DOCUMENT RESUME

ED 035 540 SE 006 766

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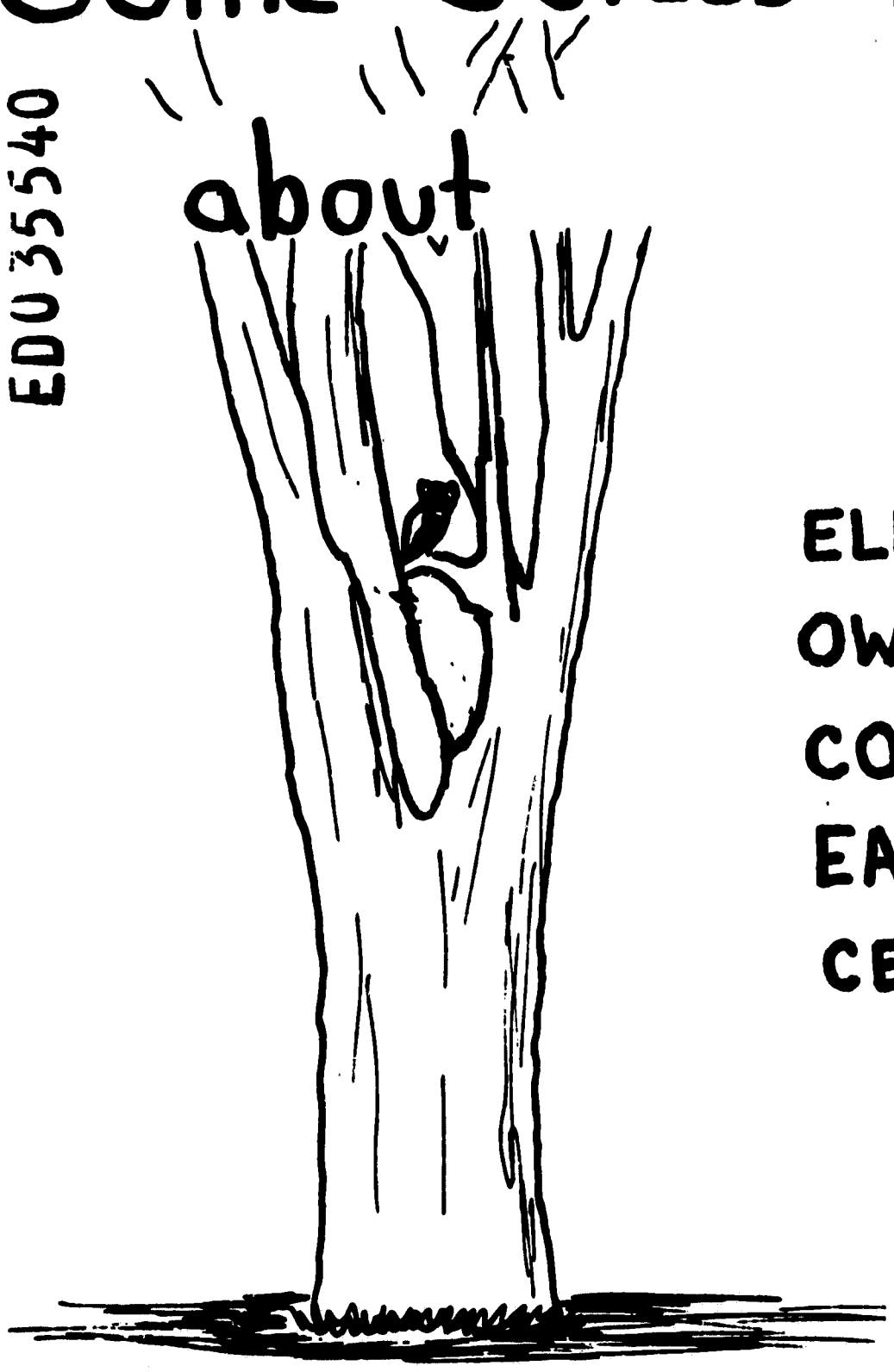
TITLE Some Guides to Discovery About Elm Trees, Owls, Cockroaches, Earthworms, Cement and Concrete.
INSTITUTION Ulster County Board of Cooperative Education Services, New Platz, N.Y.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Elementary and Secondary Education.
PUB DATE 69
NOTE 18p.

