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Nature Study

SAMPLER

OF

TIPS

FOR

Nature and Environmental Education

President's Message

The first connection I ever had with the American Nature Study Society was a paper connection, just as this issue of the Journal is now connecting on paper with each reader. The paper I had was a reprint of a Teaching Tip, and I am sure it had been written by Helen Ross Russell, now our editor. I am also sure it was about ten minute field trips in the school yard, long before her book by that same title was first published and now republished.

Many Teaching Tips later I met Helen and a number of keen members who continually contribute, with skill and dedication, to producing Nature Study. Never did I dream that one day I might be a member of the board, making decisions and plans to revise a number of Teaching Tips for re-publication in Nature Study!

For over 80 years, the A.N.S.S. has focused on promoting excellence in the writing and teaching of nature study. This year marks the fortieth year since the idea of Teaching Tips was formalized for publication by the Society. On the eve before this special issue focusing on Teaching Tips goes to press, I am reminded of a tale, source unknown, about a mouse contemplating on the weight of a snow flake:

> "Tell me the weight of a snowflake", a deer mouse asked a wild dove.
> "Nothing more than nothing" was the answer.
> "In that case I must tell you a marvellous story," the mouse responded.
> "I sat on the branch of a fir, close to its trunk, when snow began to gently fall. I counted the snowflakes as they came down on the twigs and needles of my branch. There were exactly 3,741,852 snowflakes. When the next one dropped onto the branch - nothing more than nothing as you say - the branch broke off."

Whatever cumulative effect Teaching Tips has had already, we offer this issue of Nature Study to ensure a continuing effort. Perhaps it may take only one more to make a lasting break-through!

Joy Finlay - President A.N.S.S., currently teaching environmental education for pre-service teachers at the University of Alberta in Edmonton.

A Word From the Editor...

THE TIPS SAMPLER

In 1951 Dr. Richard B. Fischer of Cornell University suggested that the Nature Study Journal should carry a regular feature entitled "Nature Study Tips" and that these Tips should be practical hands-on activities suitable for use by teachers. In the past forty years a great variety of tips have been published both in the Journal and the Newsletter. Many have been duplicated to be used as handouts in answer to requests for information by teachers and students.

Recently, with our stock of reprints practically exhausted and with a steadily increasing request for help, the Board of Directors decided we should do a study of the Tips and come up with recommendations. With this in mind two weekend work sessions attended by John Gustafson, Betty McKnight, Baiba Woodall, Judy Thomas, Sean Duffy, Lenore Miller, Sandra Burns, Kay Flynn, Ruth Melvin, Ron and Joanna Clees, Mary Houts and Bob and Helen Russell were held at the Russell's home in Pennsylvania.

All the Tips were read. Recognizing the fact that good teaching is good teaching anytime; and that the basic relationships of the natural world are a constant, we could find value in most of them. On the other hand, times have changed, the landscape has changed, materials and equipment have changed, knowledge has been added to. Some of the Tips were discarded or at least laid aside to be totally rewritten (e.g. a good tip on migration written thirty years ago needs to be redone in the light of recent discoveries; a tip using egg cartons is no longer usable since the shape of cartons have changed).

We decided that all the tips need to follow a definite format. All should stand alone, fitting on one or two pages so they could be used in a loose leaf notebook. All should be punched for a three hole binder. Illustrations need to be updated.

We organized the tips by topics: Energy, Environment, Plants, Animals, Astronomy, Photography, Weather, Language Arts and Science, Sensory Awareness, Native Americans, Physical Science. Of course, many tips fall in more than one category.

At this point we are ready for help. This Tips Sampler is made up of 14 Tips covering most of the topics above. Please fill in the following questionaire and return to **Helen Ross Russell, Editor, 44 College Drive, Jersey City, NJ, 07305.**

What would you change? _____

_____

What would you delete? _____

_____

What topics are you willing to prepare a new tip on? _____

_____

Could you take several tips and edit them to fit the format? _____

_____

Could you help with illustrations? _____

_____

Are you interested in participating in a work weekend this winter? _____

_____

Could you help us obtain a grant for publication? _____

_____

What is your particular interest in ANSS? _____

_____

How are you employed? _____

_____

H.R.R.

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Using Poetry for Developing Nature Awareness and Sensitivity

Curriculum Area: Literature, Nature Study, junior high and up.

Rationale: Anytime a topic is approached through two or more subjects the learning is increased exponentially. In these tips literature and nature study are brought together through poetry.

In The Poetry Nature Trail the leader brings together the written word and the natural setting. The audio experience is enhanced by the total sensory involvement in a piece of nature.

Haiku starts with an experience, a moment of nature, and challenges its viewers to catch it with minimal words.

Both experiences increase appreciations and sensitivity and may leave a permanent mental image.

A POETRY NATURE TRAIL

John A. Gustafson

From the beginning of the nature study movement one hundred years ago, it has been recognized that what we now call "environmental education" has as its ultimate aim the development of awareness and sensitivity to nature. Liberty Hyde Bailey and other early leaders of the movement recognized that knowing about nature was not enough. Nature study was more than science education (although they were careful to maintain scientific accuracy!). It also developed feelings of love and respect for the natural world . Aldo Leopold restated this idea in the development of his "conservation conscience". Today we talk about "environmental ethics" and the "rights" which all living things share with human beings, and which therefore circumscribe what we as the dominant species may do. How does one add this dimension of "conscience" to the content of concepts of natural history?

It has been said that great ideas properly expressed always lead from the particular to the general and then ultimately to the universal. In nature study and environmental education we almost always deal quite adequately with the first two, but we often fail to reach the third. By so doing, we fail to bring wholeness in our teaching , to integrate facts and feelings , intellect and emotions. We persist in the artificial separation of human knowledge into compartments conveniently labeled "sciences" and "humanities". But, just as the natural world is "all of one piece" and we as individuals are (or should be) integrated persons, so should our educational and learning processes also bring together all knowledge and human understanding into a unified whole.

An effective way to do this is to use a "poetry" nature trail. Good poetry almost always leads from the particular to the general and finally to the universal. Nature poems often refer to some specific natural object or event, then lead to a general observation, and end by shifting our focus to the larger "universal" dimension. Over the past twenty years I've developed poetry nature walks using Robert Frost's poems, the Psalms, and others. Frost's "The Road Not Taken," "Spring Pools" or "The Tuft of Flowers" are excellent examples of poems which may be used effectively to deepen or enhance the meaning of a field trip. Even Frost's short poem "Dust of Snow" illustrates how poetry can add a new dimension to a field experience: *"The way a crow / Shook down on me / The dust of snow / From a hemlock tree"* (the "particular" situation)

"Has given my heart / A change of mood"
(the "general"situation)
"And save some part / Of a day I had rued"
(the "universal" implications of time)

Poetry nature walks work best with mature participants, but youth can also be caught up in the spirit of the experience. A former student of mine used the technique with considerable success in a 4-H camp one summer. He told me that after he used it once, the kids were begging for more poems on subsequent nature trips.

There are a few basic rules which greatly improve the effectiveness of these walks:

1. The group is instructed at the beginning that there is to be absolutely no talking, either with one another or with the leader, while the trip is in progress. They are encouraged to interact with nature, to drink in the poetry and the context, then to move quietly along with the leader. (There should be no smoking or other distractions.)
2. Focus attention on the object to which the poem refers; urge participants not to watch the reader or leader, or other participants. The less inter-personal interaction, the better. It's a nature experience.
3. Let the poetry speak for itself - use a minimum of introductory comment. Avoid "breaking the spell" by digressions along the way, even if some very "teachable" moment comes along. What you are after is the "reachable" moment — that inner voice in each participant which can be heard in the silence and the

introspection which develops as the walk progresses. (At the end of the trip, when you "break the spell" by releasing everyone from the vow of silence, you might want to refer to something unexpected seen along the trail, or to emphasize a point in the poetry. For many, however, a further time to be alone in the natural setting may be an effective way of "sealing" the experience.)

A trip of this type requires preparation. First of all, you must be familiar with the poems you use so that you read them well! Forget about the lines and stanzas, and even the rhyming - make it flow for clarity of meaning. The poems need not be memorized - although that is an effective way to deliver them. I carry a notebook with poems copied on separate pages, arranged in the order of each particular trip.

The trail should be scouted out beforehand, looking for situations which will fit the poetry. With a little planning, you can usually develop a progression in the poetry stops which sustains a theme or mood. If you're alert as the trip unfolds, you might come upon something unplanned or fleeting which fits - if you have a quick index to your poems, you can slip them in when appropriate.

Trips of this type should be about an hour in length. Avoid long gaps between stops. Walk slowly enough so that the stragglers (of which there is always at least one) will be up to the group before you start reading, without a long time of standing around waiting. Always position yourself in such a way that the subject of the poem will not be trampled or out of view behind someone. A little silent "traffic directing" can usually get people arranged for best effect.

Try to involve as many senses as possible - listen as well as look, feel and smell if it fits the situation. Even without talking, participants will often follow your lead in some such sensory activity.

If there is time for follow-up, you might encourage participants to write their own poems. The Japanese poetic form "haiku" lends itself nicely to nature themes.

"God, how great you are,
You made the heavens, the earth
Yet you still love me!"

"Loon, loud and lonely,
From the trees around the bay
He talks with himself."

Of all literary forms, it seems to me that poetry is meant to be read aloud - and to read nature poems in the natural setting really makes them "come to life". Try it - you'll like it!

John A. Gustafson has held several offices in ANSS and is currently Treasurer. He has retired from teaching biology at the State University of New York, College at Cortland.

Robert Frost

HAIKU POETRY: A NATURALIST'S TOOL

Patricia Culver

Poetry has always been a primary vehicle for expression of humankind's interactions with the natural world. Of all the poetic forms in use for this expression, the Japanese have given us perhaps the easiest, free-flowing form in "haiku."

What are the characteristics of "haiku"? First, they are very brief poems. Their "art" lies in the distillation in as few choice words as possible of one's thought or emotion as nature is observed. It is meant to capture a moment, an action, a color, an impression. Secondly, the poems suggest more than they say. A single word or phrase may act as a clue to a season of the year or a whole class of creatures or phenomena. Thirdly, each

poem represents an emotion, such as surprise, humor, joy, anger, sadness, or love.

For example, here is the poem "Chickadees."

CHICKADEES
cheerful ubiquity!

What went into this writing? One day, while spending the few moments I had free before going off to a particularly harrying day at work, I noticed a great crowd of gaily twitting chickadees eagerly flitting around my bird feeder. I made a few notes, which later were worked over until I had the combination of words that best described my moment at the feeder with my chickadee friends. I wanted a brief poem for a tiny bird, enthusiastically positive in tone, and although the word "ubiquity" is sometimes used negatively, I wanted to express my belief that there are never too many chickadees around.

Some other samples:

CAUTION
Twitting chipmunks
fill this stone wall;
heard but not seen, by intent.

COUNTRY DANCE
swaying hayfield

FREEDOM
Purple loosestrife
standing tall and bright
on the Fourth of July

Thus may "haiku" be taught as a means of preserving one's experience of nature, much as the more scientific tools of photography, leaf-pressing, rock-tumbling, and the preparation of microscope slides are used.

It is said that a photograph can say more than one thousand words. A "haiku" can often say more than a several thousand word tract written as a scientific treatise.

More examples:

TECHNOLOGY
In the race between
the turtle and the Rabbit.
the Volkswagen won.

NUKE PLANT
bald-headed mass murderer
with no face
and no voice

Obviously, if humanity, let alone the humanities, is to survive, as many disciplines as possible must be brought into the service of ecological consciousness-raising, including "poetic license." However, the preferred mood of "haiku" will always be one of surprise, joy and wonder, as the developing poet-naturalist of any age comes to deeper perceptions and appreciation of our natural environment.

HAIKU: More Than Meets the Eye

Ruth Yarrow

How do haiku express so much in so few words? I will describe half a dozen key points in writing haiku that have helped me answer this question.

In contrast to much of our western poetry, in which the poet's thoughts and feelings about an experience are spelled out at length, a haiku simply presents the experience.

dirt farmer's wife
at the screen door:
no tractor sound
Randy Brooks[1]

The poet does not describe how the woman is aware, perhaps almost subconsciously, of the tractor sound filtering through the screen and connecting her with her husband, or how fearfully she looks out the same screen after the ominous silence begins. The brief poem hints at all this powerfully and yet leaves us free to experience the moment and react with our own thoughts and feelings.

Haiku captures such moments of awareness so well because it is brief like the moment itself. A majority of haiku now published in English no longer adhere to the traditional 5-7-5 syllable pattern but are shorter. Interestingly, as George Swede[2] notes, this change brings the number of words closer to the average Japanese haiku, and enables the poem to be expressed easily in one breath.

the dragonfly
wings still
in the fossil rock
Kenneth Knight[3]

Haiku is written in the present tense, making the experience immediate.

The waves now fall short
of the stranded jellyfish...
in it shines the sky
Mabelsson Norway[4]

While the past life of the jellyfish and its motion in the waves are contrasted with its present death on the still sand, the haiku focuses on the present.

The experience is almost always described directly, without use of similes or metaphors.

low winter moon:
her cheeks curves the shadow
of the crib bar
Ruth Yarrow[5]

I could have compared the baby's cheek curving the shadow, to her daily antics chasing away the shadows in our lives, especially those that appear to imprison us. I could have made a simile or metaphor about her chubby moon-lit cheek resembling the full moon itself, or about the small, warm and immediate parts of our lives having power over the large, cold and distant. But such additional description is obviously unnecessary in haiku.

The inclusion of some aspect of nature, often a reference to season, lends some echoes of the universe to an apparently mundane event. Being a naturalist, this first attracted me to the form. I soon found that haiku can depict natural events while really expressing human feelings, or can focus on humans while expressing the feeling of our connectedness with the natural world.

Asleep on the bus
Sunlight is carried crosstown
on the old man's face
Fruud Smith[6]

A key aspect of haiku is that it should arise from "a moment keenly perceived."[7] George Swede describes such a moment as a feeling of awe;[8] Eric Amann calls it a touching on life itself.[9] All this sounds intimidating but is really the stuff of everyday life. At the end of the day jot down some moments that catch in your memory - the prick of rain on your arm, the sound of a lawnmower through your nap. With practice on such fragments, you can more easily capture those moments of awareness before they escape, and try expressing them in haiku.

Writing haiku in English has flourished in the last twenty years, with several anthologies, a dozen established haiku magazines and many collections now being published in the U.S. and Canada. Some examples are given in the footnotes; several fine introductory books are listed below. You may find, even as a skilled naturalist, that reading and writing haiku helps you perceive more than first met your eyes.

[1] Randy Brooks, *Barbwire Holds Its Ground*, Battle Ground, Ind. High/Coo Press, 1981.

[2] George Swede, *The Modern English Haiku*, Toronto: Columbine Editions,
1981, p.17.

[3] Cicada: *A Magazine of Haiku Poetry*. Vol. 5 (2): p. 7.

[4] In. Cor van den Heuvel's *The Haiku Anthology*, N.Y.: Amber, 1974.

[5] Ruth Yarrow, *No One Sees the Stems*, Battle Ground, Ind: High/Coo Press 1981

[6] *Modern Haiku*, Vol. XII (1), p. 11.

[7] Haiku Society of America's definition in van den Heuvel's *The Haiku Anthology*, p. 249.

[8] *The Modern English Haiku*, p.24.

[9] *The Wordless Poem*, Toronto: The Haiku Society of Canada, p. 38.

Some books introducing you to haiku in English:

Brooks, Randy, and Shirley Brooks, Eds., *Haiku Review* , High/Coo Press, Route 1, Battle Ground, IN 47920. The comprehensive directory of haiku books, articles and magazines with a review of recent publications.

Drevniok, Betty. *Aware - A Haiku Primer*. Portal Publications, 4431 Aldrich Rd., Bellingham, WA 98225. 1980. An enthusiastic, handlettered book of information and encouragement for the beginning haiku poet.

Henderson,Harold. *Haiku in English*. Charles E. Tuttle, Rutland, VT 05701. 1967. This remains the classic introduction to writing haiku in English starting from an understanding of the Japanese haiku.

Swede, George. The Modern English Haiku, Columbine Editions, Box 277, Station F, Toronto, Ontario M4Y 2L7. 1981. A book of succinct, up-to-date essays on the modern English haiku.

□

Using Snow to Teach Geology

by Charles Roth

Curriculum Areas: Geology, Earth Science, Middle school and up.

Rationale: Water, the only mineral that changes back and forth from solid, liquid and gaseous states at Earth's surface temperatures, provides a wonderful opportunity to observe and study geological processes first hand in any school area where snow and ice form.

Water-The Mineral

A mineral is considered to be made up of elements combined in definite, well ordered fashion and exhibiting a characteristic set of physical properties such as luster, hardness, cleavage and streak. Molecular structure of a mineral is usually expressed in a crystalline form. Water, formed form two parts hydrogen and one part oxygen, and having a six-sided crystal pattern as a solid, fits the description of a mineral. Like mercury it normally occurs in a liquid state due to its low melting point.

Since any large mass of one or more minerals is a rock, the blanket of snow over the landscape or layer of ice on a pond are bonifide rocks. Like all rocks they are formed by one of three major processes - solidification of molten material, sedimentation, or metamorphosis.

