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ABSTRACT

This manual is intended for use with the PINE (Projects in Imaginative Nature Education) discovery box in elementary school conservation education. The box contains 21 natural specimens which can serve as the starting point for simple student investigations. Specimens and activities are keyed for grade level. For each item, background information is given, followed by several suggested student activities. Many of these start in the classroom then take the children outdoors. Most investigations are related to natural history and simple ecological relationships. This work was prepared under an ESEA Title III contract. (EB)

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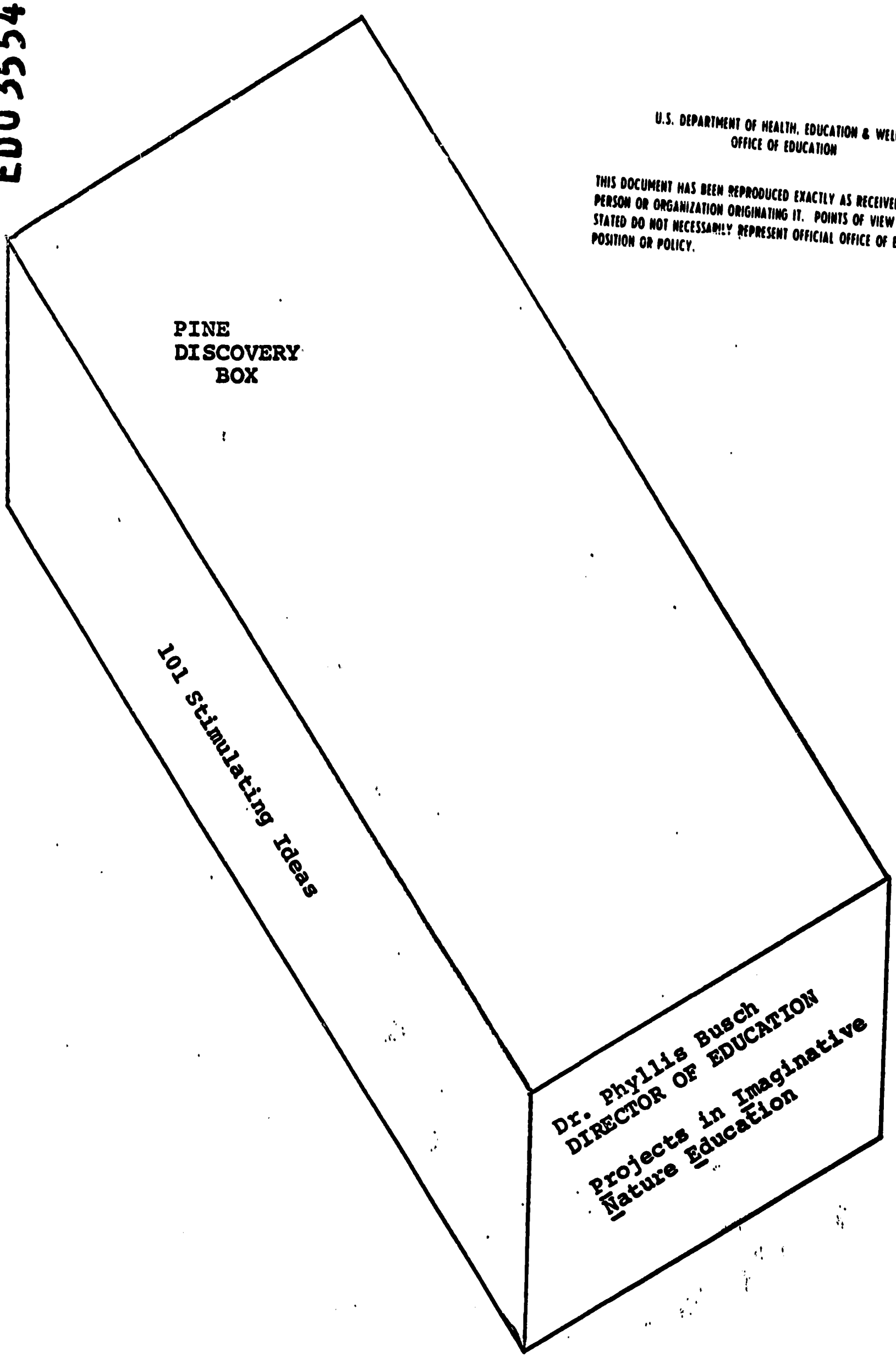

PINE

A Teaching Guide To Discovery Indoors & Outdoors

101 Stimulating Ideas

Authored by

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E.S.E.A. 1965 Title III
Projects in Innovative Nature Education

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Mid-Hudson Catskill Museum
New Paltz, N.Y.

To the Principal:

CONGRATULATIONS!

You are the lucky recipient of a

PINE Discovery Box

PINE = Program of Imaginative Nature Education

This box is designed for use by all the children in grades K through 6.

How to Make the Best Use of the PINE Discovery Box

The aim is to provide specimen and teaching guides to stimulate science and conservation discoveries. Most effective results will follow if the material is utilized as recommended.

First: Plan a display for the entire school. A large table will accommodate the 21 items. Arrange all the items so that their signs can be read by the children. A large sign announces the display. Put this in a central location.

What can YOU discover in the PINE Discovery Box?

Note that the signs of the objects are on differently colored backgrounds. Each color is keyed to a specific grade:

K = blue

1 = yellow

2 = pink

3 = green

4 = white

5 = tan

6 = cherry

Advise the teachers to encourage their pupils to look at all the 21 items but to recognize their own by their grade color.