EDRS PRICE EDRS Price MF-$0.25 HC-$1.00
DESCRIPTORS Biology, *Conservation Education, Discovery Learning, *Elementary School Science, General Science, *Instructional Materials, Resource Guides, *Science Activities, *Teaching Guides
IDENTIFIERS ESEA Title III, Project SPRUCE

ABSTRACT

The introduction emphasizes the need for environmental and conservation education, and advocates an inquiry approach. Outdoor resources available to every school are listed. Detailed suggestions are made for investigating cement and concrete, cockroaches, earthworms, elm trees, and owls. In each case general background information and a list of references is followed by suggested student activities. Identification keys and instructions for constructing simple apparatus are given where needed. This work was prepared under an ESEA Title III contract. (EB)

Some Guides to Discovery about



ELM TREES
OWLS
COCKROACHES
EARTHWORMS
CEMENT and CONCRETE

Grades K-6

by Dr. PHYLLIS S. BUSCH
Director, Project S.P.R.U.C.E.

SOME GUIDES TO DISCOVERY

about

CEMENT and CONCRETE, COCKROACHES, EARTHWORMS, ELM TREES, OWLS

By Dr. Phyllis S. Busch
Director, Project S.P.R.U.C.E.

S.P.R.U.C.E.
(Science Project Related to
Upgrading Conservation Education)

A Title III: E.S.E.A. Project

Administered by:
Ulster County B.O.C.E.S.
New Paltz, New York 12561

The work presented or reported herein was performed pursuant to a Grant from the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Office of Education and no official endorsement by the U.S. Office of Education should be inferred.

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INTRODUCTION

There are several points of agreement among the members of the science-teaching community today. It is accepted that "telling the facts of science" is a waste of time. Telling is not teaching and facts are easily forgotten. Moreover, "solid facts" change.

However, there are so-called "Big Ideas" or "conceptual schemes" which do not change. One example is that living things in a community interact with each other and with their environment. Another "Big Idea" is that everything is constantly changing: nothing remains static.

A point of agreement is that learning by inquiry -- by exploring -- by investigating is a most fruitful way to pursue one's education. Such learning involves the child in problem-solving. Great emphasis is placed on the processes of science. One might say that children who are exposed to such techniques learn how to learn.

Everyone may not agree on the extent of the sorry condition of our planet but all will accept that there is great need for improvement. Science has been used to develop a technology which is decreasing the earth's resources while it is increasing air and water pollution, crowds, junk, noise, ugliness. Man suffers from all of this. Little has been done to combat or prevent these conditions either through ignorance of the consequences or through indifference.

Man is a part of the world of living things and reacts to environmental changes as do other living things. This calls for an ecological emphasis in our teaching. Such emphasis will logically lead to conservation. Conservation is something active. One has to do something. When man realizes that only he can willingly alter his environment and that only he can predict the outcomes of these alterations perhaps he will be prepared to assume a sense of responsibility which he will translate into action. It is agreed that this might be achieved by inculcating appropriate attitudes and values. How? By education. Who? Everyone -- beginning with Kindergarten --- and higher, higher, never stopping.

In order to emphasize man's relation to and interaction with his environment, the teacher must incorporate experiences in the total environment, outdoors as well as indoors.

The Guides to Discovery is one way that has been designed to introduce children to their world -- indoors and out. They are stimulated and made aware of some parts of their environment by concentrating on small samples from it. They are led to inquire and to investigate. The results will be most profitable where the children recognize interrelationship and where they realize man's manipulations of the environment, the effects, the possible cures. Best of all will be those lessons which result in constructive action by the children, action appropriate to their grade levels.

There is some corner in each classroom which can be designated as a "Discovery Corner". If the teacher should wish to construct a special hanging or standing corner, instructions for this purpose are included.

The essence of the "corner" is the item which is selected. The five items which are described in this booklet are but some ideas of materials which can be introduced and some problems which can motivate children to make discoveries for themselves.