Sedimentary Rock At the Bottom of a Sea

To look out a window at the sight of snowflakes settling gently earthward is similar to watching particles of limy animal skeletons drifting by the porthole of a bathysphere resting on the ocean floor. You are more secure in your home, of course, and the sediments, settling through a much less dense medium are moving by faster. In both cases, however, you would be observing the process of sedimentation - one of the primary rock-forming actions. The settling snowflakes would shortly become the sedimentary rock, snow; the limy particles would form limestone.

Look at the surface of new fallen snow. The tiny crystals on top lean against each other in a loosely packed jumble. Slowly they shift and settle. Enough heat is generated to cement the crystals together. Within several hours individual crystals cannot be distinguished. A rock has been formed. Each succeeding snowfall will add a new layer just as each annual cycle of plankton adds another layer of limy sediments to areas of the ocean floor. Whether at the bottom of a sea of water or of air, the formation of sedimentary rock proceeds in the same way.

Metamorphosis A Pressing Situation

Under the increasing pressure from added layers above, heat is generated which will cause changes in the rocks below. This is the process of metamorphism. It brings about the change of limestone to dolomites and marble, and of shale to slate. Particularly under the vast accumulations of arctic regions, snow clearly shows metamorphism also. First it changes to granular rock, névé, and eventually to the much harder ice. In such a fashion glaciers are formed.

In temperate climates the deposition is seldom enough to show these changes clearly in open fields but they can be seen in snowbanks tossed up by snow plowing.

Of course not all metamorphism is due to heat from pressure. Some is due to contact with a layer of molten rock. This can sometimes be seen after a winter rain.

Water Crystals

Igneous or Metamorphic?

The rock, ice, is not always metamorphic in origin. As the molten water (heat is a matter of degree, is it not?) loses heat it solidifies to form ice. The surface of a pond will often show both this igneous form of ice and metamorphic ice formed from the snow blanket which settled upon it. Can you distinguish between the two? Igneous ice tends to be clearer, metamorphic ice is more grainy.

The Cycle

Thus we see that molten water can become rock upon cooling. Sometimes this is a metamorphic ice, sometimes as tiny crystalline sediments which ultimately form the sedimentary rock, snow. Under heat from pressure or other sources this may metamorphose into névé or ice. As the vagaries of weather, or the inevitable progress of this planet through its orbit, add heat, these rocks will be changed to the molten state thus completing the rock cycle.

Of course with water-derived rocks, the cycle shows shortcuts and reverses due to erosion and deposition just as it does with other rocks. The major difference between water-derived rocks and magma or organically-derived rocks is difference in relative heat and relative time.

A great tool for teaching earth science lies near at hand each winter. Let's all make the most of it.

Teacher - Student Activities

1. During the next snowfall catch some snowflakes on a previously chilled microscope slide. With your chilled microscope, hand lens, or reading glass examine them for crystal structure. How many physical characteristics of minerals such as luster and hardness can you determine for snow? Do these characteristics differ in the case of ice?

2. Preserve snowflake patterns by the method described below. It was developed by David Miner of the Massachusetts Audubon Society staff. This is a variation of a process pioneered by Dr. Vincent J. Schaefer.

Secure a piece of clean glass, a holder made of some insulating material such as wood, and a push button spray can of Krylon Crystal Clear plastic spray No. 1301. Cool all materials to below 30 degrees F.

Place the glass with an even coating of Krylon, tilting it so any excess runs to one edge. Expose the treated glass to the falling snow until the desired number of snowflakes has been collected. Place in a cold ventilated place for 15 minutes or until solvent has evaporated.

The plastic spray will replace the snow crystal and will be white in color like the original crystal. It is essentially a replacement fossil. The replicas are delicate and should not be touched or handled roughly. Examine them at your leisure with hand lens or microscope.

3. Maintain an open container in your school yard to act as a snow gauge. This can be a wooden box roughly two feet square by two feet high, or a large plastic straight sided waste basket can be substituted. Measure the amount of snow which falls during each storm. Record this on an appropriate chart.

After several storms have passed, take a shovel and cut through the snow-blanket to the ground. Can you determine each sedimentary layer? Does local air pollution have any effect upon your ability to distinguish between the layers? How does the thickness of each layer compare with your snow gauge record? Can you account for the differences?

The removal of soft snow from beneath the hard crust in exposed areas creates mini-replicas of the wind-sculpted canyons of the Western U.S.

4. To demonstrate that enough heat can be formed under pressure to make a rock melt briefly and change form, make a snowball. Pack it as hard as you can. Notice the ice forming on the outside from the heat added by your hands. Finally cut the snowball in half carefully with a chilled knife blade. If you have exerted enough pressure you should find a layer that is ice or nearly so inside your ball. The comparative wetness of the snow will effect the success of this demonstration.

5. Take a field trip on the school grounds or nearby area to look for evidences of wind erosion. Easterners will find this especially revealing for wind-carved geological formations are seldom seen in that region. The force of the wind driving particles of snow has the same carving action upon massive snow deposits as wind driven sand has upon harder rocks. Look for flat-topped, steep sided mesas and sloping, drifting dunes.

Sand dunes tend to move with the steep slope leading. Is this also true of snow dunes? On windy days sheet erosion on fields is obvious and you may even be caught in a snowblast which is essentially the same as a desert sandstorm.

What other wind erosion features can you find? A natural bridge perhaps?

Slumping, or slope failure, is the downward and outward movement of rock or unconsolidated materials such as gravel due to the pull of gravity. Each peaked roof presents an ideal situation for slumping to occur, as do steep snowbanks. Watch for slumping near your school as warm weather occurs and the snow becomes somewhat more fluid. How long will slumping occur before ending in a complete avalanche? □

Connect the Dots and Pinhole Constellations

John Kominski

Curriculum Area: Upper Elementary and beyond. Astronomy, Language, Arts.

Rationale: For countless ages men and women have looked to the heavens in awe, and have in every age and every culture picked out familiar shapes formed by groups of stars in the sky. Once an individual gains a familiarity with the asterisms and constellations, the beautiful, yet confusing , night sky becomes more organized in the eyes of the sky watcher. Seasonal patterns, the apparent circumpolar movement of the stars, the passage of planets and satellites, and the location of meteor showers, comets and other celestial phenomena become easier to predict and appreciate once we learn the road map of the sky.

Materials

Ideally, skywatchers will find a place to enjoy the night sky, which is far away from the lights and polluted air of big cities and industrial sites. Armed with a trusty field guide to the stars, a star map, almanac, notebook and binoculars you can begin to pick out geometric shapes, the dippers, bright stars and with some imagination, a dragon, scorpion or other popular mythological forms.

Activities

While introducing young people to the constellations in our school district's planetarium, I would often project a transparency of a "connect the dots" picture puzzle onto the planetarium dome. Transparencies can easily be made on most photocopy machines loaded with the appropriate film, or they can be hand drawn with wax markers or special felt tipped pens on blank acetate sheets. Even the youngest students were eager to come up to the overhead projector, take the felt tipped marking pen and connect the numbered dots sequentially to form a rabbit, kite, or some other image.

Next we would view a transparency of un-numbered dots on the dome. The students who volunteered to connect these points were encouraged to use their imagination and form any familiar subject or design that they desire. They could even make up a little story about the picture that they formed on the dome.

By viewing more than one dome picture at a time, the stories become more involved as the children colorfully describe the interactions of the planetarium pictures.

The transition from puzzle pictures to the classic constellations of the night sky became so much easier for these skywatchers. It was simple to dim the lights, project the stars and with a pointer to "connect the dots" to form stars in a crown (Corona Borealis), or a backwards question mark (the familiar asterism in Leo the Lion), or the arms, legs and belt of Orion the Hunter. When the planetarium projector overlayed the traditional constellation line drawings on top of the stars already on the dome, a collective "WOW!", was heard in the darkened room. Sure enough, there was the formidable Orion, The V-shaped faced Taurus the Bull, the dippers and lots more.

Oatmeal boxes and tin cans become the students' own constellation projectors. Tracing paper was used to copy a drawing of a constellation that would fit onto the bottom of the can or cylindrically shaped box. The tracing was next flipped over with its obverse side facing the bottom of the container and taped into place. Holes were punched through the tracing and the container with thin nails and a hammer. Thicker nails made bigger holes, which would eventually be brighter stars. When the star pattern was punched into the bottom of the container a flashlight was placed inside and its light would shine through the holes and create a constellation on the wall. Or a student could simply hold the can up with its bottom facing a sunny window or light, look inside the can and see the constellation it contained. Unlabeled cans provided the students with a challenging identification activity.

Pinhole constellations can also be made from old photographic slides, which all too often come back from the photo lab terribly underexposed or completely unexposed. In either case you find yourself holding a 2" x 2" cardboard mount containing a black slide. I used to save these black slides to use as spacers in my

slide show. This would keep the screen from being bathed in harsh white light when the projector ran out of pictures to project. On one occasion, however, I experimented by puncturing the black slide with a straight pin several times and was able to project a cluster of simulated stars onto my screen.

Now I suggest to teachers at workshops to save their black slides or make their own by inserting a square plastic or aluminum foil into a cardboard slide mount. There are several kinds of slide mounts available at photo supply stores. Some are folded around the slide and carefully sealed with a hot iron, while others come in the 2" x 2" finished size with a slot built into the cardboard mount. You simply slip the photo transparency, plastic film or foil into the slot and you are ready to go.

Tracing paper may be used to accurately locate pinholes (stars) on the black slide as in the tin can constellation project. Use sharp smooth needles or pins to make neat holes in plastic or foil. A hole with ragged edge will look like a messy star when projected on the screen. Remember, thick needles make bright stars and thinner needles make fainter stars. Therefore, assemble a variety of needles with different diameters. Embroidery needles are very thin and carpet needles are quite thick. You may find that push pins and dissecting needles will provide you with a convenient tool handle when making pinhole constellations.

These pinhole star slides look surprisingly realistic when shown on a screen. By proportionately reducing the size of the constellations you can place two or more star pictures on one slide to indicate the relationship of these patterns in the actual night sky. You may also want to "connect the dots" by drawing lines between the appropriate pinhole stars. This is easily accomplished by carefully scratching a line between the holes on the emulsion side of the black slide. With a little practice you will be able to determine how much pressure should be used to scribe a line of suitable brightness on the pinhole constellation slide. A bit of transparent colored plastic carefully cemented over a pinhole star can give the star a new hue. Try this method to make the star Aldebaran - the red eye of Taurus the Bull.

I have also had fun creating simulated nebulae, lunar phases and eclipses on black slides. For example, by making dozens and dozens of tiny holes on the emulsion side of the slide in the typical spiral nebula pattern or in an ellipse, a reasonable facsimile of these impressive astronomical features is gradually developed. Or try punching a neat hole in your black slide with a common paper punch . The result is a quarter inch hole that projects as a "sun" or a "full moon" on the screen. If you save the little disc of the black plastic that was punched out, it can be carefully cemented over part of the newly punched hole. This results in a simulation of the moon eclipsing the face of the sun or of the earth's shadow eclipsing the face of the full moon. By using this punch-out and cement-over method you can create simulated phases of the moon including the gibbous and crescent phases. To make a last or first quarter simply cement a small straight edge piece of black slide plastic over half of one of your "full moon" punched out slides.

□

Nature Study With the Microscope

Dwight E. Sollberger

Curriculum Area: Middle school and up

Rationale: Students in middle schools, high schools, and colleges throughout the country universally use microscopes to get a more complete picture of the fine structure of the cells of plants and animals. Microscopes and biology have become so intertwined that the mention of one automatically calls the other to mind.

The fine structure of cells and tissues is important, and students need to know something about it. We would also agree that a microscope in the hands of each student does not guarantee an understanding of the fine structure of cells and tissues.

Background Information

Microscopes have been made easier to use, but the material is still difficult to understand. There are several reasons for this. The following may not be all the problems, but they are certainly problems to many teachers:

1. The microscope enlarges images so greatly that it is difficult to see any relationship between the original material and what is seen even under the low power of the microscope.

2. The fact that thin sections have to be made requires the student to construct a three dimensional structure in his mind from the section. This is no easy matter.

3. Unless there is special equipment available, the student and the instructor cannot be sure they are looking at the same thing. Usually there are so many things visible that the student is hard put to know just what is the right thing to examine.

Using the face of a clock with 12 at the upper point of the circle and 6 next to the student makes giving instructions infinitely more precise. Students should be taught not only to locate specific details with this technique but to use it in helping others; and microscope instruction is certainly a place for student to help student.

4. Staining techniques, while most useful in bringing out certain structures otherwise invisible, confuse the student since they bear little resemblance to any living creatures.

5. Comparing drawings in books with what is seen poses certain problems also. The drawings may be a composite picture of many slides. The student may have but one slide on which he can see only a few of the structures in the composite picture in the laboratory manual or textbook.

As if the above hurdles were not enough, many teachers have been indoctrinated with the idea that students must study the slide by themselves and learn to "read" without help. In the ordinary laboratory period with many slides to examine, I suspect that many students spend all their time hunting and never do find very much.

The answers to these criticisms are not too difficult to find by a teacher who wants to help students learn to understand something of the fine structure of plants and animals. I have found the following useful. I am sure others have additional helpful devices.

Activities

Students can often make their own slides from the original material. By seeing the gross material and cutting their own sections with a razor blade, they can learn what cross sections and longitudinal sections are. The slides they make take them from the known material to the enlargement in a much more meaningful way than to present them with a slide already prepared. Some slides that can be made and that compare favorably with purchased slides are the following:

Monocotyledon Stems (Corn)

Place the ends of mature corn stems in red food coloring for ten minutes or more. Take them out of the dye and wash off the excess color. Notice the small more deeply stained dots scattered throughout the pith. These are the ends of fibrovascular bundles. Using a block of wood so as not to mar the table, make a number of slices across the pith as thinly as possible and examine these with the low power of the compound microscope, and then with the high power. You will be able to see 6-sided parenchyma cells, xylem cells, sieve tubes and companion cells.

Cut the pith of the stained corn stem lengthwise. Notice how far the red food coloring has moved up the stem. Make longitudinal sections as thinly as possible with the razor blade and examine these as before. By repeated effort, you will see lengthwise views of the same cells whose cut ends you saw in the cross sections previously made.

Dicotyledon Stems (Basswood)

Place a number of one- or two-year old stems of basswood in water containing red food coloring for several hours or over night. Wash the food coloring off and make a number of cross sections across the stem. Examine these as you did before with the low power of the microscope and then with the high power. Some will be cut more or less diagonally and the very thin portions will show some structures better than others.

You should be able to see pith, xylem, wood rays, cambium, phloem, cork cambium and bark.

Fern Spores

Marginal Shield Fern, Spinulose Wood Fern, Christmas Fern, and others are evergreen and sporangia are available throughout the year. Spores may be found still clinging to the sporangia. Crush these sporangia between two microscope slides and place some of the crushed material on a slide in a drop of water, and you can easily find spores. Incidentally, these can be grown into prothallia. (See Ferns, p. 27)

Stomata

With forceps pull off strips of the lower epidermis of a geranium leaf. Place these in a drop of water, and the stomata visible will compare favorably with prepared slides purchased from biological supply houses.

Lichens

Crush and macerate a small piece of a foliose lichen between two microscope slides. Mount the material on a slide in a drop of water. Hyphae of the fungi and unicellular algae can be seen quite clearly.

Cell Study

Red onions have red or pink cytoplasm. The usual plasmolysis demonstration is enhanced since the space between the pink cytoplasm and the cell wall is clear as compared with the cytoplasm.

For other ideas

Beeler, Nelson and Franklin Branley, Experiments With a Microscope 153 pp. of information and ideas. Junior High and up.

Selsam, Millicent, Greg's MICROSCOPE, A Science I Can Read book for primary grades.

Headstrom, Richard, Adventures With a Microscope, 59 "adventures" with clear instructions, reprinted by Dover Press. □

Fresh Water Life

Carol Susan Kestler

Curriculum Area: Science- Elementary through college.

Rationale: Any little pond or stream in your neighborhood can begin your fascinating adventure. One class armed merely with kitchen strainers is a formidable army for surveying stream life. Books listed at the close of this article will help you get started in identification and in the study of relationships. Although identification to species becomes important for advance work, group names are quite sufficient to open vast ecological horizons.

Background Information

Wherever riffling streams tumble over rocky bottoms, wherever clear water sweeps over jagged falls, mayfly nymphs cling to jostled rocks —and live.

Wherever slow streams and quiet pools nurture rooted plants, wherever fresh-water flows lazily toward its mouth, dragonfly naiads silently stalk unwary prey.

Wherever similar aquatic environments exist over our country, similar animals and plants, adapted to cope with these environments, exist also.

Life in Fast Streams

Fast stream animals must fight constantly for their positions in life. They must either cling tightly to rocks, offering virtually no resistance to the powerful currents, or find more sheltered "underneath" places to hide. The water penny is so much flattened that as it clings to the undersides of rocks it looks more like a copper-colored stain than a beetle larva.

Stonefly nymphs are also flattened , and have a pair of strong claws on each leg with which to cling to rocky undersurfaces. When disturbed, they immediately scatter into the water, clambering for new places to hide.

Mayfly nymphs resemble stoneflies. Most find precarious roosts on top of alga-covered rocks, and use their rake-like jaws to scrape a livelihood from the stones that shelter them.