After the entire school population has viewed the exhibit, and pupils have been motivated to make discoveries with materials allotted for their grades, the display is dissembled and then distributed according to grades.

Each grade level is assigned 3 items. At least one of the three will be in quantity: 30 pieces. This quantity item will allow for greater individual exploration, experimentation, discovery.

Second: Each teacher receives the three kinds of specimen designated for his grade. Where there are 2 or more classes of a specific grade the teachers plan the distribution amongst them so that all the material is circulated and each child of the same grade has equal opportunities for working with the materials assigned to his grade.

In addition to the specimen, each grade teacher receives that part of "A Teaching Guide to Discovery Indoors and Outdoors" pertinent to his grade. For convenience the printed material is also color-coded according to the scheme already stated.

The goal of this entire project is for the children to learn by discovery. This calls for acute observations, experimentations, recording data, making inferences, etc. Practice in such processes of science is achieved as well as growth in science. Besides developing science concepts, aims are to develop understandings of concepts in conservation. In order that this learning assume proper dimension the teacher is encouraged to explore the outdoors as recommended in "A Teaching Guide to Discovery Indoors and Outdoors."

This teaching guide which accompanies the PINE Discovery Box has been developed to provide maximum assistance to the teachers using the materials provided. It contains two important sections in reference to each item.

First, there is a "Background" section. This provides some necessary and interesting information about the specimen for the teacher. The second section, called "Investigations", consists of 101 stimulating problems. These problems are motivational and are designed to guide the children in making discoveries. The remarks in the background material as well as in the section on investigations contain the information needed by teachers and pupils to plan how to go about making

their discoveries.

Note that some activities are carried on indoors, but that all of them lead to a frequent opening of the door in order to explore and to discover the outdoor environments. While carrying on such problem-solving investigations children should be encouraged to explore other problems which occur to them. Stimulating original inquiries and following through is a very important part of this program. Only as children become involved in solving problems which beget more problems do they get the spirit of discovery and really learn how to investigate what lies outside the classroom and home.

For most children such indoor-outdoor investigating and exploring will be a new experience. They should come away from all of this not only richer in a growth in science concepts where interrelationships amongst living things and their environments have been stressed, but also more knowledgeable about conservation and man's responsibility in relation to his resources. The teacher should help to interpret such responsibilities so that they are appropriate to the child's age level.

Both the PINE Discovery Box, with its 21 kinds of natural specimen, and "A Teaching Guide to Discovery" with the prepared 101 guides to investigation, provide a joyful invitation to inquire--to wonder--to explore--to discover.

Educationally yours,

Mid-Hudson Supplementary
Educational Center
Program of Imaginative Nature
Education (PINE)

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Winter 1967
For Use With This Manual

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KINDERGARTEN

Fragment of Hornet's Nest

Background: The pupils of this grade level usually explore homes of living things. They learn about suitable homes for pets and some other animals. Homes for pets are built by their owners or share the owner's homes. Animals in the wild make their own homes.

Wasps and hornets build paper homes which serve as a place to raise their young. The hornet house pictured here is made of cells which are all enclosed by a paper covering. It may house 10,000 hornets. The hornet makes the paper by mixing soft wood or bark from twigs with a liquid produced in its mouth. The female does this work in the spring. Each cell receives one egg. When it hatches the mother feeds the young. When the young has completed its growth it covers the cell with a cap of silk and remains inside, changing to a pupa, then an adult which cuts itself out of the cell.

The adults leave the nest and find a safe place for the winter. In the spring each female starts all over again.

These hornets sting. Their homes should never be touched while they are used. In the winter, when you are sure there are no hornets inside, a nest may be collected. Adults feed principally on other insects.

Investigations: Have the children feel a variety of substances: wax paper, fabric, aluminum foil, newspaper, paper

towel, etc. Then feel the paper wasp's piece of home, in order to discover which of the tested materials it resembles most.

2. Examine the cells with a magnifier. How large do you think the young are?

3. Take a walk around the school in order to discover a hornet's nest. Look in trees, bushes, behind shutters, etc.

While hunting you might discover other homes built by other animals. Look for large clumps of leaves high up in a tree which might indicate a squirrel's nest. Find some bird nests. Can you discover from where the material came for making these nests?

4. You might plan to hand out bits of yarn, string, straw, etc. in order to discover whether an animal might use it for house-building.

Chicken Bone

Background: Chickens develop hard bones from the minerals in their food. The plants upon which they feed get these minerals from the soil in which they grow. People have minerals in their bones too. This comes from the food which they eat and this, too, can be traced back to the soil.

Investigations: 1. Have the children discover how a bone feels by handling it. They might examine beef, lamb, pig, etc. bones too. Boil the bone with a little bleach and it keeps very well. Soak a small chicken bone in 5% hydrochloric acid (obtainable at drug store) or in white vinegar for 3 or 4 days.

Rinse with water and let children bend the bone. They can then discover whether bones are made of all hard materials or also contain soft materials.

2. Examine parts of plants which grow outdoors: bark of trees, parts of leaf, stems, flowers, etc. Discover which are hard. Which are soft?

3. Look for worms, insects, other available animals which can be handled. A pet dog, cat, guinea pig, parakeet, chicken will do too. Let them discover which parts are hard and which parts feel soft.