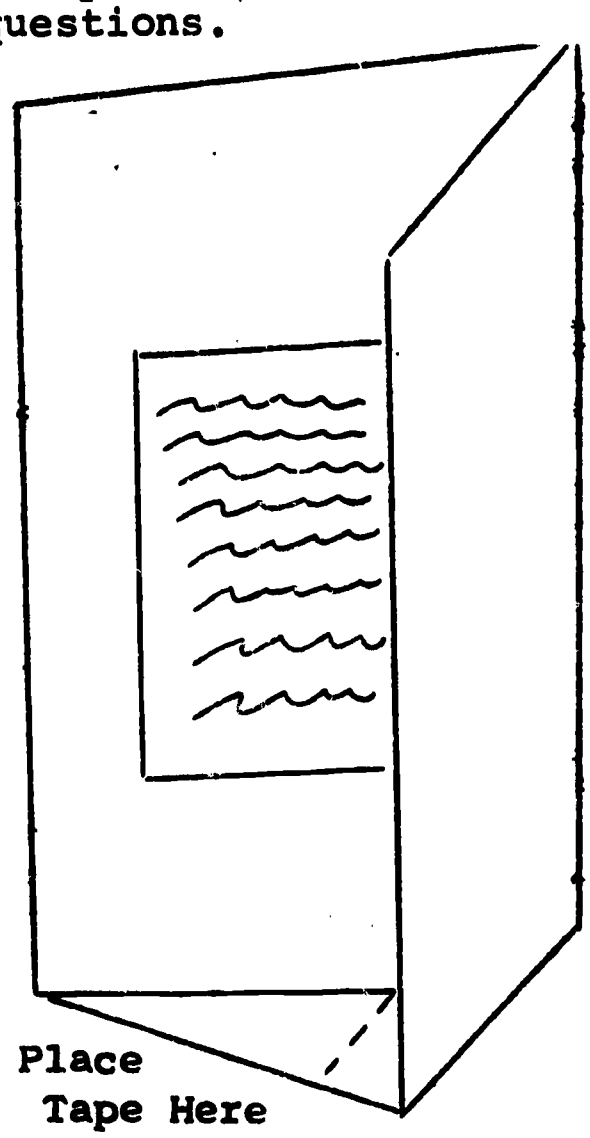
It is hoped that the teacher uses this presentation as an Idea for developing many such Guides to Discoveries.

A CORNER FOR GUIDES TO DISCOVERY

Here is a method of constructing a Discovery Corner -- we hope that it will be a center of interest for you and your class.

A large piece of heavy cardboard 24" x 24" is folded lengthwise down the center. Then fold across 6" from the bottom. This smaller section is cut to form two central triangles which when they are folded up and their edges taped together will form a firm base to the corner. Label the top "Discovery Corner".

Now post written material on the sides and place a sample on the shelf. This display may be placed on a table or hung in the corner. Wherever you put it, it is sure to create interest and stimulate curious questions.



Another method of making the corner would be to cut diagonally across a large, sturdy cardboard box.

SOME COMMON RESOURCES OUTSIDE EVERY SCHOOL

Certain environmental resources are an inherent part of the outdoor environment of all schools. These are the elements which can be explored and investigated by the pupils. The teacher can relate these investigations to indoor studies and then develop "Guides to Discovery" concerning these resources which will direct children to outdoor investigations in their environment. Thus the children will be aided in learning about their total environment both indoors and outdoors. A list of some resources sure to be found in the outdoor environment of any school, rural or urban, follows.

Air

Birds (sparrows, starlings, pigeons)

Building materials (artificial: brick, cement, concrete) (natural: bluestone, limestone, marble)

Clouds

Flags in the Wind

Insects (flies, mosquitoes, ants)

Mammals (cats, dogs, mice, people, squirrels)

Odors

Puddles of Water

Rain

Shadows

Soil

Sounds

Space

Sunshine

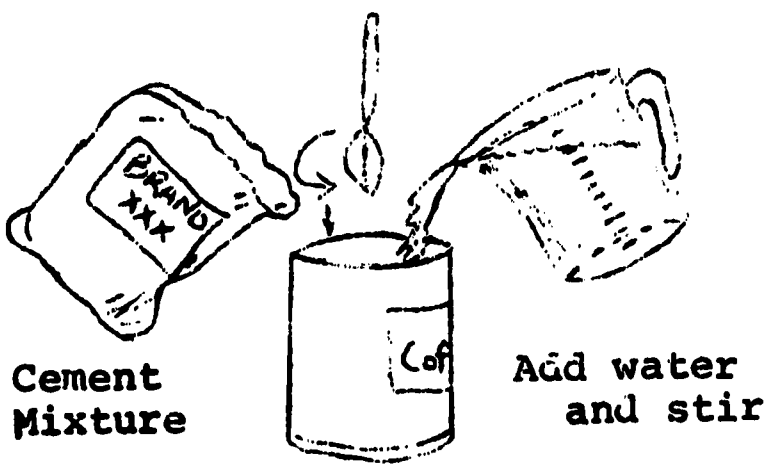
Trees

Weeds

Wind

CEMENT AND CONCRETE

BACKGROUND



Concrete and cement are used for many purposes inside and outside buildings: walks, walls, foundations, floors, etc. Concrete is a manmade molded stone. Cement is one of the ingredients.

Cement is manufactured from limestone and clay, resources from the earth. Adding sand and water to cement results in concrete. The grains are bound together as the cement hardens. Concrete is strengthened by the addition of stone. The proportion of cement, sand and stone as well as the size of the pieces of stone determine the strength of the concrete.

Cold temperatures slow down the chemical action which results in hardening the cement. Cement sets quickest in warm, humid weather. It is common practice to spread straw over freshly paved roadbeds in order to keep them damp.

The best proportions of water, sand, gravel and cement for specific uses are available to builders. In general, the less water used, provided the mixture is workable, the stronger will be the resulting concrete.