Powerful currents make hunting trips precarious for fast stream animals. Most creatures depend upon the current to bring food to them. Hydropsyche, a caddis fly larva, spins a net on a rock; facing upstream, it strains plankton from the current. Macronemum, another caddis "worm", builds an ingenious rock trap. Most others of these larvae fasten tubehouses to the bottom, awaiting unwary creatures who pass within reach of their powerful jaws. They are so thoroughly adapted to fast water that they are unable to build their houses in slow currents, even if all their other needs are provided for.

Tiny, black, wormlike blackfly larvae hold themselves fast with a caudal sucker, as they reach out to strain the water with fanlike brushes on their

heads. Should they become detached, (a constant danger to all these animals), they will grab some nearby surface with a second sucker located near the mouth. When they travel, these larvae anchor themselves by a silken thread, assuring a path back home.

Although most fast stream inhabitants are immature insects, some snails, flatworms, and leeches also dwell here. A few minnows and darters scuttle between the rocks, and one family of salamanders stalks the bottom. These Plethodontidae breathe through their skin, having neither gills or lungs as adults. Their presence is testimony to the fact that riffly water is well oxygenated.

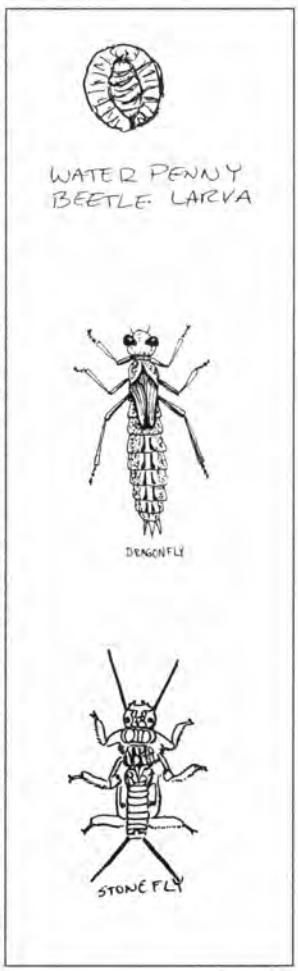
Rooted plants cannot survive in fast water, but diatoms and other algae are plentiful. These are at the base of all the food chains, supporting the zooplankton as well as most mayflies, stoneflies, and others.

Some food comes into the slow stream from other environments — washed down from banks, or from pools and tributaries where life is slower , and rooted plants can grow.

Life in Ponds and Slow Streams

Let's look at the slow stream, where rooted plants as well as algae are such an important part of the habitat. They provide not only food and shelter, but oxygen as well. Here photosynthesis must do the job that riffling currents do in the fast stream.

Hunters thrive in slow waters. They can stalk their prey and strike with scissor-like jaws, like the dragonfly naiad or diving beetle. They can strike and suck their prey like the upside-down back swimmer. They can strike and snap like the snapping turtle.

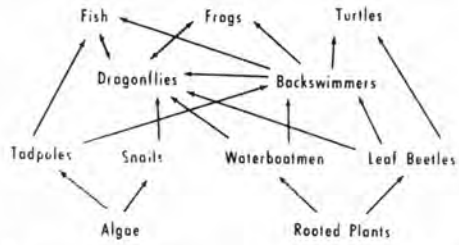


With no jostling currents to disturb them here, many animals take advantage of the high surface tension of water. Mosquito larvae hang with only the openings of their anal air tubes above the surface. Hydrae dangle upside down from the film. Snails and flatworms glide along its undersurface while water striders walk on top.

Every micro-environment is exploited in the slow stream. Stems are covered with snails and plant-eating worms, leaves are floating hatcheries for minute snail and insect eggs. Among the plantains, cattails, and arrowheads closest to shore, algae, and the tiny crustaceans which eat them, thrive.

In deeper water, where lily pads merge with Elodea and eel grass, sponges encircle stems, red water mites live under leaves, and tube-dwelling caddis "worms" cling to leaves and stems.

A scoop of bottom mud reveals hundreds of worms — the red Tubifex and the pale Nais among them. These scavengers on decaying organic matter are well adapted to a low oxygen supply.



A Generalized Food Web. The arrows connect things that eat with those that get eaten.

Floating logs are ferry boats for frogs and turtles, and many fish and salamanders are among the hunters and hunted in the underwater jungle.

The struggle to stay alive in the slow stream is with one's neighbors, instead of the current. Every animal is fit food for another, and the unwary are short lived. The process that fitted the mayfly with its claws and the dragonfly with its lightning jaws, fitted these animals for the rapid, hectic, specialized life in fresh water, fast and slow.

Materials

Kitchen strainer dip nets can be improved by tieing them to handles of various lengths. They may be lined with cheesecloth to produce a finer mesh.

White enamel trays prove very useful for examining specimens in the field, and for sorting bottom sediments. Hand lenses, forceps, eyedroppers, labels, sharpened pencils, old tennis shoes for wading on rocky bottoms, and jars and vials for transporting specimens.

Activities

The Food Supply

In addition to finding out about the adaptations and specializations of individual animals that you encounter, your group might begin to explore the energy relationships which underlie nature's balance. A count of the organisms at each nutrition level in your stream can be organized into a pyramid of numbers, graphic demonstrations of how food chains work (see illustration). Any basic ecology text would indicate other types of energy pyramids. A more detailed quantitative picture of "Who eats what" is the food web. (See Illustration).

Field notes

As your students work in the field, it is essential

that they take notes. These should briefly record the environment, the weather, and the techniques used as well as "finds". Each specimen should be listed by number in the notes, with a brief account of exactly where it was found and what it was doing. For example: #14 — Stonefly — Under rock, in fast current, midstream. Holding on — tried to escape when rock turned. #29 — Dragonfly — clinging to plant stem just below surface. Feeding on tadpole.

Collections

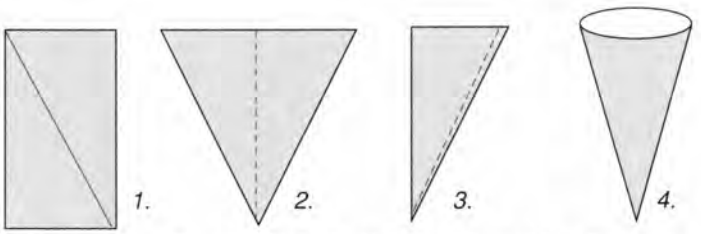
Specimens which cannot be identified in the field may be brought back either live or preserved. Living invertebrates and fish can be transported in jars of water, along with plants on which they were found.

You might set up a natural aquarium to study some animals more fully at close range.

Invertebrates and plants can be preserved in the field in vials of 70% alcohol; rubbing alcohol will do.

Plankton Study

One very interesting activity is the collection and study of plankton. A plankton net concentrates the organisms for study. To make your net, obtain a piece of woven nylon or silk bolting cloth 15 inches by 1 yard. Cut this diagonally, and sew the pieces together, forming an acute triangle. Join the outer sides to form a cone. The apex of the cone is cut, and a lipped vial secured in this opening with a rubber band. Sew the top of your net to a metal ring, 9 inches in diameter. Secure to this three pieces of strong twine, placed equidistantly around the ring, and anchor the loose ends together.

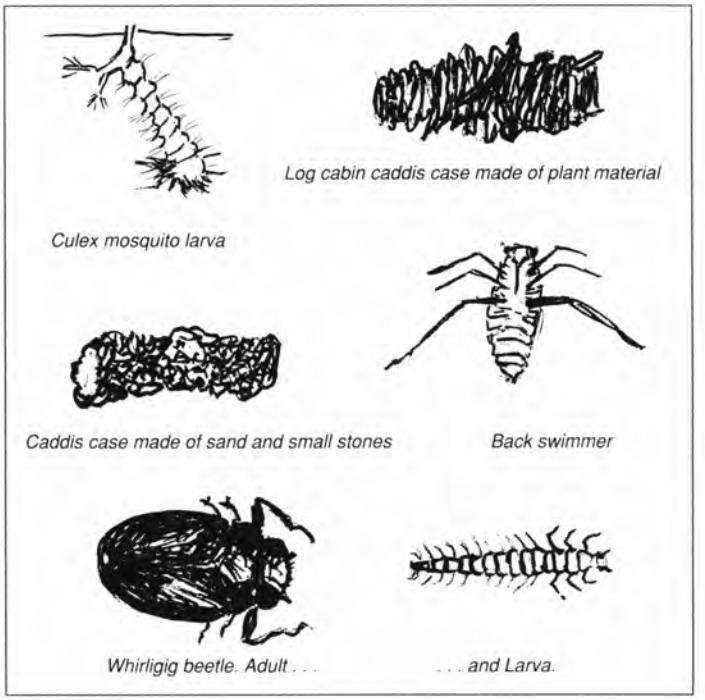


Making Your Plankton Net. 1. Cut piece 1 yard by 15 inches on the diagonal. 2. Sew pieces together forming triangle (dotted line indicates seam). 3. Sew outer edges together; cut off point so vial can be inserted. 4. Net attached to wire with vial in place; now attach chains to rim for handle.

Your net may be dragged through the water, attached to a line, for a plankton survey; or a measured amount of water may be poured through it for a plankton count, and relative numbers of organisms determined.

Since the fast stream contains so many immature insects, one fascinating activity involves raising these to adulthood. Faster forms are very difficult to keep in aquarium, so Dr. James G. Needham devised a way to raise them as captives in their own streams. The first reference describes this method.

You are now launched on a study both exciting and interesting. Ingenuity and experience will suggest many new experiments and techniques as well as many ways of applying your new found knowledge to your studies of adaption and life processes.



Books To Help You

Two out-standing books for children are: Aquatic Insects and How They Live by Robert McClung provides excellent information on kinds of insects, collecting techniques, metamorphosis and activities that children can read and follow.

In a Running Brook by Winifred and Cecil Lubbell is a beautifully illustrated book that introduces young people to the beauty and excitement of residents of streams.

A Child's Guide to the Ecology of Ponds by Kathleen Schmidt, Bard College, Annandale-On-Hudson, NY 1989. Primary grades - 16 pages of drawings, questions, seat work, vocabulary on plants, invertebrates and vertebrates - Good for pre-trip or follow up. □

Researching Energy and Water Use at Home

Verne Rockcastle

Curriculum Area: 7-12 Science/Math
Rationale: Only with first hand experiences do we really understand!

Background

Measuring your shower-power (wise or wasteful?)

You may hear it said that a shower takes less water than a bath. But have you ever actually measured to see for yourself? And have you measured to see how much energy is consumed in a shower? Try it! You may be surprised. It may change your morning routine!

It would be enlightening if each time energy was supplied to the hot-water heater, a sound was made, and the sound was made louder as more energy was supplied. What would your days and nights be like if this were the case? Would they be whisper-quiet, or thunder loud? What is your contribution to the energy picture because you take a shower?* Let's find out...

Activities

First, calibrate a mop pail as follows. Fasten a strip of adhesive tape vertically on the inside of the pail. Set the pail on a level surface and pour into it exactly one gallon of cold water. Mark on the tape where the water level comes. Use a marker whose mark won't wash off with water. Add a second gallon, and mark, and a third gallon ... and so on until the pail is full. Now you know how much the pail holds.

Next, put a strip of adhesive tape vertically on the inside of the tub, near the drain. Stopper the drain. Then, using the calibrated pail, add water to the tub, a gallon or two at a time, each time marking where the water level comes in the tub. As before, use a water-proof marker. In this way, calibrate the tub to at least 12 or 15 gallons. Also take the temperature of the coldest water you use in calibrating the tub. That is about the temperature of the water coming into the house or apartment from the water pipes outside. It probably will be about 50°F. (10°C.) *Temperature of coldest water :* _____.

When you take a shower, stopper the tub so that all the shower water is collected. Also, take the temperature of the shower water as it comes out of the shower head. (Taking the temperature of the water in the tub will not be accurate; too much energy is lost in evaporation, in warming the tub, the air, the walls, etc.) When you have finished your shower, look at the calibration marks on the tape and see how much water you have used. Record both the amount, and the temperature that you measured at the shower head. *Number of gallons* :_____. *Temperature at shower head :*_____. Then make the following computations:

Multiply the gallons of water by 8 to find pounds of water :_____lbs.

Multiply the pounds of water by the change in temperature (Fahrenheit) between the coldest water used in calibrating the tub, and the temperature of the shower water at the shower head, to find Btu's (British thermal units): _____Btu's

Multiply the Btu's by 0.0003 to change to Kilowatt-hours of energy used: _____Kw-hrs.

Assuming that energy costs about $0.10 per kilowatt-hour, how much did your shower cost? $_____ .

To compare this much energy with something that is more personally tangible, try this...

Find your weight in pounds: _____lbs.

Divide 778 (foot-pounds per Btu) by your weight to find out how far, vertically, in feet, you would have to move to use energy equivalent to one Btu.:_____ft.

From the Btu's used in your shower, how far up would you have to move to equal this expenditure of energy?:_____ft.

* In response to drought conditions in California, billboards on city buses in Los Angeles show a man taking a shower with the caption "Sing shorter songs!".

Native American Uses of Some Trees of the Eastern Woodlands

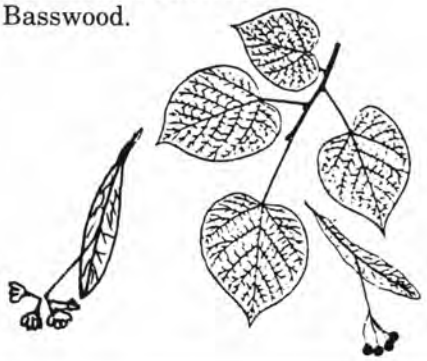
Helen Ross Russell

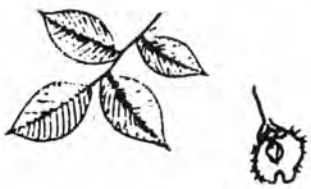
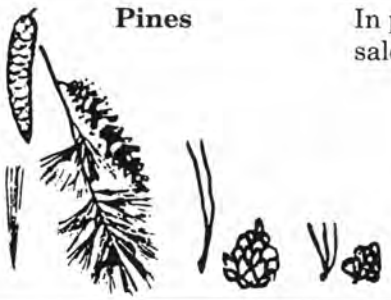
Curriculum Areas: Science, Native Americans, Art

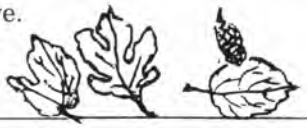
Rationale: Tree study is enhanced as we learn about their individual properties; at the same time experiences which recognize the Native Americans knowledge of, and sensitivity to, the environment help create a better understanding of their skills and life style.

Even though the Native Americans who lived in Eastern United States when European explorers and settlers arrived had garden plots and grew corn, beans, squash, pumpkins, and tobacco, their culture and life style was shaped by their woodland environment. They understood forest interrelationships and sometimes practiced forest management when they kept areas open for wild strawberries or cut or burned out young trees which were overshadowing blueberries. While their crops provided them with more than half of their food, hunting, fishing, and gathering were important sources not only of food but of medicines, clothing, utensils, tools, and other accouterments of everyday life. Children learned to recognize plants early as they foraged with their mothers. They also learned about plant uses, habits, and seasons. When boys were well enough coordinated to draw a bow, they started to travel with their fathers but girls continued to learn about the many plants that they would need to know when they had their own household. Both boys and girls learned to recognize trees and to appreciate their many special qualities.

While many trees that are planted today came from Europe and Asia, there are still many native trees growing in the area. The chart that follows provides information on some of these trees.

Tree	Location	Some Native American Uses	Suggested Activities
Basswood Most basswood planted in cities is European but except for its smaller leaves and size it is much the same as American Basswood. 	Along streets, in parks, and yards.	Inner bark was used for making twine for tying bundles, weaving mats, fastening framework of wigwams, making fishing lines and nets, etc. Flowers were gathered and dried for medicine, beverage, and flavoring food. Iroquois carved masks on the living tree so the tree's spirit would be transferred to the mask. When complete they cut it free, hollowed it out and used it in ceremonies.	Basswood sends up sprouts at the base of the trunk. Get permission to cut them off. Make cord by rolling or twisting thin strips of bark. Use it to make a mat or sew a pouch. Gather flowers. Dry them. Make a pot of tea.
Sugar Maple, Red Maple, Silver Maple 	Sugar and Red Maple are relatively rare in cities but Silver Maple is common (as is the European Norway Maple.)	Maple syrup. Burls were cut off the tree and used for making bowls.	If you have a maple in late winter on your property, break a small branch. When the sap is flowing, attach a clean bottle and collect sap. How does it taste? Native Americans cooked in sap. To make syrup the sap must be boiled until only 1/40 of the sap remains.