Burdock

Background: These have been placed on a red "mitten" because they frequently stick to clothes. They are the fruits of a plant with deep penetrating roots and can be a troublesome weed. It comes from Europe, originally. The purple flowers are quite attractive.

The "mitten" can be cut up so that each child can have one burdock fruit to examine or the fruits may be put in a dish or on paper. Advise children not to handle. It is best to use a tweezer or toothpicks.

Investigations: 1. What causes the burrs to stick? Can you discover why these are called "stickers"?

2. Discover the kind of fabric to which the burrs stick best, and to what kind least. Try many different samples: silk, wool, paper, cotton, velvet, aluminum foil, etc. How

could you dress so as to avoid the "stickers"?

3. Can you discover where burdock grows around the school? Do they stick out above the snow? Do you see any animals eating them?

GRADE I

Beaver Wood Chip

Background: Beavers are called "engineers." They fell trees, strip bark, build dams which flood areas where ponds form, construct intricate lodges partly above and partly below the water level. Since beaver fur is sought for the market beavers are hunted and at one time were completely exterminated in the northeast. They have been reintroduced from the west and are multiplying. When an area gets too much water the Conservation Department traps the beavers and relocates them elsewhere. Their value in soil building and flood control is greater that their fur value.

Beavers cut a variety of trees. They show a preference for aspen, willow and cottonwood. They use their two front teeth for cutting. These teeth grow throughout the life of the animal. Unless they are continually worn down they interfere with the animal's feeding and result in death from starvation.

Investigations: 1. Feel the wood. Can you dent it with your fingernail? This beaver chip was cut from a willow tree. Do you have a willow tree near your school? Try to discover one more willow in your neighborhood.

2. If you have a pond or stream nearby you might discover a beaver dam. Watch it several times during the day. When is the best time to see the beavers? What do they do if you move or talk? Why is the beaver ready to hide even if he sees a first grader?

3. Can you tell the difference between soft and hard woods? Oak floors are hard. Pine is soft. Try digging your fingernail into various woods to feel the difference. You might discover some samples in a wood pile. The inside and outsides of buildings have wooden parts made from different trees.

4. If you have a stream nearby hold a piece of wood across the stream. It does not have to reach all the way across. Even a little piece will help you to discover what happens to moving water when it is stopped by a piece of wood. What happens to the water when beavers build dams across an entire stream?

Twigs in Winter--With and Without Leaves

Background: Some trees are evergreen and some are deciduous. Deciduous trees and shrubs are those which lose their leaves each fall and grow new ones in the spring. Evergreens do not lose all their leaves at once. They may have needles or broad leaves. The Scotch pine has needles (2 in a bundle). The cedar has small flattened needle-shaped leaves. The sumach loses its leaves. You can recognize the staghorn sumach by its fuzzy branches. Smooth sumach lacks this fuzz.

Investigations: 1. Into how many ways can the twigs be sorted? Some suggestions are: according to color, size, shape, smell, feel, presence of leaves.

2. Taking one twig at a time, make a survey around the school and match the twig to a tree or a bush. This is how you can discover whether these plants grow nearby. A simple map

can be used to locate each type of plant. Use a different symbol for each plant.

3. Find the scar on the sumach where last year's leaves fell off. Where are the little vessel marks through which water entered the leaf? Can you discover next year's folded leaves by breaking a bud with your fingernail?

4. Discover what will happen when several twigs are cut and placed in water for about two weeks. Why do they grow indoors before they grow outdoors?

Multiflora (Fence) Rose Fruits

Background: This prickly shrub is recommended as a "living" fence for livestock. It is full of sharp prickles. The little red fruits are eaten by many wild animals. The plant is a good soil binder. It was originally imported from Asia. Small, pale fragrant roses grow in spring.

Investigations: 1. What part of the plant would cattle avoid? How could a fence made of such plants be used around a farm? Why is this recommended?

2. Which part of the plant would birds feed on? Open this part (the fruit) to discover what is inside.

3. Will new plants develop from the fruit seeds if planted?

4. Discover where there are plants growing around your school which have some kind of prickles. Who avoids such plants?

5. If you can find a multiflora rose hedge you might get permission to cut a piece about 12 or 15 inches long. Wear gloves. Place the cutting in water. When roots appear start a hedge in a place where you would like to attract wild birds and make a safe place for rabbits to hide.

GRADE 2

Gray Birch Log

Background: Birches are slender trees which spring up quickly on burnt-over or abandoned land. They grow on poor soil. The young trunks and branches are reddish brown or gray, becoming whiter with age. Dark triangles are found under branches or where branches have been.

Gray birch is easily injured by ice and snow. It is a short-lived tree. Its shade makes it possible for other sturdier trees to develop. It leads beauty and grace to the landscape.

Investigations: 1. Think of a tree near the school. Make a picture of it. Color the bark. What color did you make your tree? How would you color the tree from which this log came?

2. Discover the colors of the barks of the trees around the school. Divide 10 school trees among the class. Match your crayons to the bark, then draw and color a tree. Count the number of birch trees, if you have any.

3. Find a spot where you think a birch tree might grow. Perhaps you can plant one and discover the kind of leaves it has, the kinds of flowers, seeds, and who are its visitors. Chickadees frequently build their nests in birch trees, See whether you can discover a chickadee in a birch tree.

4. If you rub the side of a fat dark crayon on a piece of tracing paper held firmly over the log you can

discover the pattern of the birch bark.

5. Make bark "rubbings" of other trees around the school and compare these to the birch "rubbings." Play a guessing game with the bark "rubbings." Exchange "rubbings" and try to match these with the trees from which they were made.