SOME REFERENCES

Goodspeed, J. M. Let's Take a Trip to Watch a Building Go Up, G. P. Putnam

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Gilmore, B. "Why You Must Cure Concrete". Popular Science, April 1962, pp. 147-150.

SOME INVESTIGATIONS ABOUT CEMENT AND CONCRETE

1. Make a survey inside and outside the school in order to determine where natural stone is used and where artificial stone is used. What parts are made with cement and concrete?

2. How can sidewalks be patched with cement?
After obtaining necessary permission for this repair job, obtain some cement. Examine it as to color and texture. Different brands require the addition of different materials. Follow the directions. Make a cement mixture. Apply to broken areas. Put up a barrier to prevent people from stepping into the fresh cement. Put up a warning sign.

Touch the cement several times during the day and for several days in order to determine whether it is hardening.

3. Does the temperature of the water affect the rate at which cement hardens?
Make four mixtures of cement in four identical pie pans. Use the same amounts of all the ingredients. The only variation will be the temperature of the water. To #1 add cold tap water. To #2 add ice water (made from mixing ice cubes with water). To #3 add hot tap water (either from the tap or heated without bringing to a boil). To #4 add boiling water. Label each pan. Inspect each mixture at once, then hourly, keeping a record of observations.

4. How is concrete affected by the amount of water used in the mixture?
Obtain some cement, coarse sand, and water. (The amounts roughly are: 1 cup cement, 3 cups sand, and enough water to produce a mud consistency). First mix the sand and cement, then add the water slowly as you stir. Make several different batches, each with a different amount of water. Label. Observe results and keep a record.

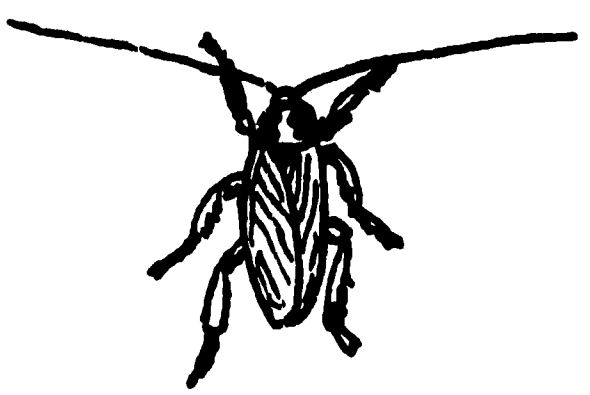
5. Which produces a more effective patch, cement or concrete?
Select an out-of-the way area around the school which needs patching. Patch some holes with cement and some with concrete. Test the effectiveness of each. Permit the class to develop the criteria by which to judge.

COCKROACHES

BACKGROUND

EGG

NYMPH



ADULT

Grasshoppers are common in meadows in the summer. A relative, the cockroach can be found all year round, surviving indoors. It is not restricted to the city. Many country homes are infested with roaches too. However, this pesty insect is more frequently found in the cities, and in crowded apartments.

Cockroaches have been around a long, long time, starting their history at the time when coal was in the process of being formed, millions of years ago. Cockroaches existed when dinosaurs first appeared on earth. And when these reptiles became extinct the roaches continued to live and survive to this very day.

There are many kinds of cockroaches, not all are pests. The smallest, known as the German cockroach is also the one that gives people the most trouble. These are the insects that crawl out of the woodwork at night. They are less active by day. Most cockroaches carry on their activities when the day is over.

They feed on almost anything: garbage, soap, cigars, wallpaper, books, all kinds of fresh food. A smelly brown deposit is left around the holes leading to their homes and all along the trails they travel. The food which they visited is also spotted with this brown substance.

There are just three stages in the development of a cockroach. From the eggs hatch nymphs, who in a half hour begin to resemble the adults. A roach may live about two and one-half years and deposit some 1800 eggs in its lifetime. Some enemies of cockroaches are toads, centipedes and man. The best way to get rid of them is to discourage them by making food unavailable. Poisons and sprays are dangerous to people and pets.

SOME REFERENCES

Ballantine, Bill. Nobody Loves a Cockroach. Boston. Little, Brown & Co., 1967.

Fichter, G.S. and Zim, H.S. Insect Pests, A Golden Nature Guide, Golden Press, New York. 1966.

Zim, H.S. and Cottam, C. Insects, A Golden Nature Guide, Golden Press, 1951.

SOME INVESTIGATIONS ABOUT COCKROACHES

1. Where are cockroaches found?
Cockroaches feed at night. By day you can detect their presence from certain clues. They give off little brown specks - dots which they leave behind on food, around the holes from which they emerge to seek their food, and along the areas over which they crawl. The brown material has a definite odor - cockroach odor.