Tree	Location	Some Native American Uses	Suggested Activities
Willow 	Along waterways, in parks, in yards, and along roads.	The pliant branches were used for baskets, mats, and framing wigwams. Medicine was made from roots.	Much willow grows on private property. Get some cuttings and use them for basket making, or the frame of a miniature wigwam.
Honey Locust 	Common along city streets and in parks.	The sweet tissue between the green beans was eaten as a nibble. It was also scraped out and fried for flavoring in cooking. The big thorns (not always there on today's trees) were used as fasteners.	In September, be a Native Amercan child and use dried beans as a rattle. Beat out a rhythm.
Elm 	American Elm is almost extinct in our cities, but some Slippery Elm can be found in parks as well as European and Chinese ones.	Bark was removed and used for wigwams, mats, baskets. Elm seeds were eaten, either as a nibble taken out of leafy wings, or entire "flying saucers" were put in stew pots for an early spring green.	In April - May: 1-Try the tiny seed as a nibble. 2-Gather seeds and plant them. 3-Watch for birds congregating in elms to enjoy this fresh food.
Pines 	In parks and yards; for sale in December.	Young needles were used to make a tea rich in Vitamin C. It was "medicine to cure scurvy", seeds and male catkins were used in the stew pot and pitch was used for sealing joints of bark containers.	Learn to identify pines, all of which have their needles in bundles: White, 5 in a bundle; Red, 3-4 inches long, 2 in a bundle; Pitch, short needles, 3 in a bundle.
Sweet Gum 	Parks, yards	Sap was used for chewing gum and for medicines. Dried and powdered it made a sweetening.	Try to find some of the sticky sap. Gather the round fruits and use them in crafts.
Tulip Tree 	In parks and yards. Inwood Park in NYC, has many giant tulip trees. It has a marker showing the circumference of a giant tulip tree that died in the 20th century and was a sapling when the Dutch purchased Manhattan Island at that site.	The giant trunks were cut down, hollowed out with fire and scraping, shaped into beautiful canoes. There were no White Birch trees south of Connecticut and no Tulip Trees in New England so canoes were entirely different. Frequently the whole village, men, women, and children, worked on making a big dug-out canoe.	Find a Tulip Tree and become acquainted with this beautiful giant.

Sassafras 	Parks, Wild places	Beverages and medicine were made from roots and bark. Leaves were chewed.	Make leaf prints of four different shaped leaves. Sassafras root or bark may be purchased at natural food stores. It no longer is sold in drug stores since it is listed as a carcinogenic plant. So is coffee if you drink more than 5 cups a day. The mice that developed tumors were on a pure sassafras diet. Moderation is a basic rule for all good nutrition.
Mulberry Red Mulberry is native. (The berries are dark purple) 	In parks, in yards, along streets.	Eaten fresh. Dried for use in the stew pot.	Sample some mulberries (there is no fruit like it growing on trees). Do a survey of the birds who visit a Mulberry tree.
Hawthorn **or** **Thorn Apple** Many species are planted as bushes, others are small trees.	In fence rows, in parks, along parkways, and streets and in yards. 	Thorns were used as pins. Some fruits were eaten raw or added to the stew pot. None of the Hawthorn fruits are poisonous but some are tasteless.	Examine a tree and decide where the name Thorn Apple comes from. Carefully feel a thorn. How would you rate it as a pin? What would you fasten with it?
Sumac All red-berried Sumacs are edible. The white-berried Poison Sumac grows in swamps. 	In parks, along highways, on abandoned lots.	The red berries were used to make a beverage.	Collect some sumac "bobs" (clusters of berries). Pull the berries off. Cover with cold water. Crush. Strain. Add more water and drink. This will taste like lemon - weak brew is refreshing. Strong brews need sweetening.
Oaks **White Group**: rounded lobes; acorns mature in one year. **Red group**: leaves have pointed lobes, acorns take two years to mature, are very bitter. 	Along streets, in parks, in yards, and in woods.	Acorns were leached for food. Burls were cut and burned off trees and made into bowls.	How many kinds of Oaks can you find? Collect white oak acorns and roast them at 250° F. They are edible when they are no longer bitter. Red oak acorns must be leached. Local Native Americans did this by putting shelled nuts in a fiber bag in a stream or marsh. You can do this by putting them in an onion bag in a flush tank for several weeks.

What other native trees grow in your area? What characteristics do they have that would have been useful to the Native Americans?

Squirrels - A Teaching Resource in Your Schoolyard

David E. LaHart

Curriculum Area: Science, Middle school and up

Rationale: Excellent teaching aids are available in your back yard or school grounds. These high quality, natural tools enable students to learn more and faster than in classroom demonstrations. Several common animals make excellent candidates for teaching ecological principles outdoors, but I think squirrels are exceptionally well qualified for this purpose. All you need to become a student of squirrel behavior and ecology is the desire to learn and the time and patience to observe.

Background

Squirrels are diurnal (daytime) rodents that enjoy a wide distribution and many species have become uniquely adapted to both urban and rural areas. Squirrel populations can usually be found a short distance from any teaching situation. Semi-domasticated varieties, like those found in city parks, are often easier to observe than their wild cousins in a country wood lot.

Equipment

The equipment used is simple. A good field notebook and a pen (preferably with waterproof ink) and a careful observer is all that is really needed. A pair of binoculars is helpful. Many types of arrangements are possible for studying individuals, populations, behavior, and other aspects of squirrel ecology, but each will vary with the individual teaching situation. Certain general methods are adaptable to any area with a little imagination. These are some of the methods I have found acceptable.

Activities and Observations

Populations

One of the basic considerations of any field ecologist is the number of animals present. This problem has many facets and intricacies connected with it (including some rather involved mathematics), but for small areas, the spot-map method is quite effective.

1. Squirrels are easily seen and heard in their home ranges. A census taker can simply walk on a given route on different occasions and at different hours and record on a map the location of individuals seen. It doesn't take may trips before one can notice the clumping of observations on the map. These may be considered as separate individuals.

The Squirrel Society

As soon as a squirrel leaves its nest, it enters a society as complex and unusual as our own. Squirrels learn a language consisting of a variety of calls, each conveying a specific message. You will soon be able to distinguish these calls and be able to anticipate squirrel reactions. One evening I was watching a red squirrel feeding on tamarack seeds when another squirrel gave the call of fright or warning. It was too late. A red-tailed hawk scooped up the feeding squirrel before he could retreat from his exposed position.

A young squirrel will soon make acquaintance with other arboreal creatures near his home. Many people think that where two similar species occur in one community there is competition between the species. Ecologists call this interspecific competition.

2. Where two species of squirrel occur together, such as the fox and grey squirrel, interspecific competition and the niche principal can be easily demonstrated. By careful definition, the niche is the individual, but for practical purposes, we can say that it is the animal's "occupation" or place in the community. Different species have different niches or there would be direct interspecific competition. If two species of squirrel occur in one community, you can examine their role in several ways.

Look carefully at the times they feed. Squirrels feed in early morning and toward evening. A close look at these habits often shows that where more than one species occurs, the time periods may be sub-divided with one species feeding earlier and ending sooner than the other.

Differences in food preferences are often noticed. Grey squirrels prefer tulip poplar seeds to pine cones, but a red squirrel will take the pine cone every time. When both species compete for the same resource, they may divide it by using different parts or feeding in different areas. This spatial distribution occurs in my neighborhood with red and grey squirrels. The reds are more often found on the farthest branches of trees eating spring buds, while the seemingly more cautious greys tend to remain closer to the trunk. When watching squirrels, divide the branches into four quarters and record in what quarter each species of squirrel is found. Perhaps you can find a similar distribution pattern.

Behavior

3. Studies have shown that interspecific competition

is not as serious as intraspecific competition or competition among members of the same species. Intraspecific competition in animals that are not highly territorial leads to the formation of social orders or hierarchy. Young squirrels will soon learn that the older squirrels take the higher places, forming a "peck order", in which males are more dominant than females.

The hierarchical type of society can be studied by marking individuals with colored tags or dyes, but if you look at each animal closely enough, you may soon be able to recognize individuals. By placing food at feeding stations, you can observe which squirrels have the right to feed first or which ones leave the feeder when others arrive. The "boss" squirrel in my neighborhood was an old, one-eyed male. Last winter he disappeared and now the boss of my squirrel feeder is a brown-headed, grey squirrel that was number two in the peck order last year. The top individual in the peck order usually has more freedom to roam over the feeding area and he will do most of the mating.

Eastern Gray Squirrel (Sciurus carolinensis) in a typical pose, holding a nut in his forepaws. The large tail is an excellent stabilizer as these agile mammals leap from limb to limb or run along telephone wires.

Squirrels soon learn their place in the hierarchy. The social order is strict, thus minimizing aggression and disruption to the everyday life of squirrels.

Social behavior is just one of the many things squirrels are willing to show the nature observer and recorder. Ethologists have noticed several other types of behavior that can be easily observed.

Agonistic Behavior involves the motivations of attack and escape. Ritualized displays of threat are often seen in sciurids. The animals usually try to make themselves appear as large as possible and fold their tails over their backs. Such threats usually force one animal to flee without actual physical contact.

Appeasement is also common in squirrels. Usually appeasement behavior consists of withdrawal or avoidance movements. The ears are laid back, with the head pulled in and the tail depressed. The function of this display is to avoid physical contact with a higher individual.

Reproductive Behavior can be observed twice a year in most parts of the country. This behavior consists of many parts, most of which can be easily observed and identified in squirrels. Coordination of sexual development is a physiological reaction which results in certain types of behavior. The dominant males become more tolerant of females and less tolerant of other males. Squirrel observers often see restatements of positions in the hierarchy during the reproductive period.

The sexually mature animal must be fully capable of recognizing the species, sex, and status of sexual development of a potential partner. This results in displays and ritualized courtships. Mating chases can be observed throughout the breeding season. Studies indicate that squirrels are promiscuous, thus males continue chasing females even though they have already mated. Unmated females are often chased by several males, although evidence shows that most of the mating is done by the dominant male.

Ecology

Ecology is the study of relationships. Plants influence the abundance and distribution of animals, but animals also influence plants and often other animals. Spring and early summer finds squirrels

high in red maples, oaks, hickories, and other trees eagerly consuming tender buds. The "horns" on the sumac in my yard weren't even ripe before squirrels had stripped them of their fruits. Unlike the birds, who just digest the fleshy parts and leave the seeds to germinate, squirrels digest the whole fruit, seed and all, thus influencing the next generation of trees.

Squirrels play an important part in the reproduction of trees. Nuts are a well known squirrel food and every squirrel watcher has seen them bury acorns and other seeds in the forest litter. This behavior, known as "caching", has great influence on the plant composition of the area. During the fall, squirrels bury thousands of nuts and during the lean months of the year, they retrieve their caches. Many nuts are not found and those often germinate. John Burroughs suggested that almost every hickory tree in America has been planted by a squirrel.

To see the efficiency of squirrels as planters, drive a numbered stake into the ground wherever you see a squirrel bury a nut in fall. In the spring see how many are still there. Are any sprouting?

Trophic level refers to a position in the food web. Squirrels are on a low trophic level because they are primarily herbivores. They eat plant material that converts the sun's energy into food. Squirrels are food for a variety of animals on higher trophic levels. They also form part of the food for parasites such as warbles and mites, thus adding more links to the web of the community.

The more links in a community's web, the more stable the community. If more than one squirrel community is available, study them both and determine which one is more complex. Measure the densities of these communities several times a year for a few years. It is surprising the fluctuations that occur in a park community when compared to a more natural situation.

Common animals can be used to study basic ecological principles without a great deal of equipment or field trips to distant regions. Existing animal communities can be used to study many aspects of ecology and behavior. This can be done by individuals and classes. Teachers only need imagination and a willingness to try something new to open frontiers in outdoor education to their students.

Some Helpful References

Tree Squirrels - Colleen S. Bare - gr. 8-12 -Putnam 1983

Squirrel Habits and Habitat - Jana McConoughey - gr. 5-6 - illus. 48pp - Macmillan 1983

Squirrels - Brian Wildsmith - illus. 32pp-paper - Oxford Press 1987

Squirrels and Other Fur Bearers - John Burroughs - Reprint of 1900 pb 1989

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Studying Evergreen

Dorothy K. Platt

Curriculum Area: Elementary science - Secondary Biology

Rationale: To many people all conifers are Christmas trees or at best pines. Visiting tree sales outlets in cities and villages affords an opportunity to learn differences in appearance and in uses.

The twentieth century American Christmas tree is the culmination of several hundred years of development and synthesis and modification of numerous customs and traditions from many parts of the world. The origin of the unique custom of using an evergreen tree as a symbol of the Christmas spirit is unknown. The many accounts and legends of its use indicate that the present custom may have grown out of some of the rituals and ceremonies followed by pagans celebrating the winter solstice or observing the feast of Saturn coupled with the experiences of early Christian priests and missionaries.

Perhaps the first true Christian Christmas tree was the Glastonbury Thorn (a Crataegus species). Joseph of Aramathea is supposed to have established a mission in Glastonbury, England, about 41 years after the death of Christ. As a sign of possession he "planted" his staff which took root and grew. Beginning with the First Christmas Eve and thereafter, the tree was covered with beautiful snow-white blossoms. In the 17th century some religious fanatics chopped it down but it sprouted anew. Cuttings have been taken from it and planted in many places and are still supposed to bloom on Christmas Eve. One offshoot was brought to Washington, D.C. and planted on the grounds of the Washington Cathedral.

Germany, probably more than any other country, adopted the "Tannenbaum" as a beloved Christmas symbol. One legend relates that the Christmas tree was miraculously revealed on Christmas Eve over 1200 years ago. Winfrid, an English missionary (later named St. Boniface) went to Germany to spread the teachings of Christ. One Christmas Eve he found a group of worshippers gathered around a sacred oak of Zusin preparing to make a human sacrifice to the god, Thor. Winfrid stopped the sacrifice and cut down the bloody oak. As it fell, the legend says, a young fir tree appeared in its place. Winfrid said the fir tree, always green, was the symbol of eternal life and he went on to tell them of the birth of Jesus. The Christmas tree became very popular during the life of Martin Luther (1483-1546). Walking home on a clear, cold Christmas Eve, Martin Luther lifted his eyes to the starry skies.

Trees in December

Thousands of stars were sparkling and seemed to cling to the lofty evergreen trees along the roadside. He was moved to share this beauty with his family. That night a glittering tree ablaze with star-bright candles was his gift to his loved ones and to the world. Another legend tells of a Swedish officer who, wounded in the Thirty Year's War, was cared for by the people of Leipzig, Germany. As an expression of his gratitude he set up a lighted tree in the church on Christmas Eve. Hessian soldiers in the American Revolution brought the Christmas tree to the American Colonies.

Evergreen trees have been venerated in the Scandinavian countries for centuries. A small fir tree is still placed upon the ridgepole of a new home for good luck. (This custom is still followed on some construction jobs in the U.S. today.) In Syria, Austria and some other countries, the tip of a fir or spruce tree is hung upside down from the rafters and decorated.

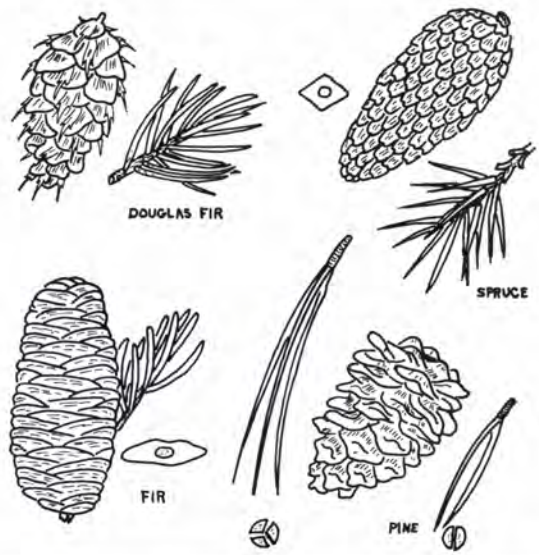
The Christmas Tree Today

Almost all species of conifers have been used at some time as Christmas trees. The deciduous larch and cypress and the hemlock which sheds its needles soon after being cut are not desirable species. Among the sixteen species favored today, the most popular is Douglas fir. The second choice is balsam fir, which may be because its twigs grow at right angles resembling little crosses and its needles are the most fragrant of these greens. Other favorite species are the black, white and Norway spruces, the Scotch and red pines, eastern red cedar (Juniper) and the white fir in the west. Other western species such as pinyon pines have gained popularity in recent years.

In answer to those who question the practice of cutting so many trees for the Christmas trade, the U.S. Forest Service states that it has an important place in forest management. Dense stands of trees need thinning to produce quality timber. Such stands may mature, if let alone, less than 100 trees to an acre, the survivors of 5,000 to 10,000 seedlings. These surplus seedlings are needed while young for shade to prune lower limbs to prevent deep knots. The Christmas tree trade provides an income from the trees which are removed in the thinning. Other sources of Christmas trees are the privately owned woodlots, tree farms established for the purpose, and from trees on marginal lands.

Some Common Kinds

The normal Christmas tree sizes often do not bear cones which are helpful in identification, but attention given to the needles (leaves) and their arrangement on the twigs, and to the buds, will give clues to the identity of the tree in most cases. Needles which are scale-like would suggest a Juniper. The tree is a pine if the needles are in clusters (2-5) with a sheath at point of attachment. In some pines the sheath drops after the first year. Needles not in clusters but attached singly to branches and twigs are characteristic of firs, yews and spruces. If the twigs are roughened because of the persistent woody leaf-bases (petioles) of the needles, the tree is a spruce.



The needles of the firs have no persistent woody leaf-bases and leave round oval scars on the twigs when they drop.

DOUGLAS FIR *(Pseudotsuga taxifolia)* is not a true fir but in a different genus. The needles (3/4"-1 1/4") are soft, flat and slightly pointed, usually dark yellow - or blue-green. They grow in spirals around the twig giving it a rounded appearance. The bark is grayish to reddish brown, deeply furrowed in old trees. The oval cones (2"-4") have a distinctive three-toothed bract extending beyond the cone scales. They hang down from near the tips of twigs. The needle scars are small and oval.