6. Examine some wooden spools and clothes-pins. How much do they resemble the gray birch wood? These are the kinds of things which are made from gray birch. Perhaps you can discover other uses for gray birches.

Honey & Black Locust Pods & Many Kinds of Seeds from Pods

Background: There is a large family of plants which develops pods. The pods (the fruits of these plants) have seeds within them. When the pods open the seeds scatter and grow. The locusts, beans, peas, peanuts, etc. all belong to the same family. They enrich the soil, wherever they grow.

Investigations: 1. After you examine the pods of the locust trees you can discover whether such trees are found where you are. The black locust pods hang on the tree all winter. You can find the larger honey locust pods on the ground. If you do, open them, and you can discover the bony seeds.

2. Seeds of locusts can be planted. You can start them indoors or start them directly in the ground. First put them in a dish and pour very hot water over them. Leave them in water until the next day. Then you are ready to plant them. If you wish you can discover the difference between locust seeds treated with hot water before planting and untreated ones. Which

grow first? Can you explain why?

3. People do not use the seeds of locusts as food but they do eat green pea and string bean seeds. Obtain some pods of these plants and compare them to the two kinds of locust pods. You can compare their smell, how they feel, their color, size, shape, sound they make when shaken.

4. There are many different kinds of seeds which come from relatives of the locusts. These are in the little bag. There are brown lentils, beans, and the beautiful orange Egyptian lentils. Plant these in separate containers and observe them as they grow. These are some discoveries which you can make. Which grow first? How fast do they grow? When do their first leaves appear? What kind of leaves does each one have? Which grows tallest?

5. Plant some outside when the weather is right for planting. Perhaps you can see their flowers and seed pods.

6. Examine plants around the school. Discover whether you can find other plants which belong to this group of plants such as alfalfa, clover.

Work of Animals

Background: Wild animals are not easily seen. They are wary and many of them are active at night. There are many ways to observe animal activities indirectly. Look for clues such as nests, droppings of fecal matter (scat), evidences of eating, etc.

In the animal activity bag are the round pellets, the scat

of rabbits, glued to a card. There are eaten and uneaten pine cones. The animals, such as squirrels, mice, eat the seeds between the scales, not the scales. However, they remove the scales which are usually found scattered under trees.

Investigations: 1. Look at the droppings of a rabbit. This is a clue you can use to explore the grounds around the school. If you discover a rabbit dropping you will know that rabbits live nearby. See whether you can use this clue to find out where the rabbit feeds, lives, hides. What does it find to eat here?

2. The long cones are from the Norway spruce. The needles of this tree are short but the cones are long. With this clue explore your school area. If you discover a Norway spruce look for uneaten and eaten cones. Where are the eaten ones found? Can you explain why they are found there? Take off some of the scales of the uneaten one. Can you find the little seeds which the animals seek?

3. Use the short pine cone as a clue to discover a pine tree to which this cone belongs. Look for a tree with needles which come two in a bundle. Compare the shape of the eaten and uneaten cones of the pine tree with those of the spruce.

4. Would you like to discover pine cone seeds which squirrels, chipmunks and birds seek as their food? If you look under a pine tree or a spruce tree you might find an unopened cone which fell off the tree. Place the cone on a dish or on a piece of aluminum foil and keep it in a warm place such

as near a radiator. Examine it after a few days. What happened to the tight scales? Shake the cone. How many seeds fall out? What part of the seed do you suppose is the nourishing part?

5. See how good a detective you are. Look for clues of animal activities, which have not been mentioned. How many can you discover?

GRADE 3

Fallen Leaves

Background: These are chiefly fallen oak leaves. They were all collected from beneath oak trees. The leaves eventually decay, become part of the soil, and enrich it. Oak leaves do not decay as quickly as other fallen leaves because of the tannin which makes them more resistant. Some oak leaves hang on all winter.

The small bag contains pure sand.

Investigations: 1. How many of the leaves are whole and how many have pieces which are missing? Can you judge which are older and which are younger?

2. Take a leaf which is whole or almost whole. Take a walk around the school to see if you can match your oak leaf to an oak tree which has the same kind of leaves on it or under it. You might discover an oak tree near school.

3. Find an oak tree. Look for old oak leaves on the grounds. Can you discover what happens to fallen leaves? Examine some to discover whether insects live in fallen oak leaves.

4. You can discover whether the radish seeds grow best in plain sand, plain crushed leaves, or a mixture of crushed leaves and sand? Which do you predict will furnish the best growing conditions for the seeds? How will you set up your experiment?

5. How will radish seeds grow outdoors in your school yard? Do they grow equally well on all sides of the building? Does it matter whether you water them or not? If you carry out this investigation you can discover where and how to get the best crop of radish seeds around your school. Do you think that what you discover about radish seeds will also be true for other seeds? You might plan to investigate other seeds too.

6. Find a place near your school where the plants seem to be growing well. Take a handful of soil from around each plant and try to discover how many pieces of leaves there are in the soil.

Porcupine Quill and Cactus Spines

Background: Plants and animals frequently bear structures which appear to have survival value. The porcupine is a slow-moving animal which would have difficulty escaping from other animals seeking it for its meat. However, its enemies avoid the porcupine because of its quills. The quills are not shot out but they come off easily and stick to animals who encounter them. The tip of the quill has little barbs which hook into the flesh, getting deeper and deeper. Quills are difficult as well as painful to remove. Thus animals often avoid the porcupine.