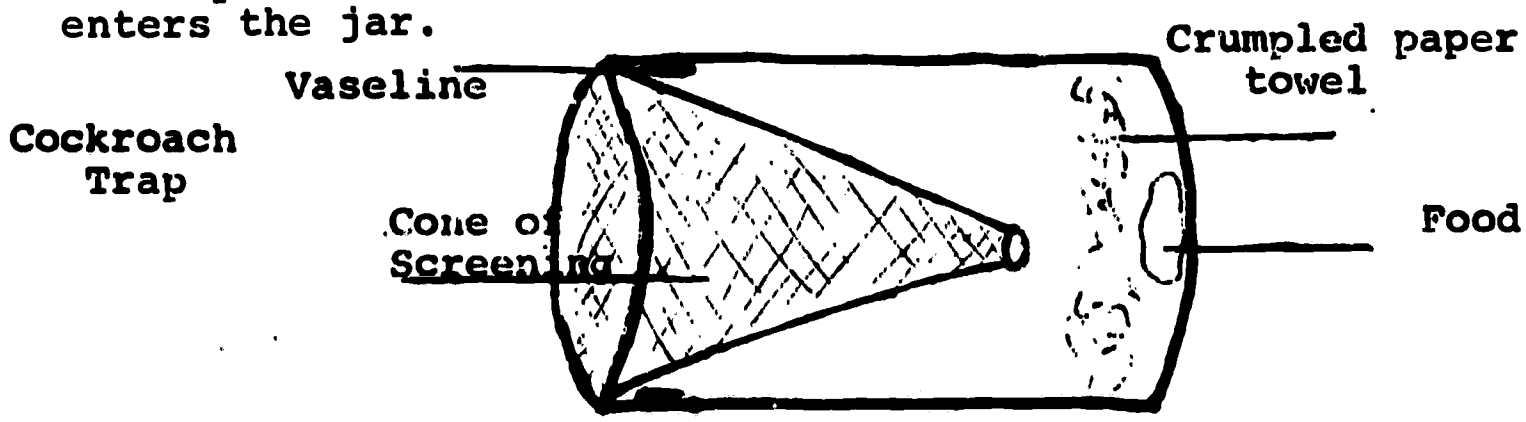
Look around the floor, woodwork, and where it is dark and damp. Can you see signs of cockroaches? Do you smell signs of cockroaches?

2. How can you attract cockroaches?
A cockroach trap can be made out of a pint jar, such as a mayonnaise jar. Cut a piece of fine screening into the shape of a cone. The narrow opening of the cone should be about ½ inch wide and about one inch above the bottom of the jar. The wide top of the cone should extend long enough to overlap the top of the jar. Sew the sides of the cone.

Spread a thin coat of vaseline on the inside of the top inch of the jar. Place a slice of very ripe banana or other rotten fruit in the bottom of the jar. Then put some crumpled paper toweling on top of the fruit.

The trap should be left where placed for a day or two. After some cockroaches have entered the trap screw the lid on to keep the insects inside.

The top of the lid should be replaced with screening so that air enters the jar.



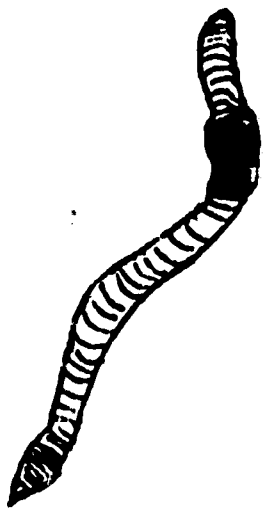
4. Where are most of the cockroaches found?
Make several traps. Place them in different parts of the room where you are trying to locate them: near a pipe, under a table, in a dark corner, a light corner, etc.

5. How does the cockroach compare to other insects?
Try to catch a fly by inverting a clear plastic tumbler over it. Compare the number, size, shape, and color of the parts of the body, wings, legs. Compare their means of movement and the ways in which they clean themselves.

6. Among the closest relatives to the cockroaches are crickets, praying mantises, and grasshoppers. Secure an example of these if you can and examine them to find out how they resemble cockroaches and how they are different.

EARTHWORMS

BACKGROUND



The next time you see an earthworm in your garden, don't think of him only as fish bait. Our common, but often unnoticed, earthworm is man's number one helper when it comes to soil care. This four inch plowman consumes his own weight in leaves and grass every 24 hours. A tiny humus factory, he helps us by releasing otherwise unusable elements back into the soil. His tunnels help aerate the soil, turn it over, and keep it soft and loose so that water can enter; plant roots often follow earthworm tunnels. The worm's tunneling activities also bring up additional materials from below thus increasing the depth of the soil profile. Earthworms produce an enormous amount of castings on the soil. These castings contain minerals which enrich the soil.