TRUE FIRS *(Abies)* have needles which are flat, blunt, and usually grooved on the upper side. They arise singly and are irregularly spaced around the twigs and branches of the upper part of the tree, but the petioles twist until they seem to be growing featherlike on the opposite sides of the lower branches. Needles are usually dark green above with two light

lines below. The cylindrical cones grow upright near the top of the tree. They are purplish or green and usually very resinous. They do not fall from the tree whole but when mature the scales separate leaving the wood center spike standing upright. In young trees the bark is smooth, white to grayish, with conspicuous resin blisters. Leaf scars are oval to round.

SPRUCES (Picea) have needles which are sharp-pointed, 4-angled in cross section and usually less than an inch long. Arising singly, they grow thickly in spirals around the branches, pointing in all directions, making them prickly to the touch. When the needles fall their woody bases remain, which gives a grater-like feel to twigs and branches. The cones range in size from 3/4" (black) to 6" (Norway).

PINES (Pinus) are grouped into "soft" pines which have soft, light-colored wood and "pitch" or "hard" pines whose wood is dark-colored and hard. The tree shape is more rounded than pyramidal. The sheath remains until the needles fall in the "hard" pines but in the "soft" species it is shed when the needles develop. The cross section of a cluster of pine needles is a circle with each needle being a proportion of it depending on the number in a cluster. The scales of pine cones are of a firm woody texture and the size varies considerably. Some of the largest cones produced by the conifers are pines.

Selection and Care of the Christmas Tree

The Christmas tree will not become a source of tragedy if certain precautions are taken in advance. Select a fresh, green tree. If the needles are beginning to turn brown it will become a fire hazard. When you get it home, saw off at least one inch of the butt end and place the tree in a container of water and set in a cool place. Sprinkle the foliage daily until the tree is to be trimmed. Set up the tree in a container of water or wet sand, adding water as needed. Do not place the tree near a radiator, fireplace, television set, or blocking an exit. Check lights and wiring before placing on the tree and avoid frayed and worn cords. Do not overload the electrical circuits. Never leave a lighted tree unattended. Do not use lighted candles or open flames near the tree. Avoid combustible decorations. Metal foil icicles should be kept away from bulb sockets. Investigation indicates that the use of fire-retardant chemicals often does more harm than good, therefore the use of water is preferred.

When the Tree is to be Discarded

After the holidays, the tree can be used in one or more ways. Bird lovers may wish to stand the tree in the yard attaching food to its branches, or several trees are piled in a heap to give winter protection to the birds and other animals. Branches can be clipped off and placed over plants for a mulch. The trees from a community might be used to check an eroded area. (Before doing this, inquire if any species may harbor insect-carried diseases.) The needles of the Balsam fir can be used in small cushions to give fragrance to a room. The trunk and larger branches can be saved for craft projects. Or trunk and branches may be cut into short lengths and tied into small bundles for burning in the fireplace for crackle and odor. (Never allow a young child to do this unsupervised.) Park Departments and Nature Centers may collect trees to chip into a fragrant surface for trails and paths.

Activities

1. Visit several Christmas tree retailers to study the variety of trees offered.

2. If the retailer is preparing the trees for sale, he will probably discard broken and lower branches from which samples of each kind can be selected.

3. Butt ends from each kind may be obtained, sanded, and polished on one side. Count the growth rings for estimate of age of tree.

4. Make a chart of all the kinds offered in your community using twig samples and cross-sections of the trunk.

5. Visit a nursery which raises living Christmas trees for sale. Ask why they raise only certain kinds. Ask advice as to the best site to plant the tree after the holidays.

6. Look for information about large Christmas trees, unusual ones and interesting community programs involving Christmas trees.

7. If there is a Christmas tree farm near by, visit it to learn what kinds are raised, how they are grown and harvested, and other information.

8. In the reference given below, read about the species your family has selected this year.

References

A NATURAL HISTORY OF TREES OF EASTERN NORTH AMERICAN, and A NATURAL HISTORY OF WESTERN TREES. Donald Culross Peattie. Houghton Mifflin Company, Boston, Mass. Reissued 1991.

These 2 volumes are a rich source of information about human/tree relationships through the ages, and would be an excellent addition to any library. □

Soil and Litter Animals

George Lippert

Curriculum Area: Science; Middle school through college

Rationale: The upper layer of soil is teeming with miniature living things which make higher forms of life possible. Discovering some of these tiny animals is exciting. It can also lead to a better understanding of the complex web of life.

Backround

In the plant litter which covers the soil, and in the humus-rich layers of the soil itself, there are hundreds and often thousands of small animals per square foot. Many of these are easily visible to the naked eye, and their interesting features may be seen with a hand lens or low-power microscope. This article describes some of the common forms, and suggests a simple extracting device by which these animals may be obtained for study.

Many kinds of soil animals such as moles, earthworms, snails, and ants are familiar to most people. We will skip these larger forms here and concentrate on some of the smaller, less familiar, but none-the-less very common, types.

One of these, the springtails, are often the most abundant animals in the litter and upper soil layers. They vary in form from elongated to almost circular, and in length from less than a millimeter to a centimenter or more. Some scientists classify these animals as insects, but others refuse to do so, placing them one step lower in the evolutionary scale. They have many peculiarities not found elswhere in the insect world, such as the possession of only six abdominal segments.

On warm days, particularly in early spring when some of the litter has been exposed by melting snow, these animals can be seen jumping to a height of as much as two to three inches. Often they land on the snow and then are given the misnomer of snow-flea. Jumping is accomplished by inserting a stiff, forked, tail-like appendage known as a furcula into a clasp on the bottom of the third abdominal segment. The furcula is snapped forcefully out of the clasp, slaps against the substrate and propels the animal into the air. This is the way it is dispersed and escapes enemies.

To really appreciate springtails one should look at them under a microscope. Their colors vary from purple, blue, crimson, green, and yellow, to pure white.

In any collection of springtails that you make, you can determine whether they are permanent soil dwellers, or whether a large part of their lives is spent near the surface in the litter. Those that are soil dwellers have a much smaller area in which to move about, as contrasted with those that live in the looser leaf litter. Thus they have shorter legs and antennae, and since they certainly can't jump in the soil, they often have no furcula. Protective coloring has little value in the darkness of the soil, so most of them are white, as compared to the more colorful species in the litter.

Equally abundant as springtails, and often more so, are the mites. These animals have eight legs in all stages except for the one immediately following hatching, when they have six. The most common type belongs to a group known as the Oribatids. These animals remind one of a turtle or beetle , because they have a hardened convex body. Their legs are usually short, and they seem to have a rather hard time walking. They feed mainly on decaying plant materials.

Several other kinds of mites will be found also, some of them quite attractively colored red or green. Body shape varies greatly; some are triangular and others ovoid, plus intermediates. Those with very long legs, as contrasted with the Oribatids, are rapid runners and usually chase down small animal prey.

Another group of animals that will surprise most people when they are extracted are the pseudoscorpions. Like true scorpions, they have two claw-like appendages which they hold out in front of their body when they walk, but they lack the tail-like stinger. Further they are only three or four millimeters long, so can hardly harm anything other than the springtails and other small animals on which they prey. These animals will occur only in a few collections since they seem to be rather scattered.

The more familiar millipedes, or "thousand legged worms", are commonly collected in litter and soil. These animals, which feed on decaying plant material, have two pairs of legs on each abdominal segment, as opposed to the centipedes which have but one pair. Centipedes are able to move much faster, and chase down their prey, paralyzing it with a poisonous bite. In the southern United States, care should be taken in handling centipedes, because some of them are capable of giving humans a painful bite.

These animals, then, are the most common types you will find in the soil. Several other kinds, such as snails, insect larvae and adults, sowbugs, and a few others will be extracted from time to time, but usually in lesser numbers.

Ecological Considerations

What determines the presence or absence of soil and litter animals in an area? What makes some areas richer than others? This can depend on several factors, among which moisture is most important. Many of the animals such as certain species of springtails and mites have such thin body walls that they are easily desiccated in dry situations. Some of the springtails have become so dependent on moisture that they have lost their spiracles, or breathing pores, and get their oxygen by direct diffusion from water through the thin body wall. Thus they must live in a 100% relative humidity atmosphere where their bodies can be constantly covered with a thin film of water.

A moist habitat also has the advantage of keeping leaves and other debris soft, allowing fungi and bacteria to survive and further soften it. This is essential before many of the larger soil animals can feed on it.

Since most of the litter which the soil animals ingest passes straight out their gut undigested, scientists have come to the conclusion that it is actually the bacteria and fungi on this material which is their food.

Temperature as an ecological factor seems most imortant in its ability to dry the soil out. Many of the animals are able to survive a wide range of temperatures, and samples of soil and litter collected when frozen solid will produce hundreds of animals upon thawing.

Equipment

To get these animals for study, an extraction apparatus is quite easily built, as shown in the illustration.

To start extracting, place a layer of litter and soil with humus in it, two or three inches deep in the 1/4 inch mesh screen basket, and place this in the funnel.

Beneath the funnel place a small jar such as that used for baby foods, and fill it about an inch deep with 75% alcohol. Be sure the alcohol does not evaporate before you are through extracting.

Place a light bulb about six inches away from the sample, and leave it there for about 24 hours. This will slowly dry the sample from the top down, forcing the animals to move down into more favorable moisture conditions. Since the majority of the soil animals are negatively phototropic, few will escape from the top of the funnel because of the light bulb.

After 24 hours, you can move the light closer to the sample to dry it faster. Soon the sample will be so warm and dry that the animals will leave it, fall into the steep-sided funnel and into the alcohol.

It is very important that the funnel be kept dry, because if it gets wet, the animals will adhere to it and desiccate when it dries out.

If you wish to see these animals alive and active, the funnel will have to be modified. You will need a large cork in which you can bore a hole large enough to fit over the small end of the funnel. This can be glued in place. A vial is then placed in the other end of the cork so there will be free passage for the animals to fall from the funnel straight into the vial. The whole apparatus can be supported by a bottle whose opening is large enough to fit the cork.

Before placing the vial in the cork, put about 1/4 inch of water in it, and also a strip of paper about the length of the vial. This will create a 100% humidity which the animals perfer and give them a surface on which they can crawl.

Activities

Use in Teaching

Tullgren exraction, as this method is known, has immense appeal to both children and adults, as has been demonstrated by Tony Shanley, a graduate student at Cornell University. He made extractions as part of a teaching assignment with elementary school children, using a microprojector to show the various animals on a screen. He said the students were so enthralled he had a hard time breaking away when the period was over. The same proved true when this method was demonstrated to a college natural history class.

Tullgren extraction can be used by the teacher to illustrate many concepts of biology. By sampling a wide variety of habitats, it can be shown that not all are equally rich in life. A woodland with very little development of a humus layer, for example, will be poorer than one that has a well developed layer. The reasons for this include the greater water holding

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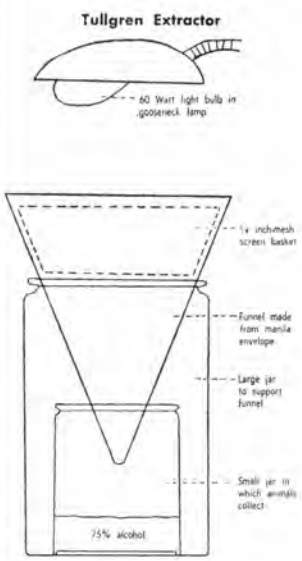
Springtails jump by using the tail-like appendage as a spring.

Many soil mites are bright red. Adults are 1/16 to 1/8 inch long with 8 legs. The 6 legged young are almost invisible.



FERNS

Helen Ross Russell

Curriculum Area: Science, Middle School and up.

Rationale: Of all the plant groups, the ferns present greater satisfactions or challenges to both the beginner and the expert. There are several reasons for this. The number of species is small, less than 10,000, in contrast to some 300,000 species of flowering plants, an estimate given by Boughton Cobb (1956). Since most fern species occur in the tropics and less than 100 species are to be found in the United States and Canada, it is possible for an interested person living in North America to learn all the ferns of the temperate zone and certainly those in his locality.

A beginner without previous botanical training will gain considerable knowledge of that subject while searching for ferns in a variety of habitats, though the total discovered in a summer of exploration may amount to only one to three dozen kinds. On the other hand, a person with a good botanical background will be stimulated to explore other aspects of this plant group than just finding new species. Alternation of generations in plants is beautifully demonstrated by ferns. Awaiting original research are unanswered questions about juvenile forms and hybrids, and riddles of genetics and evolution.

Background Information

"How does one recognize a fern?" The answer of the uninitiated is, "That's easy. Ferns are feather-like in general pattern." But in fern habitats may be found lousewort (*Pedicularis sp.*) and Yarrow (*Achillea millefolium*) whose leaves might fit this description. Many members of the Parsnip Family, including poison hemlock, water hemlock, caraway, wild carrot (Fig 1), wild parsnip, coriander, and fennel, have pinnately compound leaves which are just as "feather-like" as the most "typical" fern. Though all of these have flower spikes when mature, in their early rosette stages they can be confusing to the beginner. In addition, some ferns are not feather-like. Adder's tongue fern, walking fern (Fig. 2). and water clover fern are all striking examples of this.

Ferns do not produce seeds or flowers, but have an alternation of generations with two distinct and separate forms. On some of their leaf-like parts are structures which produce spores. Another characteristic is the way in which the plant emerges from the ground. With the exception of the succulent ferns (Genus *Botrychium* and Genus *Ophioglossum*), all ferns have what is technically called circinate vernation, wherein the frond emerges from the ground in a coiled state which is known as a croiser, fiddlehead, or shepherd's crook (Fig. 3). This coiling pattern is the result of the lower surface of the frond developing more rapidly than the upper.

In order to discuss and read about ferns one must learn a special terminology. Some botanists use the terms applied to flowering plants to describe similar parts in ferns while others use an entirely different vocabulary. This is illustrated in Fig. 1. On the left is the fern-like leaf of the wild carrot (*Daucus carota*) which sometimes confuses the beginner. On the right is the frond of a spiny shield fern. The labels on the fern are to be applied only to ferns and other non-seed bearing, vascular plants, while those on the left are comparable terms which are always applied to flowering plants and sometimes ferns.

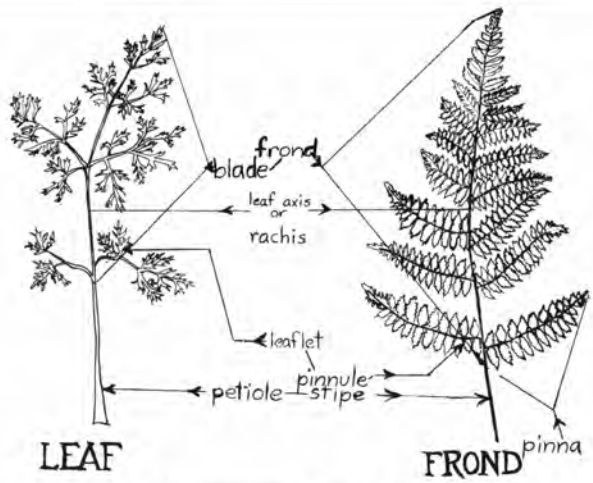


Fig. 1 - Comparison of a leaf and a frond.

Alternation of Generations

Many plants have alternation of generations but none illustrate this botanical phenomenon as well as do the ferns. The well known fern plant is called a sporophyte, which means spore plant because it spores in structures called sporangia (singular is sporangium), which grow in clusters on the underside of the fronds. These clusters are known as sori (singular sorus). A hand lens is needed to study the detail of the sporangium but the sori may be observed without magnification.

The spores are single, haploid cells resulting from reduction division. From the spore develops a new

plant distinctively unlike the parent plant which is called a gametophyte. This plant resembles a fern so little that its parentage was unrecognized until 1845. This little heart-shaped structure ranges in size from 1/8 to 1/3 of an inch in temperate zone species. On its lower surface develop female structures, archegonia, each of which produces an egg, and male structures, antheridia, which produce sperms.

Fig. 2 - Walking Fern

When the sperms are mature, they escape from the antheridium and swim by means of flagella through rain water or other moisture. If a sperm succeeds in locating an archegonium containing a mature egg, it fertilizes this egg which then develops into a new plant, the familiar sporophyte with which the cycle started.

Although each gametophyte produces several archegonia each containing an egg, only one sporophyte develops from each gametophyte. The young plant grows up through the notch in the heart-shaped gametophyte. The first fronds to emerge do not resemble the adult form. Identification of genera and species at this stage is a highly specialized skill. In fact, even a one year or two-year old sporophyte may possess juvenile characteristics which are different from the adult form. (Fig. 4)

Activities

Fern Collection

Plastic bags are excellent containers when collecting ferns. An added advantage to their use is that they fold to a small size, are light and can be carried at all times. A good collection should display as much information as possible. Specimens should include spore-producing as well as other vegetative parts of the plant. At least one frond should be mounted to show the sporangia. If the fern is small, the whole plant may be included provided the species is not a rare one, or a stand is not threatened with extermination by taking it.

Labeling is important. Locality records should be specific. A label which says "5 miles north of Ashby Center on Route 31 in woods at left, Worcester County, Mass." would be helpful for future field trips. Habitat, too, should be specific. The habitat of the specimen mentioned above would be "swampy area with sphagnum and sundews." The date is important in relationship to the development of reproductive structures. All of this information should be recorded at the time of collecting. Identification can come later — even years later, but details of location can be easily forgotten or confused.