The same appears to be true with sharp prickles on plants such as spines on cacti. Sharp points seem to keep most animals from eating the plant. There are many kinds of spiny plant

structures. Cactus plants are not the only plants with spines. There are many kinds of cacti, each with different sharp appendages. It might be safest to examine the demonstration of cactus spines through the transparent container in which they were put.

Some plants, such as poison ivy, is poisonous to the touch, though it lacks sharp parts. The poison is in a chemical. Poison ivy is poisonous at all times of the year. It is not poisonous to wildlife. Birds feed on the berries.

Investigations: 1. Examine the porcupine quill and the cactus spines with a magnifying glass. Can you discover what parts make animals avoid these objects?

2. Walk around the school looking for plants which are avoided by people as well as animals. You might find thistle, barberry, rose. These can be handled if you wear gloves. You can examine them with a hand lens outdoors. Can you discover how the sharp parts of each plant is different?

3. Some plants do not have thorns or prickles but are avoided by people just the same. Poison ivy is one such example. Can you recognize poison ivy at this time of year? Do you know where poison ivy grows around your school? When you find some observe it frequently. Who visits this plant? What happens to its white berries?

Limestone and Chalk

Background: Sedimentary rocks are a class of rocks which were formed from particles settling down as sediments in water.

Usually, these sediments originated from older rocks which were being worn away. The sediments settled slowly, forming layers, which formed rocks under pressure. Sandstone and shale are common sedimentary rocks. So is the limestone.

Crushed limestone is made into cement, an artificial, man-made rock. Plaster is also made of cement. Plaster of Paris is used for many things. One use is the making of chalk. At one time chalk for writing was natural chalk. This natural product formed from the calcium deposits which came from the skeletons of microscopic animals. It is cheaper to use manufactured artificial chalk.

Limestone and limestone products bubble or fizz when acid is added to it. A 5% solution of hydrochloric acid can be mixed at the drug store and used for testing limestone. Ordinary white vinegar is a good substitute, especially if slightly warmed.

Investigations: 1. How does chalk, a limestone rock, react with vinegar (or hydrochloric acid)? Add a little vinegar to the piece of chalk in its container.

2. How does limestone react to the acid test?

3. Discover which rocks around your school are limestone. Small quantities of vinegar in little plastic containers with droppers in them can be used by the children for testing rocks.

4. Artificial chalk can be made easily. A piece of waxed paper can be rolled up to serve as a mold. It should

be the size of a cigarette. Fold one end up so that liquid poured into the mold will remain there. Stand the molds in a jar. Mix some plaster in a bowl by adding water to the powder until you see little "islands." Stir and fill the molds. When they are dry you can write with the chalk.

5. Impressions of dog or cat footprints in the mud can be made with plaster of Paris. You might find other animal footprints. Make an impression of these with plaster.

Either dust the track with talcum or pour a little light automobile oil over it. With a strip of cardboard about 1½ inches wide and about 18 inches long, make a "collar" around the track. Fasten the collar in place by pushing mud around it.

Mix plaster in a can. Add enough water into the plaster, mixing it with a stick until it can pour (like a very think pea soup). Usually it takes less than half as much water as plaster. Pour the mixture into the mold.

After 20 minutes remove the collar. Lift the cast, mud and all. The next day, after it is well hardened the soil can be brushed off.

You can "collect" tracks this way and discover what animals visit the area.

GRADE 4

Galls

Background: No living thing really lives alone. Other living things are around it and on it. These are constantly affecting it and are, in turn, affected by it. This is clearly evident in the plant growths called galls. These are swellings of the plant which may occur on any part of it. The swelling provides food for a tiny organism. And it seems to protect it against enemies and weather, also providing shelter.

Among the many living things which cause these plant distortions are bacteria, wasps, flies. Each organism is associated with a particular plant.

The willow pine cone gall is found on willows. A tiny fly lays her eggs on the buds in spring. These hatch into maggots. A fly secretion stimulates the plant to grow the deformity shaped as a pine cone. Here the maggot feeds, grows, becomes a pupa, and in the spring will emerge as an adult fly. However, in the winter other organisms seek this fly which serves as food for them.

Investigations: 1. Open one willow pine cone gall and look for a tiny worm-like form---only about an eighth of an inch long. If it is not present, can you discover any evidence of other tiny organisms which might have been feeding on the gall maker?

2. If there is a pond or stream nearby look for

such growths on the ends of twigs. If you find them you have discovered a willow tree. (These flies do not go on weeping willow trees.)

3. Beside the two pine cone willow galls is a "mystery" gall. Match this to the pictures of galls which accompanies these materials. Can you discover what kind of gall it is and who made it?

4. Explore all the plants around the school to see if you can discover other kinds of galls. Galls are found on spruce, cedar, oak, maple, rose, goldenrod, cherry, etc. They are very, very common. The colored pictures will help you make gall discoveries.

5. Discover who the gall-makers are. Take the uncut pine cone willow gall or the "mystery" gall or any other gall you find. Put it in a plastic bag. Tie the opening. Hang the bag containing the gall near a window. When the gall maker hatches out you will discover the cause of that particular type of gall. You might have to use a magnifying glass to see it.

Elm Tree Section

Background: An elm tree is a beautiful tree. It has a shape like a giant vase.

This section of elm comes from a tree which died from Dutch elm disease in 1965.

