day. Food:

### House Mouse

Eats seeds, or scavenges for whatever vegetable remains it can find.

### Meadow Mouse

Eats grass and some seeds.

## Gophers

Live on roots of plants. (Gophers only leave dirt mounds at the entrance or exit to their tunnels; they seal their tunnels so you cannot stick your fingers into them.)

## Moles

Eat animals like earthworms and grubs. (Moles make shallow tunnels and leave holes you can stick your fingers into.)

## Squirrel

Do not feed directly on lawn, but will pick up or bury nuts on lawn.

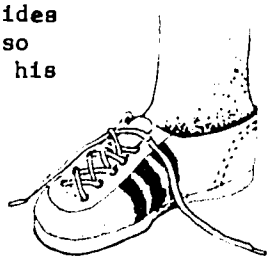
## Dogs

Rarely eat on lawn, but do leave waste products (which serve as food for many other animals).

## Cats

Occasionally eat gophers, mice, or moles.

## Man



Very common; doesn't eat on lawn but does cut and remove grass. Kills big and small animals with traps and pesticides and plants with herbicides. Man also generally stomps on everything with his big feet.

212

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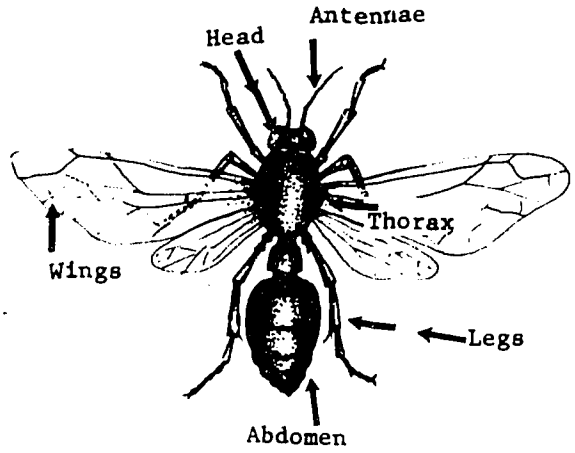
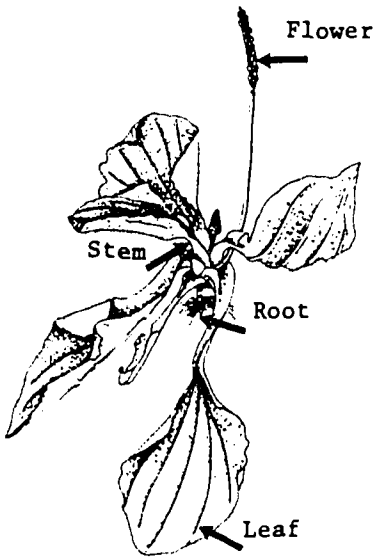

Antennae
Head
Thorax
Wings
Legs
Abdomen


Flower
Stem
Root
Leaf

## GLOSSARY

| | |
|---|---|
| Predator | An animal that eats other animals. |
| Herbivore | An animal that eats plants. |
| Scavenger | An animal that eats dead or decaying plant or animal material. |
| Annual | Plants that complete their life cycle from seed in one year. |
| Perennial | Plants that live longer than two years. |
| Biennial | Plants that don't flower until second year; complete life cycle in two years. |
| Runners | Long stems that grow close to the ground, rooting and sending up new leaves and stems. |

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University of California Division of Agricultural Sciences. Turfgrass Pests. Berkeley: Agricultural Publications, 1971.

# 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.

# 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 |
|---|---|---|---|---|---|---|
| | Black[illegible] bulb for safan lamp | each | .05 | | $8.97 | |
| | Blacklight fluorescent tracing powder | 20 gr. pkg. | .10 | | .95 | |
| | Bluepnnt paper (22 cm x 30 cm sheet) | 25 sh. pkg. | .20 | | 1.75 | |
| | Bug box | each | .01 | | .35 | |
| | Colbat chlonde crystals | 110 gr. pkg. | .15 | | 3.75 | |
| | Colbalt chlonde 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 Cntter 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 measunng cup (250 ml) | each | .020 | | .30 | |
| | Plastic vials with lid (14 dram) | pkg. of 10 | .150 | | 1.30 | |
| | Spnng 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 Tnal Edition, Set I | each | 1.20 | | 8.50 | |
| | OBIS Tnal Edition, Set II | each | 1.20 | | 9.50 | |
| | OBIS Tnal Edition, Set III | each | 1.20 | | 10.50 | |
| | OBIS Tnal 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'd like air mail shipment
OTHERWISE, ALLOW FOUR WEEKS FOR DELIVERY
(Air mail takes approximately one week.)



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

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

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# 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 |
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## 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 | 1-3 | 1.50 | 1.50 | 1.50 | 1.75 | 2.00 | 2.25 | 2.50 | 2.75 | 3.00 |
| ZONE | 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 | 1-3 | 3.25 | 3.50 | 4.00 | 4.25 | 4.50 | 5.00 | 5.50 | 6.00 |
| ZONE | 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 | 26.00 | 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 |