Growing Ferns

A herbarium specimen, no matter how carefully it is selected and mounted, cannot compare to the beauty of the living plant. Many followers of fern trails find the challenge of growing ferns an extremely satisfying hobby.

Several species of woodland ferns can be successfully grown if they are transplanted to a shaded area to which humus has been added to the soil and are provided with sufficient moisture. The area may be devoted entirely to ferns or may be a combination of ferns and wild flowers, or other shade-tolerant plants.

Ferns which are particularly well adapted to such planting areas are Maidenhair, the Beech ferns, New York fern, Marginal Shield fern, and other wood ferns (*Dryopteris sp.*). The Christmas fern will thrive as long as the soil is not too rich and no fertilizer is applied.

Other ferns adjust well to rock garden habitats, but it is essential to know the type of rock habitat to which a species of fern is adapted. For example, the Oregon Woodsia grows in any kind of rock except limestone; Obtuse Woodsia and Mountain Woodsia are indifferent to rock type. Other successful rock garden ferns are Rock Polypody, Resurrection fern, the Oak ferns, Bulblet fern, Brittle fern and the Lip ferns.

The Hay-scented, Bracken, Cinnamon, Royal, Interrupted, Lady, Ostrich, and Sensitive ferns grow rankly and crowd out other plants. Frequently they are listed as weed species or plants to avoid. However, their very hardiness may make them a good choice for some situations. You can always share extra plants or consign them to the compost pile.

Fig. 3 - Emerging Crosiers of Christmas Fern.

The serious follower of fern trails who would like to grow all the ferns of an area might suggest this as an excellent project to a school which has a school woods or outdoor biological laboratory. Even in an optimum situation such as this, some modification and construction of required habitat will be necessary. This may be especially true for the bog ferns such as the climbing fern, *Lygodium palmatum*.

Growing Gametophytes

Some ferns are rare and should not be dug up in their native habitat but may be propagated from spores. Furthermore, whether a species is rare or common, there is great satisfaction in following through the life history of a fern. A single plant may produce from 10 to 50 million or more spores. The spores of most species are light weight, durable, and are carried on wind currents all over the world. When they fall in favorable moist and shaded areas they germinate into gametophytes, but it is easier to grow gametophytes than to find them in the wild. This is done by scattering spores on the surface of a moist mixture of equal parts of sand, loam and humus in a clay pot set in a pan of water. Cover the pot with a pane of glass or plastic and place it in a dark spot. When the gametophytes begin to develop, transfer the pot into the light.

Fig. 4 - Three young and adult of Cliff Brake.

If specimens are desired for laboratory study, the spores may be placed on filter paper which has been pressed down on heat-sterilized, moist earth. When the gametophytes develop on this surface, bits of the paper with a specimen attached may be cut off and placed on a microscope slide for observation.

Fern Hybrids

In 1902, Margaret Slosson proved that *Dryopteris cristata* and *Dryopteris marginalis* were the parents of a fern which today is called, Miss Slosson's Wood Fern. She did this by growing the gametophytes of *D. cristata* and *D. marginalis* in separate containers. Then when the sex organs had formed but were not yet mature, she carefully cut the gametophytes in half and placed a male section of one species with a female section of the second species. The resulting sporophytes were the familiar hybrid which occurs in the wild from Quebec to northern Virginia. Students interested in hybridization can carry out similar experiments.

Activities with a Microscope

The study of spores may supplement the study of ferns. Wherry in The Fern Guide gives directions for making chromosome counts of ferns. This is an interesting field for the student of genetics since many hybrids have interesting polyploid patterns. The discharging of spores from a sporangium may be observed. Scrape unopened sporangia on a microscope slide and add a cover glass. A drop or two of strong alcohol or glycerin run under the edge of the cover glass will remove moisture from the sporangia and the explosive discharge of spores which occurs can be observed.

Forms of Asexual Reproduction

Many ferns reproduce by means of underground stems called rhizomes. This characteristic accounts for the wandering propensity of the Fragile fern and some of the other more delicate ferns.

Two other interesting forms of asexual reproduction are illustrated by the Bulblet and the Walking ferns. The former produces small bulblets on the veins on the under side of the frond. These fall off and grow into sporophyte plants. The walking fern sends out roots when the tip of the frond touches the ground (Fig. 2).

Fern Photography and Crafts

Photographing ferns can open up a whole new world of appreciations. There is beauty in the crosier of a Cinnamon fern frond, the subtle color and pattern changes of Maidenhair and Royal ferns, and the development of the sporangia of an Interrupted fern.

If you are interested in nature crafts, the various methods of making prints of fern fronds (silk screen, blue, ozalid, spatter, etc.) produce some highly decorative results.

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Activities for Developing Sensory Awareness

(Let Your Fingers Do The Walking)

Sandra Flynn Burns

Curriculum Areas: Early childhood through Grade 3.

Rationale: Spring is an ideal time to encourage the development of your students' observation skills. Many people see but are not good observers. Observation involves more than the use of visual skills. A good observer uses not only the sense of sight but also the sense of touch, hearing, smell and taste.

Many people inspect the outdoors from erect posture with hands in their pockets and downcast eyes. A teacher attuned to developing observational skills will encourage children to kneel down to touch the moss and smell the soil and to stretch up to finger the leaf and listen to the sounds it makes. The children will make comparisons, describe characteristics and share their findings with others.

These outdoor activities and follow-up classroom experiences are suggested to develop the observation skills of touch, hearing and smell with elementary age children.

Activities

TEXTURE HUNT:

Each child is given a bag containing several small pieces of materials of varying textures such as sandpaper, wax, velvet, etc. and is instructed to find some natural object in the selected area that matches the texture of the sample material. For example, velvet may be matched with the stem of a staghorn sumac. Depending on the nature of the area in which you are working, the group may either collect the specimens or match the sample to the object *in situ*. Have the class share their findings. This activity can have several variations. It can be modified to become a color hunt, a shape hunt or a fragrance hunt.

FEEL SOCK:

A Feel Sock can be constructed by placing a can or small carton in a large stretch sock.

Construct several of these Feel Soxs and place a texturally distinctive natural object such as a rock in each one. Take the Feel Soxs outside where the objects may be found. Instruct the students to feel the object carefully and then to locate it in the designated area.

VARIATION: Divide the class into groups and give each group an empty Feel Sock. Each group finds a specimen to place in the Feel Sock and then challenges the other groups to touch the object in the Feel Sock and determine what it is.

TACTILE CARDS: (An index card with a textured surface—sandpaper, waxpaper, etc.)

Make Tactile Cards (two of each texture). Shuffle the cards and give them to blindfolded children to match by texture. After the children are adept at doing this, give them specimens collected during one of their outdoor activities. Have the children match the texture of each specimen with the appropriate Tactile Card.

RUBBINGS:

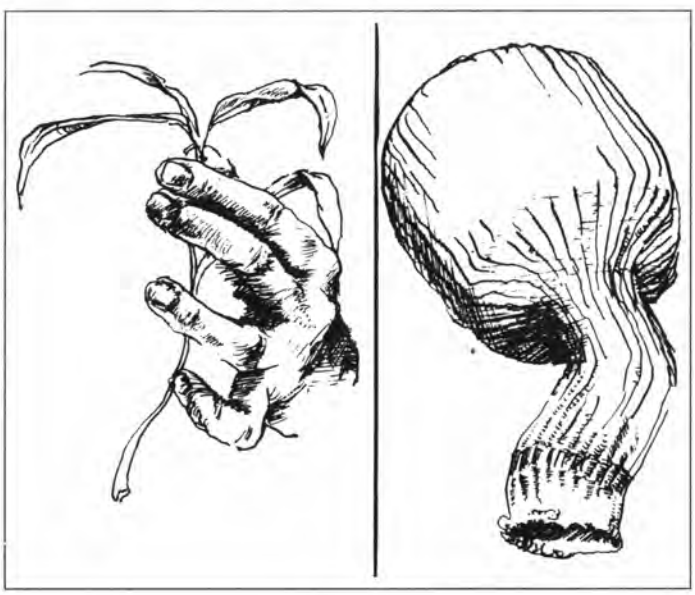
Give each child a piece of paper (manila is preferred) and a crayon. Have the children put their names on one side of the paper. Have the class locate surfaces outside with interesting textures. Instruct the children to place the plain side of their paper on the textured surface and rub the crayon over the paper until the paper is covered with color. The children then exchange the texture rubbings with classmates to see if they can locate the surface that was used to make the rubbing.

SH-SH-SH!!

Select a suitable area and tell the children to close their eyes and listen for natural sounds. After the allotted time (1-2 minutes) ask the children to draw pictures of what they heard. Start a round robin discussion in which each child names the sound heard and then shows the picture. The pictures can be taken back to the classroom and mounted on a bulletin board entitled "Sounds of the Schoolyard."

JUST LISTENING:

This is a follow-up activity for SH-SH-SH!! Using



index cards make pictures of some of the things which make sound in the school yard. Give each child some cards and return to the area where the sounds were originally heard. Have the children sit in a circle and listen for sounds made by the things pictured on the cards. When the sound is heard, the class quietly holds up the card which represents the thing making the sound.

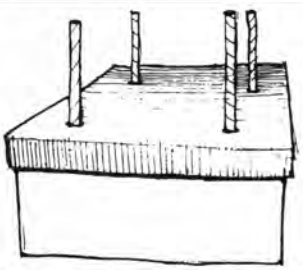
TO SMELL IS SWELL:

Instruct the children to smell as many flowers, plants, vines, leaves, bark, soil, water as they can in the time allotted. Give them a prepared form on which they can indicate the fragrances they liked, those they disliked and fragrances about which they had no positive or negative feelings. Encourage them to find descriptive words to characterize the odor. The class may share their fragrance preferences with each other.

Prior to beginning this investigation, demonstrate the proper method of smelling a leaf. The child rubs the leaf with the thumb and forefinger to release the plant's fragrance and then bends down to smell the plant. Do NOT break the plant and lift it to your nose!

THE SOUND MAKER:

Each child is given objects which make sounds. The objects could be a piece of paper, popsicle sticks, tissue papers, pennies, etc. The children are encouraged to make sounds with these objects and then to locate things in the school yard which make similar sounds. Share and discuss your results.



SMELL BOX:

Fragrant objects discovered during a field experience can be brought back to the classroom so that the children have additional experiences developing sensory awareness. The Smell Box is an intriguing and versatile way to do this.

The Smell Box is made from a decorated shoe box. Four or more holes large enough to insert a straw through are cut in the lid. Straws are cut in two and small plastic bags each containing a specimen collected on a field trip are fastened to the straw by means of a twister seal. Each bag hangs loosely within the box. Each substance is given an identification number which is placed on the lid of the box to aid the children in their discussion about and identification of the odors. Another challenge can be provided by placing the actual specimens near the Smell Box and having the children compare and decide which specimen before them matches an item in the Smell Box.

These activities are simple techniques to develop the sensory awareness of your elementary age children as they explore the natural environment. They not only encourage growth in observational skills, they also enhance the development of the skills of communication and classification.

NOTE: Instruct the children in all the dangers of the area (poison ivy, bee hives, poisonous plants) before you begin any outdoor exploration. □

Soil and Litter Animals

Continued from page 26.

capacity of humus and the availability of better food.

One of the most fascinating activities is extraction in winter, when few live animals are normally available for study. All the student or teacher has to do is shovel the snow off a likely spot and with a hatchet or sharp spade, chop out a chunk of the soil and litter to a depth of about five inches. It is best to thaw this in the wire basket in a sink until it stops dripping, to prevent the funnel from getting wet. Then place it in the funnel, apply heat as previously described and be prepared for a surprise.

Soil zoology is one of the least studied aspects of zoology, despite the ready availability of materials to work with. Many of the most elementary questions regarding this community have yet to be answered. Many species still need names. The food of many is unknown, and their life cycles are obscure. The list goes on and on. There are plenty of opportunities for naturalists to make real contributions in this field.

Though books on identification of soil fauna down to species are rarities, good general books are available. Many of these are British , but the groups and principles involved are the same as in this country. Three of the best are:

Soil Animals by D. Keith McE. Kevan, H. F. & G. Witherby, Ltd., is one of the easiest books for the amateur to understand. Discussed are the various groups of animals, the soil as an environment, different methods of extraction, and the effect of humans and other animals on the soil.

Soil Zoology edited by D. Keith McE. Kevan, Butterworth, Ltd., is a symposium by various experts in this field. Though papers are a bit more technical than the above, they will interest the more serious student. The subjects covered are the same as in the preceding book.

An Introduction to the Study of Insects by Donald J. Borror and Dwight M. DeLong, Holt, Rinehart and Winston, Inc., is an excellent book that will key any insects out to family level. One chapter is also devoted to anthropods other than insects, including those discussed in this paper. □

Solid Waste Reduction - *A hands-on study*

Diane Wiessinger

Curriculum Area: Science, Math, 6th grade and up.

Rationale: Many students still believe that recycling and using biodegradable products are the best solutions to the landfill dilema. Here is a graphic way to show the importance of source reduction in handling the solid waste problem.

Activity

Give your group the following shopping list:

Orange juice	fruit	margarine	eggs
vegetables	meat	peanut butter	milk
cookies	cereal	chips	raisins
bread	yogurt	paper towels	paper napkins
diapers			

Divide into three groups and shop - really shop - for three day's worth of groceries for a family of four in each of three different ways.

The first shoppers buy with only convenience in mind: juice packs and little boxes of raisins for school lunches, fruit on styrofoam tray, little bags of chips inside a larger bag, individual cereals,disposable diapers, little plastic margarine tubs, orange juice in a plastic jug, and so on.

The second shoppers shop at the same convenient supermarket, but keeps packaging in mind when they shop: they bring their own bags to carry the groceries, they asks that meat be wrapped in paper, they buy frozen concentrate for juice, and so on. They use diaper service and cloth napkins; paper towels only for spills and bacon grease; they recycle what they can from the trash they accumulate.

The third shoppers shop with waste reduction as a very high priority: they accumulate as little packaging as your area's stores and recycling facilities allow. They take their own bags to stores that sell in bulk; make their own yogurt, bread, and cookies; they no longer use paper towels.

Have the class save the packaging from each group, recycling what they can from the second and third shoppers, but not from the first. They can figure out how many paper napkins and paper towels the family would use, but make sure they put a 3-day percentage of napkin and towel outer wrappings in the pile too!

The size of the pile from each group will vary according to what's available for purchase and recycling in your area, but you can be sure each group's pile will be substantially smaller than the one before. In our town, for instance, the first group's trash, uncompacted, heaped three 9" x 12" x 18" boxes. One of the boxes held nothing but diapers... and the extra bag in which the bag of diapers was put by the cashier! The second shoppers filled a single box. The third group's box held only a piece of paper from the margarine and the plastic tops from two glass dairy bottles (milk and orange juice). That's all. And we'll soon be able to recycle those bottle tops.

If the group wants to imagine a year's worth of grocery packaging, tell them to multiply each of the three shopping groups' trash by 100... and then add some. All of us who were involved in this project when we first tried it, came away with a much more realistic image of our own landfill contributions and a new realization of how much control we have over the size of those contributions.

Some added shopping hints for your packaging-smart shoppers: * "Biodegradables" rarely biodegrade in a modern landfill. Even a carrot can last, virtually unchanged, for decades. * Glass is more readily and more efficiently recycled than plastic. *Paper is the biggest clogger of our landfills, and is our second-dirtiest industry. * It's not uncommon for an item - like the first group's potato chips - to be sold as a bag within a bag, then to be put in another bag at the check-out counter! * Soda is best bought in the reuseable heavy glass bottles. Next best is the lighter weight recyclable glass bottles or aluminum. Plastic should be avoided. * Buying a small quantity means more packaging per unit weight than buying a large quantity. Buying individually wrapped items or individual servings is worse still. * True recycling happens only when we also buy recycled goods; its not enough just take our empties to the local recycling center. No buyers, no market. No market, no recycling center. * It's better to reuse than to recycle, but it's best not to buy in the first place. The shopper who remembers to "reduce, reuse, recycle," in that order, will find that his trash bin can take a whole lot longer to fill!

If you'd like a 13-page, 81/2" x 11" looseleaf handout, copyright free, on additional ways to reduce your environmental impact, send $2 to:

Individual Action List
Right Before Your Eyes
PO Box 453
Etna, NY 13062

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Creative Minutes in the School Yard

Joy Finlay

Curriculum Area: All grades and ages.

Rationale: Eight field trips short on distance and long on creative learning.

The school yard and surrounding community are the school's outdoor library and laboratory, just a few steps from your door. With these short trips, even in the barest of urban school grounds, every teacher can offer intriguing opportunities to increase students' appreciation, understanding and applied skills in a real world context.

Activities

Backyard Bingo (observing, comparing)

To make a Bingo record card, fold a sheet of paper five times one way and five times across. Enter words from the list, or make up your own adjectives, nouns, or descriptive phrases for each square. Go outside and search for examples that match the words listed on the Bingo card. Draw, name, or describe the examples chosen in the matching squares. There is no need to collect the objects involved.

rough, heavy, smooth, new, straight, curved, scary, tall, tiny, old, circular, new, dull, living, big, wooden, shiny, warm, rectangular, cold, bumpy, broken, painted, pointed, moist.