Most of the earthworm's long body is a digestive tube. The earthworm's head is rounded and its tail is pointed and flat. The entire body is covered with rings. Tiny hooks help the earthworm to move.

Earthworms are common, most earthworm burrows are U-shaped, but some are straight. They line them with a special mucus to keep them from crumbling. Earthworms come out at night looking for food. They attach their flat tails to the inside of their burrows and forage with their front ends. They will eat anything in reach from dead insects to the tips of twigs. Earthworms can neither hear nor see, but they are sensitive to both light and vibration and will dart quickly back into their hole when they sense danger.

They will come out during daylight only after a heavy rain when their tunnels have been flooded. Digestion of the plant material which the earthworm gathers at night takes place outside the body. The worm moistens the leaves with a substance from its body which softens them. What food is not used by the animal passes completely through its body and is discharged as castings. These castings are what makes the soil so rich in nutrients.

Without the help of earthworms it takes about 100 years to form an inch of topsoil. With the help of earthworms it takes only 10 years. Besides being a tiller of soil, the earthworm plays its part in nature's food chain. Worms are eaten by many songbirds, like the robin. They are also the number one food source for other burrowing animals like the moles and shrews. Perhaps this wiggly creature holds many more secrets--So, the next time you see an earthworm, think of him as much more than <u>just</u> fish bait. (This page prepared with assistance from R. Copening)

HELPFUL REFERENCES ABOUT EARTHWORMS

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2. Farb, Peter, The Forest. <u>Life Nature Library</u>, Time Incorporated, New York 1961, 1963

3. Farb, Peter, <u>The Living Earth</u>. Harper Brothers, Publishers, New York 1959

4. McCormick, Jack, The Life of the Forest. McGraw Hill Book Company, New York 1966

5. Scott, Jack Denton, "The Wonder of the Worm", National Wildlife August-September 1968 Vol. 6 No. 5 National Wildlife Federation

SOME INVESTIGATIONS ABOUT EARTHWORMS

1. Make a survey of where earthworms are found. Explore the ball field, playground, lawn. Look near paved paths bordering soil and plants. Little holes surrounded with earth pellets (castings) are entrances to earthworm burrows. Greatest success is achieved during a light rain or right after a rain.

2. Map the school and surrounding area for a short distance. Locate with an "E" each spot rich in earthworms.

3. Estimate the number of earthworms in a given area.

4. Dig into the earth with a trowel to find some earthworms. How deep do you have to dig in order to find earthworms?

5. Prepare two containers (clear plastic, about one quart capacity) is good, but other sizes and materials will do too) with three equal layers of soil. Clay is placed on the bottom, sand on top of the clay, and humus on top of all. A fine layer of powdered charcoal can be sprinkled between the layers but this is not essential. On top of the soil place some decayed leaves. Then add two or three earthworms to one jar only. Fasten a black paper cover around each jar. (Earthworms live underground, in darkness.) Observe after a few days. Compare the jar with and without the earthworms: a. Examine the surface - what is the condition of the leaves? of the soil? b. Examine the layers of soil - how clear are the three distinct layers in each jar?
   (Suggestion: Water down a section of a lawn before nightfall. That night you can find many earthworms on the surface.)

6. Place an alarm clock upside down on the soil in an area where you know earthworms are found. Leave the clock in place for half an hour or longer. Lift the clock. How did the clock affect the earthworms? Try to explain this.

SOME THINGS TO DISCUSS ABOUT EARTHWORMS

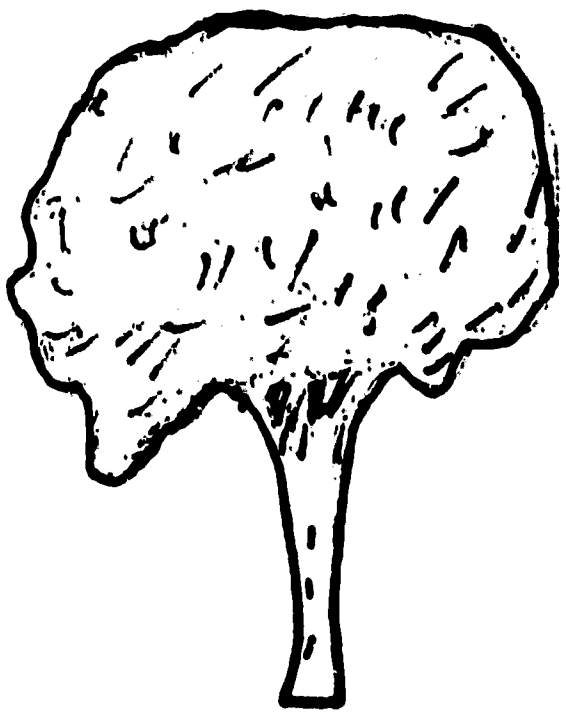
1. What would happen to the earthworms in an area if the plants were sprayed with DDT? How would this affect birds like the robin?