A tree grows in height and spread of branches as long as

it lives. The tips of the twigs lengthen. A tree also increases around the trunk and around the twigs at the same time as it increases in height and spread.

A tree, in section, shows a hard center (the heartwood, no longer alive) surrounded by an outer living section, the sapwood through which liquids travel up. Around these is the bark. Food travels down through the inner bark.

Each year an annual ring is laid down. By counting all these concentric annual rings the age of the tree can be determined. By examining their width, appearance, and condition, other information can be learned about the tree, such as rate of growth, fire damage, insect infestation, available light, moisture.

Investigations: 1. How many openings are there in the bark through which elm bark beetles may have emerged? How do these openings look on the inside of the bark? Look for the galleries made by the insects on the wood and on the inner bark. Can you discover any insects there?

2. Examine the trees around the school, looking for holes such as those made by the elm bark beetles. You might discover an elm suffering from Dutch Elm Disease. Do other trees have such holes?

3. Examine the cut surface of the elm tree section. Can you discover its age? How wide was the trunk when you were born? How big was the tree when Kennedy was president? How can you explain the fact that some rings are narrower in one

part of the trunk and wider in others? Can you discover other irregular growths of rings? Can you find evidences of what might have caused these irregularities?

4. If there is a stump of a tree near the school see how well you can interpret its history. You might make some unusual discoveries.

Sycamore Fruits (Balls) and Seeds

Background: The ball of the sycamore is its fruit. The tree is frequently called buttonwood or buttonball because of it. The fruit dangles from a long slender stem and persists all winter. In the spring these fruits break up into the little nutlets. Each has one seed. It is carried by the wind and if it falls on very moist soil it might germinate.

The bark is smooth and looks mottled as large plates peel off. Colors of white, red, green make the trunk very handsome. Sycamores are commonly planted on city streets because they are so tolerant of urban conditions.

Investigations: 1. By dividing the fruit into small sections each pupil can count the number of seeds in his section. To discover the total number of seeds, add all the amounts.

2. Find a sycamore tree. Count the number of fruits (or buttonballs). Can you discover how many seeds one tree may produce year after year? How do you explain the fact that you usually do not see many sycamore trees in one place or near each other?

3. Plant some sycamore seeds in containers indoors. Give them water but keep some very dry and some very moist, some cool and some warm, some in sunlight, and some in shade. Discover which grows best.

4. Plant some sycamore seeds outdoors. Plant some on the shaded side of the building, and some in the sun. Arrange to water some of each group a great deal, while the others get whatever water the rain provides. Observe how they grow. Now you can discover whether sycamore trees grow more successfully indoors, or outdoors, in the shade or full sunlight, with much water or little water.

5. Would you like to have a sycamore tree grow on your school grounds? Find one which is growing well. Discover the conditions of soil, water, sunshine, etc. which the healthy tree has. If you can duplicate these conditions you might transplant one of your seedlings to the ideal spot and watch the tree grow.

GRADE 5

Colored Twigs (Spice Bush, Red-Osier, Dogwood, Sugar Maple)

Background: The landscape is not drab and colorless in winter. There are many hues which can be detected by just looking around. Three common kinds of twigs have been selected for their color as well as for their other interesting features.

Spice bush, the greenish twigs, have little openings on the twig which allow for an exchange of air. These dots are pale in color. Another name for this plant is wild allspice. The bush grows in damp places. It is related to the sassafras. Pheasants, catbirds, and robins relish the fruit of the spice bush.

The red twigs belong to the red-osier dogwood. Its brilliant red stems look bloody against the snow in winter. As the spring approaches its color gets even brighter. Many wild birds feed on the fruits of this shrub. Cedar waxwings, cardinals and robins frequent these shrubs. Rabbits and chipmunks feed on the fleshy fruits too.

The sugar maple is one of the favorite trees of the area. Its shiny brown stems give the landscape a third color variation. The gray trunk stands out in contrast to the brown twigs. Maple seeds, maple buds, and maple flowers provide food for many animals such as squirrels and chipmunks. Birds frequently use the seed stalks and leaves in nest building. People enjoy the shade and maple syrup.

Investigations: 1. Can you discover the differences in the way the buds are arranged on each kind of twig? How do the shapes of the buds compare with each other?

2. When leaves are on the twigs water enters the leaves from the stem by way of little tubes. When leaves fall off in autumn a scar is left where the leaf was attached. The shape of the scar, the number and arrangement of tubes is characteristic of each kind of plant. You may need a magnifier to help you discover the shape of the leaf scars and the number of tubular structures in each twig.

3. Use your twigs to help you to discover where in your neighborhood any of these three plants is growing. Make a map of the school and the area and write in the name of these plants in the locations where you find them.

4. Select one of the bushes or trees for observation. Who goes to the tree? What plants live under it? What birds nest in it? What mammals are found there? Do any insects occupy it? These are some of the discoveries you can make about any plant you select. Can you think of others?

5. As spring approaches these twigs would develop leaves and flowers from their buds. You can discover the kinds of growths which develop from twigs by obtaining some fresh ones and putting them in a jar with water in the bottom.

Owl Pellet

Background: Owls swallow the entire mouse or snake or frog or whatever the food may be. The digestive juices can only digest certain parts of the animal. Those parts not digested are rolled up into a pellet and discarded through the mouth. By studying these pellets scientists know what animals serve as food. Owls are carnivores.

These pellets are from the Saw-Whet Owl. Saw-Whet owls feed chiefly on mice and insects. Too many mice and insects would destroy crops. Owls help to control their numbers.