Poettree (observing, describing)

Find a tree to observe, touch, smell. Make observations close-up, from a distance, sideways, or from beneath the tree. Make a long list of words about the tree. Then arrange the words in a way that they sound best. Print or write them on a piece of paper made in the shape of a tree. Outline the "Poettrees" with green yarn and display.

A Shadow Compass (drawing conclusions)

Drive a meter length of stick into the ground in an open space before lunch time. Mark the exact spot where the tip of the shadow falls. After lunch time, at least 10 or 15 minutes later, mark the tip of the shadow again. The line drawn between the two tips marks the east-west line. Based on this information, which direction is north? south?

Fact Finding Mission (investigating)

Make a long list of a facts to find out about the school yard, then go outside to investigate. Find out if the school yard is level. Which side of the playground is the longest? Where are the longest cracks in the pavement? Where are the deepest puddles? Why are they there? What is the sidewalk made of?

Puddle Mapping (contour mapping)

Visit the parking lot after a rain and find where the puddles are. Choose a large puddle and mark its "shoreline" with chalk. Draw new lines to show several shorelines as the puddle recedes. A contour map of the puddle will be left when the puddle is dry.

Miniature streamlets, drainage basins and watershed may also be identified and recorded with chalk on the school grounds following a rain.

Teeny-Tiny Alphabet Books
(awareness, developing vocabulary)

Make mini-booklets by folding over a letter- size page four times. Cut folds and staple booklet together. One sheet of paper makes 16 divisions or 32 pages including the cover. Mark each page with a letter of the alphabet.

Go outside and find objects, characteristics or events that can be seen, heard, smelled, or inferred as being in the school yard. Enter words in the mini-book that begin with each letter of the alphabet. Take time to search and share words for some of the difficult letters. Several short field trips may be needed to complete the alphabet book.

Micro-Worlds (sequencing events)

On hands and knees pretend to be as big as an ant. Using a piece of string, lay down a path to follow. For keener vision, use a magnifying glass. Explore the path and find where the obstacles are. Look for food and shelter. Are there any six legged neighbors? eight legged neighbors? two-legged feathered predators?

Take a classmate on a tour, explaining in sequence the interesting features and events of the micro-world along the path.

Space Visitors (inferring, interpreting, creative writing)

Prepare for a research journey to a far away planet by making a life line of string one meter long, tied to a nail.

Proceed on an outer space venture into the school yard. At a selected spot , push the nail into the ground and hold on the string "life line". Explore this "strange" planet in all directions within the area of the life line.

What is this world like? Are there signs of life? Water? Air? What kind of life exists? How has it changed? Are the inhabitants civilized? What changes might be made to make it a better place to live?

Return to "home planet". Collaborate with fellow space travellers and write a report about the planet visited. Make recommendations on how desirable and suitable it is for colonizing and what changes might be made. □

Clear Contact Paper - *As A Teaching Resource*

Helen Ross Russell

Rationale: In today's busy world simple, easily available materials for classroom activities are a great boon to teachers.

Background

Clear contact paper which can be purchased by the yard or the roll is a useful resource for recording a field trip, combining art and science, and making games and teaching cards. If the specimen is not thick or succulent it can be mounted without being dried. In fact, dried leaves often are brittle and break as they are attached to the contact paper.

Materials

Specimens may be mounted on charts, on light weight cardboard, on construction paper, on note paper or on non-paper products like the lid of a plastic container.

Procedure

1. Cut pieces to fit size of the project.
2. To remove the backing, moisten one corner. When this is wet it can easily be removed and the exposed edges can be lifted and the paper peeled off.
3. When working with small children keep size of contact paper small.
4. Arrange specimens upside down on the contact paper, unless you are using a large piece, as for place mats. In this case the plants can be arranged on the background and two people cooperate, each holding two corners, in putting the contact paper down.

Activities

For little folk: (Day Care to K) Go out and look at a tree. The teacher can make a drawing on a wall chart. Children may use crayons to add leaves to the branches. Collect one leaf and attach it to the chart with contact paper, write date below leaf. As leaves change color, go look at the tree and collect, mount and date another leaf, etc. (When there are no leaves make a note of that.) In spring collect and mount flowers and/or newly opened leaves. Does your tree have seeds that you can add using contact paper? Don't forget to date each addition.

Older children can make books that carry a study through a year, as individual projects.

Teachers

1. Collect and mount leaves of trees that you want to teach.
2. Collect leaves to show leaf coloration. Write notes, names, questions, dates on the back. These mounted specimens will literally last for decades often without color change.

Art

1. Collect flowers, leaves, grasses and small seeds. Use scissors to cut out animal parts of free-form pieces to make designs. Arrange the parts, bright side down, on the contact paper. Be careful not to run off the edge. Flip the contact paper over onto the paper of your choice, press the air out starting in the center. Remember you will be reversing the design, so right will be left.
2. Collect clear plastic containers. If the lid has printing, cover it with a solid color circle of cloth or paper. Cut out a circle of clear contact paper the size of the lid. Make a design for the top using flowers, seeds, leaves, grasses, ferns, evergreen needles etc. Flip over onto top and press down firmly pushing air from the center to the edges. Fill with goodies; use for jewelry box; give it for a Mother's Day gift.

Language Arts

Write poems or messages to be used inside a folded correspondence card that has a front page decorated with a design made in art class.

Art, Science, Language Arts, Culinary Arts

Using 12 x 18 inch construction paper make place mats using plants to make designs. Use the back of the paper to identify edible wild foods used in the designs,or to write a Thanksgiving poem for Earth's bounty, or to present a recipe. Cover the back with clear contact. This will produce a durable waterproof place mat. □

Good Reading

E-The Environmental Magazine. Published bimonthly by Earth Action Network, Inc., 28 Knight St. Norwalk, CT 06851. $20 per year.

In an article "Education That Can Not Wait" in last spring's education related issue, Mike Weilbacher stated that if you "scratch any environmental educator's surface, you'll quickly discover she's got an ambitious agenda: a transformation of your attitudes and a change in your behavior." It further suggests that a firm grasp of ecology, economics, politics and ethics is needed to make responsible ecological decisions.

This article seems to embody the philosophy of the editors of E, a relatively new entry into the environmental publishing scene. As you turn the pages of each issue, you find articles that explore the background, complexity and the interrelationships inherent in environmental problems; discover ways that you can become an active participant in improving our environment; and are enticed to purchase products from environmentally oriented companies. The magazine raises the reader's environmental awareness, provides knowledge, and then encourages the reader to transform this into environmental action.

The magazine, through interesting and colorful articles, makes us aware of our environment and then provides us with the information to enable us to take positive environmental action. The most recent issue highlighted business' relationship with the environment. The articles ranged from an interview with Anita Roddick, head of a billion dollar cosmetic empire, who believes that good environmental convictions make good business, to the attempts of waste management companies to turn Indian reservations into giant landfills.

Sandra Flynn Burns

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The Pinnipeds - Seals, Sea Lions, and Walruses

by Marianne Riedman, University of California Press, Berkeley/Los Angeles, 1990. Hardbound. 462 pages with appendix of common names of various pinniped species, glossary, and bibliography.
$29.95.

Living on the coast of California, the reviewers have been able to observe many seals and sea lions. However, they have not found a book that satisfactorily answered all of their questions about these animals, until now. Marianne Riedman has written probably the most detailed book on the pinnipeds to date. All 344 pages of text are packed with information and research about every aspect of pinniped life imaginable.

Although there is a lot of research and scientific terminology prevalent in the text, this remains a very readable and interesting book. Her personal anecdotes add life and personality to what could have been a boring scientific document.

In addition to the thoroughly researched text, there are many photographs and illustrations that add interest to the book. The supporting appendices give extra information should the reader wish to further pursue a topic.

The Pinnipeds is a delightful book full of practical information. Marianne Riedman provides a readable and substantive presentation of the pinniped. This book should be in every library and private collection of pinniped lovers.

David Scherer and
Dr. Esther Railton-Rice
A student and Professor
Evaluation

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THE GYPSY MOTH IN THE CLASSROOM - A Teaching Packet

by Erik Mollenhauer, 309 Roosevelt Avenue, Pitman, NJ 08071.

Occasionally a science teaching packet is developed that is educational and fun! "The Gypsy Moth in the Classroom" is all of this and more. The packet is easy to start, easy to run, and inexpensive. It requires minimal space to house in the classroom and can be attended to as often or as little as time permits. The program will also help to bring research into the classroom and turn students into active learners.

"The Gypsy Moth in the Classroom" was developed and pilot-tested by Erik Mollenhauer in cooperation with the USDA Forest Service, the New Jersey Department of Agriculture, and the West Deptford (NJ) Township Schools. In the project, students raise wild gypsy moths from eggs to adults. They learn why this moth has become one of the most despised insects in America and why the Federal government has spent millions of dollars trying to eradicate them. They also learn how to rear these insects and observe them as they go through their entire life cycle.

The key to teaching this project is the Teacher's Guide. This guide provides information on how to rear

the gypsy moths along with twenty "field tested" classroom activities. The initial activities introduce the gypsy moth and tell students how to feed them and keep them alive in the classroom. Students then proceed to an "Egg Mass Hunt" where they collect gypsy moth eggs. These are brought into class and hatched. Further activities allow students to learn more about this unique pest. These include "Measuring Caterpillars", "Caterpillar Weights", Crowded Caterpillars", "Collecting Caterpillar Skins", "How Much do Caterpillars Eat?" and others.

Teachers will have little difficulty in following the well-prepared Teacher's Guide and will find that the project will add some "pizazz" to their curriculum. Students will also enjoy playing the Gypsy Moth board game that accompanies the packet.

Though it is intended primarily for elementary grades, "The Gypsy Moth in the Classroom" can easily be adapted for middle and secondary schools.

Reviewed by Philip Pankiewicz of the Department of Natural Sciences at Stockton State College, Pomona, NJ.

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ANIMALS IN THE FAMILY : Tales of Our Household Menagerie,

by Edith A. Sisson. The Globe Pequot Press, Chester, Connecticut, 1990. Paper. 224 pages, illustrated with photographs. $11.95.

"This book is about animals I have known," declares author and ANSS member Edith Sisson. "It is a personal recollection about my relationships with animals of our household and their relationships with me. But it is also a family memoir. My husband and daughters have lived with these animals. ...My wishes here are to widen the family circle and to share with you the joys, wonders, and problems of the animal characters."

This she does admirably, for ANIMALS IN THE FAMILY is a wonderfully warm, wise, and often hilarious account of this family's adventures and mishaps in caring for independent-minded domestic pets such as geese, bantam chickens and ponies, and in adopting and raising orphaned wild babies - - skunks and squirrels, robins and owls, raccoons, frogs and snapping turtles, among others. All the pets, both wild and tame, are given names, of course: Sage the Owl, Lorenzo the Skunk, Felicity the Frog, Butter the Gander, Littlejohn the Gray Squirrel, Raccoons Bonnie and Gay, Jonathon Seagull, and Henrietta the Bantam Hen.

A delightful and educational reading experience for all ages, the book contains many valuable tips on the care of wild pets and on natural history in general, as well as many wise observations on the place of animals in nature, and the effects that human beings have on them and on the environment.

A native New Englander, Edith Sisson lives in Concord, Massachusetts. An ardent observer of nature and an animal lover since childhood, she brings impressive credentials to the writing of this book. For many years a teacher with the Massachusetts Audubon Society, she is also head of science teaching at Wayland Academy, and has previously written an instructive and valuable guidebook to NATURE WITH CHILDREN OF ALL AGES: Activities and Adventures for Exploring, Learning, and Enjoying the World Around Us. (Prentice-Hall, Inc. 1982).

"Animals give me nourishment for mind and soul which I try to share with others," Edith observes. "We share the earth with the animals, and no matter how far industrial society strays from intimacy with other animal species, our lives are inexorably connected."

Robert M. McClung

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Teaching Kids to Love the Earth: Sharing a Sense of Wonder . . . 186 Outdoor Activities for Parents and Other Teachers,

M. Herman, J. Passineau, A. Schimpf, and P. Trever. Duluth, MN : Pfeifer-Hamilton. 1991. $14.95 (1702 E. Jefferson St., Duluth, MN 55812)

"This book is intended to stimulate feelings—deep feelings for the earth. These feelings may be as fragile as the gossamer wings of a damsel fly, as powerful as the love between parent and child, as stunning as an icy blast of November wind off the vast expanse of Lake Superior, or as warm as a wilderness campfire." (in the introduction)

The authors succeed in their goal to stimulate feelings for the earth. They even go beyond that to provide many useful activity suggestions and leadership techniques. Most importantly, they inspire and motivate parents and other teachers to take kids outdoors to enjoy nature.

The book is divided into five main sections. Each part contributes to what the authors call a "Sense of Wonder Circle", based on the term Rachel Carson (Silent Spring) made famous. The section headings are: Curiosity, Exploration, Discovery, Sharing, and Passion. These headings are divided into three or four subsections, each composed of a focus story; a main activity; a background section ("Did You Know?"); a list of related activity ideas ("Other Ideas."); and a list of selected resources.

The lead stories serve to focus attention on the main

idea of the section. They help in understanding the main activity by illustrating a leadership style or motivating and inspiring the reader. In some cases, the stories can be shared with young people by reading them aloud. The main activity is presented in more detail than the other activity ideas that follow. Each one is divided into: Purpose, Age/Number/Setting, Materials and How To. The "Did You Know?" section gives more background information on the activity.

Several aspects of this book are unique. It is directed mainly to parents and their children, although teachers in schools can benefit, too. This book should be read before planning day and overnight trips. It would make a great sale item in local and national park gift shops. The illustrations by Carolyn Olson are well suited to the text and contribute to making the book inspiring. As I read along, I wished my kids were younger and closer to home so we could take up the many challenges offered. The authors include long and varied lists of helpful books available for further reference. The appropriate use of short quotes from Rachel Carson, Aldo Leopold, John Muir, and Sigurd Olson add to the interest value. These "giants" serve as inspirational models of earth caring ways.

The focus story is especially helpful in introducing activities that follow. Especially fascinating are those that describe a visit to grandma's farm (pp. 62-64), a wolf howling adventure (pp. 20-22), a walk in a creek (pp 12-13), and a search for John Muir's birthplace in Wisconsin (pp. 146-149).

I discovered some shortcomings in the book:

- I wondered how many activities could be done successfully if the reader lived too far from the Minnesota and Wisconsin Area. For example, maple syruping and wolf howling have geographic limitations.
- The subtitle suggests that there are 186 outdoor activities. I counted only 181 and about 40 of these might be best done indoors.
- The book is not designed to be "a complete guide to outdoor skills," however, in some cases, more information or cautions are needed to illuminate an activity. For example, the practice of wolf howling has been studied in Algonquin Park in Ontario and a 1989 bulletin (#3) provides many more techniques to assure success.
- The authors assume some parents have achieved an adequate level of skill (or that they will learn) in canoeing, tapping maple trees, plant identification, locating the Big Dipper, building a fire with matches, drill, or flint and steel, grafting fruit trees, collecting and planting seeds, using an increment borer to core a tree, planting a garden, making a log cabin, packsack, or chair, photographing lightning, camping in winter, and cooking in a reflective oven. For some activities, I simply wanted more information or direction to avoid difficulties in doing them.
- I detected some bibliographic errors in the list of resources. For example there were minor errors on pages 151, 130, 107, 98, 66, 39, and 17.

All in all, these "problems" didn't distract significantly from the value of the book. The authors have made an important contribution to the growing pile of outdoor books that can guide us to sensible behavior and gentler use of the earth's gifts.

The authors invite the reader to gather friends and family together and share their visions for healing the earth; then to write a letter about these plans and commitments and send it to the publisher. The authors offer to print the visions of others and send a copy to those who contribute. My vision for healing of the earth includes parents and children doing some of the listed activities. If families become more aware and appreciative of natural systems, they will eventually assume more earth-caring lifestyles and the goal of this book will be achieved.

Clifford Knapp

Dr. Knapp is a professor of Outdoor Teacher Education at Northern Illinois University's Lorado Taft Field Campus in Oregon, Illinois. He has been a professional educator for 30 years and is engaged in teaching, writing, and learning outdoors. □

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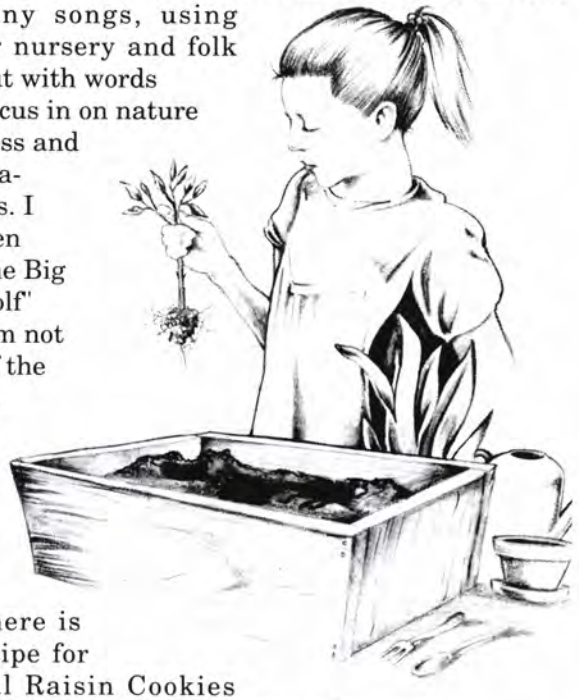
Earth Child, by Sheehan, Kathryn and Mary Waidner, Ph. D., 327 pp., Council Oaks Books, Tulsa, OK, 1991. $16.95 pb; $24.95 cloth.