2. Some people say that earthworms leave their burrows after a rain in order to keep from drowning. Some say that they seek air. How might you test which of these reasons are right by using some earthworms, two large glass jars, soil, water?

3. Earthworms eat dead leaves. Birds eat earthworms. How do both of these animals depend on green plants for food?

4. Why do fishermen flood an area from which they wish to collect earthworms?

BACKGROUND



American Elm

ELM TREES

The vase shape of the American elm is attractive in winter and summer. It was one of our most common shade and street trees. It also serves as a source of lumber. Now the elm is rapidly disappearing.

The killer is a fungus. A fungus is unable to make its own food and has to get it already made, as does bread mold and mushrooms.

So far the fungus which kills elms cannot be stopped once it gets inside a tree. The fungus grows and blocks the flow of water from the roots upward. The leaves wilt and die, then the rest of the tree gradually dies. The bark loosens and falls to the ground. The tree is said to suffer from the Dutch Elm Disease, so called because this condition was originally discovered in Holland.

It is believed that the fungus spores which are responsible for the disease were brought to the United States in a shipment of logs about thirty years ago.

Scientists are studying the life of the fungus, the life of the elm tree and of the two kinds of beetles which carry the spores on their feet, in order to find ways of saving the remaining healthy elm trees.

The elm bark beetles lay their eggs under the bark of dead and dying elms. The young which hatch from these eggs tunnel through the wood. The larvae go through several changes, become adults, and finally bore exit holes through the bark in order to escape. The adults seek new elm twigs upon which to feed. When they fly from the diseased tree they usually carry fungus spores of the disease which they can spread to other trees. If one spore falls on one crack in the tree, growth of the deadly fungus gets a start.

Infected trees must be destroyed, completely burned.

Although DDT destroys the beetles, the birds which feed on the beetles are, in turn, destroyed by DDT. Is the use of DDT wise?

The fungus can also spread through the roots of one tree to another. For this reason a deep trench should be dug around every elm tree where there are several in one location.

A natural control is being tested. A certain wasp imported from France is parasitic on the beetle larvae. This type of control shows promise.

SOME INVESTIGATIONS ABOUT ELM TREES

1. What are the differences between the shapes of elm trees and other trees in your area?

2. Make a survey in your neighborhood in order to find out:
   (a) How many elm trees there are (b) How many are healthy
   (c) How many diseased (d) How many have been removed.

3. Explore a diseased elm tree in order to find out all the changes that have taken place due to the Dutch Elm Disease.

4. Look for the holes on a piece of diseased elm bark through which the adult beetles have come out. A magnifying glass might help to see them clearer. How many beetles came through one square inch of bark? How would you discover how many beetles can come through the bark of an entire elm tree?

   Examine the inside of the bark of an elm suffering from Dutch Elm disease. Look for the galleries that these insects build. Have you an idea why they are called "engraver" beetles?

6. After you have learned about healthy and diseased elm trees you should make sure that:

   a. All diseased trees are reported.
   b. You know what should be done.
   c. Healthy elm trees are properly protected.
   d. Diseased elm trees are properly destroyed.

SOME REFERENCES ABOUT ELM TREES

1. Mech, David. "Can the Elm Be Saved?", Nature and Science, Dec. 2, 1968, Vol. 6 , pp. 11-13.

2. Sinclair, W.A. and Weidhaas, John A. Dutch Elm Disease and Its Control in New York State, New York State College of Agriculture, Cornell Extension Bulletin 1185, Cornell University, Ithaca, N.Y. 15¢ (free to New York State residents).

OWLS

BACKGROUND

Owls are carnivores. (They eat meat.) Owls swallow the entire mouse or snake or frog or whatever the food may be. The digestive juices can only digest certain parts of what is eaten. Those parts not digested are rolled up into a pellet and discarded through the mouth. By studying these pellets scientists learn what animals are eaten.

Pellets are found where owls feed and roost. During the late fall and winter, pellets accumulate under trees where owls roost. Look for what appears to be "whitewash" drippings beneath the tree and on the branches and trunk. This is a clue for a good place to search.

By studying the contents of owl pellets one learns not only what the owls feed on but also what small mammals live nearby. Many owls feed chiefly on mice and insects, which can be destructive to farm crops, orchards, and ornamental plantings.

Owls help keep the rapidly reproducing animals from over-populating an area of land. They also help to eliminate sick and injured animals from the area.