Investigations: 1. Can you discover what the Saw-Whet owl had for dinner? Get some Scotch tape which is sticky on both sides and put some strips on the black cardboard. Then use the 2 nails to tease the pellet apart. Among the fur pieces you will find little bones, some very tiny. Place these on the tape.

2. Owls live in holes in trees. The openings can be quite small. Walk around the school and try to find holes in trees which you might watch. Perhaps you will discover an owl's nesting place. You might even discover different kinds of owls. Here is one good reason for saving some old trees.

3. 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. When does he feed? How many animal pellets can you find under one tree in one day? Can you guess what time would be the best for discovering the owl?

Bark with Insect Activity

Background: The bark of the elm tree comes off easily after the elm dies. Many elms are dying from the Dutch Elm Disease which is caused by fungus spores. These spores are carried on the legs and other parts of beetles which use elm trees for feeding and nesting. Healthy young elms can resist the disease. Old trees and injured trees can be infected easily. An infected tree should be destroyed so that the spores do not spread.

The beetles lay their eggs under the bark of the elm tree. When the larvae of these elm bark beetles hatch they feed on the inner bark and wood. When they are full grown they build cells in the wood and change to pupae. Finally they become adult beetles and leave the bark through holes which they make. The beetles can chew wood. Adults are only about one-half inch long. From May on, throughout the summer, many of these beetles can be seen emerging from elm trees.

Investigations: 1. Can you discover the holes on the elm bark through which the adult beetles 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?

2. Examine the inside of the bark. Can you discover the galleries that these insects build? Have you an idea why they are called "engraver" beetles?

3. Look at the color of the bark. The elm tree grows tall, up to 100 feet, and is shaped like a vase. Take a walk in your school area, using the piece of bark to help you discover elm trees around the school. How can you tell whether elm bark beetles live there? If you suspect it and can make sure that the tree is infected and not alive, you might explore under the bark for "engravings" and for beetle larvae. The important thing would be to report a diseased tree to the conservation department. Do you know why?

GRADE 6

Shawangunk

Background: Specimen of shawangunk conglomerate (pronounced "shwangum") rock from the area shows an interesting sedimentary rock. It is a kind of puddingstone because one can see stones embedded in a substance, similar to raisins in a pudding. The word shawangunk is an Indian word meaning white rock, or great white cliffs.

Millions of years ago the land in the area was folded, causing mountains to form. The landscape never remains static. Changes always take place. No sooner were the mountains formed that they began to be worn down. Streams and rivers flowing down from the West Point area carried the weathered particles--sand and gravel. These hardened to form the shawangunk. Pebbles were cemented by the sand.

Then seas rose, drowned everything. Sediments continued to collect and harden. When, eventually, the land again rose, very tall mountains were formed, taller than today's. As these were worn down to form the mountains we have now, the originally-formed shawangunk was exposed. It is from this shawangunk that specimen were obtained. The bed extends from the New Jersey line to Rosendale--about 47 miles. Shawangunk can be seen along Route 55. Shawangunk consists of quartzite pebbles cemented by quartzite sand, and hardened to form rock by pressure under the

sea. It is a very hard rock. Gravel is sand mixed with pebbles or small stones. A conglomerate, such as shawangunk is, consists of a consolidated or hardened gravel bed.

Investigations: 1. What does shawangunk look like? What can you discover about the pebbles embedded in the hardened sand of shawangunk rocks? How do these substances look through a magnifier? Examine for color, size, shape of embedded material.

2. Some rocks "fizz" when acid is added to them and some do not. Test a piece of chalk with acid to see what fizzing looks like. You can get a 5% hydrochloric acid solution in the drug store. Ask the druggist to put it in a bottle with a medicine dropper. Or you can use a little white vinegar. Warming the vinegar a bit is a good idea. Does the shawangunk fizz?

3. Is soil formation a slow or a fast process? Since this rock is made of quartz particles which are being eroded to form part of the soil you might discover how long it takes for such soil particles to form from rock. Rub 2 pieces of shawangunk together for 5 minutes. How much "soil" did you make? Use measuring spoons and measuring cups to make your estimate.

4. Are the soil particles obtained from shawangunk fertile? You might obtain the cooperation of several students who will rub two rocks together until there are enough rock particles for at least 2 small paper cups. Several cups would be better. Plant some seeds such as bean or radish in these cups. Water and observe them regularly. At the same time as

you plant in the shawangunk, fill the same number of similar cups with an equal amount of soil taken from a garden and plant the same number and kind of seeds. Give these the same care as the first set. After a week or two have you discovered whether the seeds which you planted grow best in soil or in particles of shawangunk? Why do we consider that the part of the experiment with the soil is the "control"?

5. What does soil contain besides rock particles? Originally our planet was rock. After millions and millions of years the rocks weathered and formed small particles but this was not fertile soil. Fertile soil is more than weathered rock. Go outdoors and explore the soil around the school. Bring back handfuls of several different kinds of top soil. You might collect them in small plastic bags or large paper cups. Label the place from which you obtain each sample.

What can you discover about the difference between rock particles and fertile soil? Here are some things to explore: presence of living organisms, remains of plant and animal life, color of soil, texture, how it feels to the touch, how will it retain water, sizes of the particles. Can you think of more discoveries to make about the soil? How do the different samples compare with each other?

Can you suggest what you might do to the shawangunk particles which you obtained from rubbing the rocks together so that it is really soil and not just tiny rock particles? How might you test your suggestion?

6. Is shawangunk a "hard" rock or a "soft" rock? Collect some rocks around the school, wrap each specimen in several thicknesses of newspaper in order to protect your eyes. Try to crush each with a hammer. Then compare this with how hard it is to crush a piece of shawangunk in the same way. Which is the hardest to crush?

7. What is revealed about soil and its origin by looking underneath the surface of the soil? Look around the neighborhood of the school to find a place where a road was cut through the land. The soil on top is the top-soil. How is it different from the soil under it, or the sub-soil? Can you discover the bedrock at the bottom of all the soil? This forms part of the soil as it crumbles. Can you find small particles of soil which you recognize? Look for plant fragments, animal fragments, quartz and other minerals.

Feathers

Background: A feather is a development from the outermost layer of a bird's skin. Only birds have feathers. Even though all birds do not fly, there is no bird lacking feathers.

There are 3 principal kinds of feathers: small feathers which cover the body and are known as contour feathers, larger stiff feathers of the tail and outer half of the wings and tips known as flight feathers, and down feathers found on most baby birds and under the contour feathers of many water birds such as ducks.

A feather consists of 3 parts: the quill (or shaft) which provides support: the barbs coming off the quill to form a fan-like web; and the fluffy part nearest the body.

All birds molt their feathers at least once a year--in the late summer or fall and in late winter or spring.

Male sparrows have a black "bib" and white cheeks, lacking in the female.

Investigations: 1. Can you discover the differences among the 3 kinds of feathers?

2. What happens when the barbs of a feather separate? How can you put them together? Observe any bird which is not flying. How do birds smooth their feathers? How does it help the bird to keep his feathers smoothed?

3. Perhaps you can discover the importance of perfect feathers by making a paper fan. Fan yourself. Now cut out a few pieces of the fan. Fan yourself again. What is the difference? With the help of a magnifying glass you might see the little hooks on the parts of the feather which help to make it smooth.

4. Look for a bird on a very cold day. Why does it seem fatter than on a hot day? Hold your bare arm out in the cold. How do the hairs of your arm capture a blanket of air? What warms this blanket of air? Can you explain how fluffing out its feathers on a cold day keeps a bird warm? Perhaps you can discover how the birds use these same feathers to keep cool on a hot day.

5. Go on a feather hunt. If you know where starlings or pigeons roost you can find some feathers. Or you might just happen to find other kinds of feathers almost anywhere.

6. If you know where chickens or pheasants live you can observe how the feathers are arranged. See whether you can discover how the flight feathers of the right wing are different from those of the left wing.

7. Look for some common birds such as blue jays and crows and starlings. Describe their colors. There are no differences between male and female colors among them. Then look for the common house sparrows. Here you have differences between the males and females. How can you tell? Discover other birds in which the feathers of the sexes are colored differently.

8. Some feathers have color pigments in them while the color of some feathers is due to the way light falls on the feather. When you find a colorful feather such as a blue one from a blue jay or a red one from a cardinal, hold it up so that the light falls on it. This is as you see it on the bird. Now, in order to discover whether the color is due to a color pigment in the feather or to the way the light shines on the feather, hold the feather against the light. This means that the feather is held between you and the sun. Observe the color. If the feather seems to have lost its color, then the color you saw was due to the way the light shone on it. If the feather retains its color, then you have discovered a feather whose color is due to pigment in it.

Sumach Twigs and Fruit

Background: Sumachs are shrubs common to this area. In the winter they can be recognized by their pointed clusters of red fruits. These fruits are eaten by many song birds and game birds, while the bark and twigs serve as food for browse animals, such as deer and rabbit.

Sumachs with red berries are perfectly safe. Poison sumach has white berries. The berries in the packet are those of smooth sumach.

Investigations: 1. The branches of the sumach shrubs are of two kinds. One is called smooth sumach and one is called staghorn sumach. If you hold these twigs up to the light you can discover which is which.

2. Compare the parts of these twigs. At the cut end the wide pith is visible. What is its color? Can you dig your fingernail.into the pith or is it too hard?

3. Find the little semicircular scars underneath each bud. These scars were formed when last year's leaves fell off. With the help of a magnifying glass you can discover the remains of the tubes through which water traveled from the stems into the leaves. How are these arranged?

The buds contain the plant growth for next year.

4. Take a twig with you and explore the vicinity of the school. See whether you can discover some sumach shrubs. Which kind do you have? Do they still have their fruits? Can you discover any evidence of birds or mammals using these shrubs

as food? As clues, look at the bark near the bottom, look for animal droppings, stand still to see whether birds visit there. How else might you tell?

5. Cut a few branches. Bring them indoors and put them in water. If you watch carefully you might discover how the leaf buds develop into leaves and what form the leaf of sumach is.

6. Examine the bunch of sumach fruit. Look at one little fruit under a magnifying glass. Can you find the hairy covering?

7. Collect fruit bunches of sumach if they are available. Discover the differences between a bunch or cone of smooth sumach and of staghorn sumach. You might look to see in which cone of fruit the fruits are closer together. In which plant do the individual fruits have longer hairs, staghorn or smooth?

8. The Indians taught the Americans how to make a pink lemonade from sumach berries. They crushed the fruit in water and strained it through a cloth to remove the hairs. This was sweetened. The Indians used to dry and save the berries for wintertime refreshments. You can collect some to make a sumach drink and discover what the Indians found so refreshingly delicious. You might even improve on their recipe.