The study of owl pellets is fascinating. The pellets are clean and easy to handle.

HELPFUL REFERENCES ABOUT OWLS:

1. Curious Naturalist Volume V. No. 6 Feb. 1966. Mass. Audubon Society Lincoln, Mass. 02773 20¢

2. "Owls as Predators", Roland C. Clement. Audubon Nature Bulletin*

3. "Story of Owls", Dorothy A. Treat. Audubon Nature Bulletin*

4. "What do Owls Eat" - New York State Conservation Dept., Albany, N.Y. Information Leaflet (free)

5. (Get some mammal reference in order to identify contents of pellet as mentioned in #4 above)

6. Curious Naturalist Volume IV No. 9 May 1965. Lincoln, Mass. 20¢

*Available in packet of 14 bulletins on conservation of our natural resources $3.00 - National Audubon Society, 1130 Fifth Avenue, New York, New York 10028

SOME INVESTIGATIONS ABOUT OWLS

1. Look for pellets near your school--even if you have but one tree. Search the neighborhood. Secure several pellets.

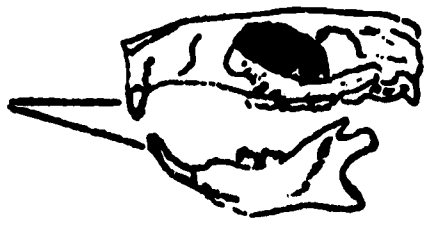
2. Examine the pellet. Spread some newspaper on your desk first. Pellets are clean and easy to handle. What is their color? Shape? How do they feel? Is the pellet made of fur or feathers? What do you see besides fur or feathers? If there are several different kinds of pellets how are they all alike? How are they different?

3. What is inside your owl pellet? Get some tape which is sticky on both sides and a small square of dark cardboard. Use two nails or two toothpicks or tweezers to tease the pellet apart. Among the fur or feathers you will find many bones, some very tiny. An old soft toothbrush can be used to brush the bones clean. Arrange all the bones on the sticky tape. A magnifying glass or hand lens is useful for examing the bones more clearly.

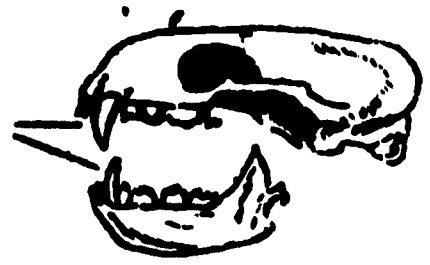
4. What did the owl have for dinner? Examine the bones carefully. A magnifier will help you see them more clearly. If the pellet was formed from feathers, the animal was a bird. If the pellet was formed from fur the animal was a mammal. If it is a mammal the "key" will help you to find out which mammal is in your pellet.

KEY FOR USE WITH OWL PELLETS

A-1 ORDER INSECTIVORA



A-2 ORDER RODENTIA



B. ORDER CARNIVORA

First decide whether the teeth fit the description of A or B.
If it is A, then choose between 1 and 2.
If it is 2, choose between a. and b.

KEY TO THE ORDERS OF MAMMALS MOST COMMONLY FOUND IN OWL PELLETS
(devised by Dr. William B. Stapp)

A. Canines absent, or not large in upper jaw.
   1. Never less than 9 teeth on each side of upper jaw.
      Order INSECTIVORA -- Moles and Shrews.
   2. Never more than 8 teeth on each side of upper jaw; incisors prominent.
      a. Two incisors above. Order RODENTIA -- Rodents.
      b. Four incisors above (2 small ones behind large ones).
         Order LAGOMORPHA -- Rabbits.

B. Large canines in upper jaw -- Order CARNIVORA -- Flesh-eaters.

When you have "keyed out" your specimen examine some reference as suggested at the end in order to find out what kind of animal was preyed upon by the owl.

5. Owls often live in holes in trees. Here is one good reason for saving some old trees. The openings can be quite small. As a rule pellets are not found near a nesting site. About eight or nine varieties of owls could be found living in this part of New York State.

6. A good clue to owl discovery is the owl pellet. If you find pellets on the ground you have discovered the spot where an owl does his feeding overhead. In late fall and early winter what do you observe at roosting sites in addition to owl pellets? When does he feed? How many pellets can you find under one tree in one day? Can you guess what time would be the best for discovering the owl?

7. Some things to think about and to discuss: a. Suppose the field where mice lived were sprayed to kill certain plants, how might this affect the owl? The farmer? You? Suppose the farmer put out poison pellets to poison the mice, how might that affect the owl? The farmer? You? c. Suppose the farmer shot all the owls because his son found a bird skull in the pellet of one? How would that affect the owls? The farmer? You?