Just as we were going to press with this special "Sampler" issue of Nature Study TIPS, a newly released book chock-full of activities for younger children arrived. EARTH CHILD, by Kathryn Sheehan and her mother, Mary Waidner, is 327 pp. of games, stories, activities, experiments and ideas about "living lightly on Planet Earth", as the subtitle puts it. After a brief prologue on "Keeping the Wonder Alive" (with a proper nod to Rachel Carson), the authors organize their material into eight chapters: The Circle of Day and Night; Earth Celebrations; Wonders in the Garden; Trees are Terrific; Home Sweet Home (dealing with our Earth-Home); Going, Going, Gone . . .? (fossils, extinction and endangered species); and Hurt No Living Thing (human-to-nature relationships).

Throughout are references to books and other materials on each topic. Attractive pen-and-ink sketches enhance the text.

I was particularly taken with the activities: there are many songs, using familiar nursery and folk tunes but with words which focus in on nature awareness and right relationships. I was taken with "The Big Good Wolf" song: "I'm not afraid of the big good wolf . . . " (i n - stead of "Whose Afraid of ..."). Then there is that recipe for Oatmeal Raisin Cookies (using your own sundried raisins, of course)!



Ralph Waldo Emerson said "We do not inherit the earth from our ancestors; we borrow it from our children. EARTH CHILD is a book to be shared by young children and adults who care for them. It is designed to foster an awareness of the natural wonders surrounding us - in turn making us better stewards of our beautiful planet. It is specifically designed for use with children ages 3 to 7. How well it lives up to its billing will be judged by those who put it to use in teaching situations (at home or in school). I could have wished for a more complete index, and a separate listing of the bibliographical references by author would be useful. Several of the Eva Gordon Award winners have their books listed in the "More Books" section at the end of each chapter.

Authors

John A. Gustafson

The Encyclopedia of Shells, by Kenneth R. Wye, Facts on File, New York and Oxford, 1991. Hardbound, 288 pp $45/US, $55.Canada.

Shells, Shells, Shells . . .

With 1200 exquisite photographs in full color, the "Encyclopedia of Shells" must be the last word on the fascinating world of shell collecting and identification. Written by Kenneth R. Wye, owner and operator of Eaton's Shell Shop in London, this handsome, full-size (8 1/2 x 11) hard-cover book provides a wealth of natural history information in a concise format (using a unique key), giving for each species the scientific and common name, locale, habitat depth, relative abundance, average adult size, and stylized shape, along with a brief general description. There are chapters on molluscan biology, fossils, distribution worldwide, conservation, collecting, and impact in human history. There is an illustrated key to subfamilies, and a useful glossary. Indices to common and Latin names, a brief bibliography, and a list of museums and shell clubs are provided.

The size of this book and its price ($45.00 US, $55.00 Canada), make it more of a coffee-table than a field guide, but shells are easily brought in from the field to be identified at leisure. What better way to re-live that tropical, idyllic vacation than to spread out those shells on the coffee table on a blustery January evening?

John A. Gustafson

President-Elect Joy Finlay presented the 1991 Eva L. Gordon Award for Outstanding Children's Science Literature to Jim Arnosky at the Ten Minute Field Trips Workshop at PEEC on April 20th,1991. Workshop leader Helen Ross Russell is at the right.

Meet Two Members:

Susan K. Ahearn

It has been at least thirty years since, as a little girl, I visited the man in the stone house by the side of the mountain road. The details of facial contours and voice quality cannot be recalled, but his overall manner and presence, to this day, evoke feelings of respect and gratitude.

Each autumn, and throughout the year on any sunny weekend, my mother would become inspired to pack up my sister and me into the old Pontiac station wagon with the watercolor paints, binoculars, field guides, thermos bottle and cheese sandwiches. Our destination was Hawk Mountain, just a short drive from our house in Reading, Pennsylvania. Upon arriving at the stone house, we would be greeted by Maurice Broun, The Hawk Man, and once again, as we had done countless times before, we would sign his guest book. I remember that my mother would let me sign the book too, since there were plenty of spaces and there sometimes were no other visitors on the same day. The Hawk Man was always pleasant and we children felt that he enjoyed our company. He allowed us to go with him to check bird traps or replenish bird feeders. He was gentle with the tiny songbirds and would share with us his knowledge of the intimate details of each tiny life. As my mother painted the landscape in watercolors, we followed this pied piper of the mountaintop to explore and discover. It was at Hawk Mountain where I accidentally flushed out a wild turkey, observed numerous songbirds in the hand, and marveled at the migrating hawks uplifted by the thermals. These experiences probably exerted some influence on me ten years later as I began to pursue an environmental profession.

As I look back on my upbringing, the most memorable and perhaps the most unforgettable experiences were those days on Hawk Mountain To me, the most honorable profession was that in which Maurice Broun engaged: conservation, activism, and stewardship. To us, he was our hero and his sanctuary was our beloved mountain. Ten years later, while serving as a naturalist trainee at Aullwood Audubon Center, Dayton, Ohio, these experiences were brought into clearer focus. Paul Knoop, the Director of Aullwood at the time, had issued the challenge to the two trainees, to "learn to earn a living teaching people about nature." Just as Paul had attempted to prove it could be done, I also embarked on the challenge and have been doing so ever since. The models provided by Maurice Broun, Paul Knoop, and many others were tangible assurance that it was possible and a worthy way in which to spend one's time.

Now I work as a professor of science education, and I observe biology students who come and go with little or no field experiences or knowledge of natural history. They can, however, perform specialized laboratory techniques such as cutting and rejoining DNA or performing gel electrophoresis. What is lacking is an intimate understanding of the non-human elements of the landscape which are inextricably linked with their own lives. It is this concern which caused a Soviet colleague and me to formulate a research and action-oriented project group of the Peace, Ecological, and Cooperative Education Project (P.E.A.C.E.) called P.E.A.C.E.: Field Ecology in Education. We were concerned about the lack of skills and interest of future biology teachers in nature study, conservation, and field ecology techniques. Our project group will focus on skill development through expeditions to nature reserves of the USSR and the USA and Canada. As we recounted to each other our field experiences and viewed collections in the Museum of Natural History in

Moscow, we marveled at the rich diversity represented there. The planning began for appropriate cooperative inquiry experiences for our students with the first expedition to commence next year in the USSR.

In the last eighteen years, I have experienced a variety of teaching settings for environmental education and nature study. These include working as a teacher with public and private schools (4 years), an environmental education specialist and preserve manager for a state agency (4 years), a museum educator (3 years), a university teaching assistant in a field school while a graduate student(3 years), and a teacher educator in a university setting (4 years).

During this time I decided that the environmental degradation inflicted upon the Earth is a reflection of a perception of being separate from the natural world, somehow special and immune from ecological processes. This perception manifests itself in schools which shut off students from the rest of the natural world and the opportunity to develop significant relationships with the non-human Other. The courses I teach therefore contain elements which provide immersion experience to students, opportunities for academic skill development through field experiences, and quiet time for reflection. Students are expected to become familiar with the cycle of life as it unfolds in one's own ecoregion of Newfoundland or Labrador. This is accomplished through interviews with fishers, farmers etc. as well as through research and observations. The ecoregion represents a natural unit of landscape which is meaningful and personal to each student because of long term residence there. Students select a global issue to study within the ecoregion and investigate ways in which the issue is manifested there, affecting the human and non-human elements. Students also select a project from the biocompetency checklist, a list of skills necessary to have before entering biology teaching. Throughout the semester, students may be monitoring a stream or studying the behavior of an organism in the field. Last May, two students accompanied me to the UNEP Youth Forum on the Environment at the United Nations in New York City. They presented their Pie-shaped Puzzle of the "Children of Newfoundland and Labrador and the Cycle of Life." This interactive exhibit, one meter in diameter, challenges others to place the puzzle pieces in the proper sequence according to the phenology of events where they live.

In a time when students are learning how to disassociate the living world into smaller and smaller bits, the American Nature Study Society and its journal promote the wholeness of the planet, in all its diversity. Readers discover within the pages of Nature Study, the interrelationships of people with their landscapes throughout time, innovative ideas, and success stories. In this age of transformation to sustain societies, the mandate has really not changed at all, only the awareness of it among the general population has changed. People still need to live properly, i.e. displaying acceptable behaviors that sustain life around them and build positive relationships. The aggregate of all grassroots efforts involve and, indeed, invite broad participation, and incorporate a spirituality toward the Earth, important efforts in this direction.

Dr. Susan Kains Ahearn is an Assistant Professor at Memorial University of Newfoundland, St. John's, a wife, and mother of two five year old boys, living on the edge of the Avalon Wilderness at the easternmost point of North America.

John Kominski

I have been involved in the appreciation and study of the natural environment since my childhood days in the "Northside" neighborhood of Brooklyn. I explored the few accessible shoreline areas of the East River, roamed the vacant lots, and traveled frequently with my family to Plum Beach, Coney Island, and the Rockaways to enjoy the waters of Jamaica Bay and the Atlantic surf. When not fishing or crabbing from rowboats or from the piers, bulkheads and shady shores, the family would frequently spend its weekends aboard the party fishing boats based in Sheepshead Bay.

I credit the Boy Scouts of America with the formalization of my outdoor interests. I earned the rank of Eagle Scout and nearly every nature and conservation merit badge along the way. Several years of experience as a summer naturalist, waterfront instructor and outdoors specialist at the Ten Mile River Scout Games near Narrowsburg, New York convinced me to become an earth science teacher.

Upon my 1968 graduation from the City College of New York, where I majored in education and geology and later earned a masters degree in environmental studies, I moved to Flushing and began my teaching career at Louis Pasteur Junior High School 67 in Little Neck. Soon afterwards, I organized the very successful Urban Ecology Club for my students, who investigated local environmental concerns and launched a wide range of community awareness and improvement projects. Much of the club's efforts and activities focused attention on the abused woodlands and salt marshes of Alley Pond Park and Udalls Cove.

I was one of the founding members of the Udalls Cove Preservation Committee and served as the group's program chairman under the leadership of Aurora Gareiss. I recall blocking bulldozers and dump trucks that threatened the marsh, and the many informative field trips and cleanups in the wetlands, especially the "Walk in the Alley" organized by the Alley Restoration Committee, chaired by Dean John O. Riedl. This event brought Mayor John V. Lindsay and public attention to the belt of parklands stretching south from Little Neck Bay to the terminal moriane of the last continental glacier. The many other cooperative community efforts that followed led eventually to the formation of the Alley Pond Environmental Center. (Udall's Cove was made a New York City park during the dedication ceremonies in the Fall of '90.)

In 1973, I became the Science Coordinator and Planetarium Director for Community School District 26. In the wake of the New York City fiscal crisis I took leave of the Board of Education in 1976 to become APEC's first Executive Director. The early APEC years were devoted to woodland programs offered

through the Nature Center in the Alley Pond Park picnic area, organizing volunteer efforts to improve the former Patio Shop which served as APEC's new home, securing the park against dumpers, trappers and vandals, and establishing an identity for the park and Center as an important resource for education, recreation, recycling and community involvement. During my directorship, APEC was declared a National Environmental Study Center.

I returned to the Board of Education in 1979 to serve at headquarters in the Division of Curriculum and Instruction, where I became the assistant Director of Science. I had an opportunity to serve as Executive Assistant to Charlotte Frank, during her last two years as Executive Director of that Division. My responsibilities included curriculum and staff development through the recently created Science Technical Assistance Centers located in Bayside and Bergen Beach, and supervision of the science, school camping and environmental education programs offered through the Gateway Environmental Study Center, as well as the Board of Education's aerospace programs offered aboard the Intrepid Sea-Air-Space Museum. The Gateway experience has provided me with opportunities to work with Ruth Eilenberg, the Center's Coordinator, the National Park Service, and the Educators For Gateway - New York City teachers devoted to science and multi-disciplinary education in the outdoors.

I am an active life member and former chairman of the Environmental Education Advisory Council, a life member and director of the American Nature Study Society, a director of the American Lung Association of Queens, and an advisor to the board of directors of the Elementary School Science Association. I have been an instructor with Hy and Joan Rosner and the Watson Ecology Workshop for many years. In addition, I am a member of the New York Academy of Sciences, the Education Association, and the New York State Marine Education Association.

I enjoy photography, writing, camping and family life. I collect beach sand, which my friends and I bring back from the beaches throughout the country and beyond. My leisure time interests also include diverse tastes in music and reading, particularly Oriental poetry. Moreover, my interest in art is expressed through unique constructions, which are composed of found objects and driftwood.

John Kominski recently replaced newly retired Ruth Eilenberg at the Gateway Environmental Center. As the center's director of the two- way program involving the NYC Board of Education and the National Park Service he will be in charge of a great variety of school programs; including overnight camping, that provides hands-on experiences for many NYC elementary and secondary school students. □

THE OWL CALLS

Teenagers step aside for the Porsche on Maple Lane
where there was a trail the white-tailed deer
followed at dusk and early morning
going down moraine to vernal pond
Split-levels there are flooded every spring
Saturday morning
the young executive on Oak Lane
lets loose the BRRRRRRRR of electric lawnmower
He pushes it over a knoll
where in May wild orchids grew
Lady's Slippers with pink balloons of flowers

In the town's new Theodore Roosevelt Elementary School
the sixth grader with the red hair tells her teacher
"Screech Owls nested in the woods in the back of our house
and I loved to hear them at night.
They didn't screech.
Their notes were round."
The teacher observes how wonderfully the child uses words
"Now they're gone, " she says
"We're all houses."

Maxwell Corydon Wheat, Jr.

Screech Owl

Florida's Shark Valley - *Don't Miss It*

Martha Munzer

Do your plans this year include a vacation visit to South Florida? If so, there is a certain spot you should by all means include in your itinerary.

Shark Valley, a small section of Everglades National Park, is reached by traveling the Tamiami Trail. The entrance is 30 miles west of Miami and 70 miles east of Naples. The site was closed for renovation for almost two years, but is now open once more. For nature lovers, a day's visit is an adventure beyond compare.

What is there about this particular place that makes it unique? Of the three entrances to the park, this one will afford you the best glimpse of Florida as it originally was.

In some sections of the Everglades, outside the National Park, you will find noisy airboats, wild rides on water slides, tourist oriented souvenir shops. On the Tamiami Trail you will come upon all of these. But once you enter the Park , there is only, as little disturbed as possible, the "river of grass" in all its vast splendor, dotted occasionally by small islands of green, known as hummocks or hammocks.

My own exploration was largely by tram, an open-sided vehicle driven by an experienced and most knowledgeable guide. In our two-hour ride we traversed a one-way, narrow, fifteen- mile long road, which had been slightly elevated during the renovation period. This was done in order to make possible the conducting of trips in the rainy, flooding season when the original road sometimes became impassable.

At first it was hard to believe we were traveling only a few inches above a real river; we were conscious only of journeying through a huge swampy prairie of tall, undulating green, the sawgrass of the shallow watercourse. Yet this river, which has its beginning far to the north, and flows with an imperceptible slope southward to the Gulf, is the very lifeblood of the Everglades' ecosystem.

Once you've experienced the magnitude and magnificence of this grassy sea, you begin to look more closely to discover the myriad forms of life it supports.

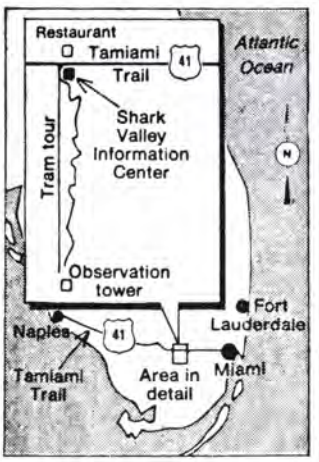
If you are a bird watcher, there are innumerable species to glimpse - a flock of snow white ibis, blue herons stalking their prey in the swampy waters: anhingas, cormorants, grebes, coots, egrets. "It seems that half the bird population of North America stop here one time or another," the guide remarks. As the train rolls by, you may be afforded an incredible sight, a flock of birds suddenly rising up in a vast, noisy cloud of color; then as suddenly dipping down to settle once more into the swamp.

If you are especially interested in other forms of wildlife, you will no doubt spy alligators basking in the newly constructed culverts, designed to improve the water flow in the rainy season. Then there are turtles and fish of various sizes and kinds, to watch and identify.

Halfway through the trip you arrive at an observation tower, equipped with a gentle concrete ramp to the top. Your climb will find its reward in the breathtaking view of the original Everglades, as the entire southern portion of Florida used to be.

To complete the loop, you ride across one of the hammocks, home of live oak, palm, gumbo limbo, all decked out with vines, ferns and blooming orchids in their season. You may catch a glimpse of a rabbit or raccoon, or even a pair of white tailed deer, seemingly undisturbed by human intrusion.

Wildflower enthusiasts will find a variety of colored blooms in summertime, accompanied however by heat and mosquitoes. In winter, you will note slender stalked white arrowhead growing out of the water lilies, perhaps even the small, insect-eating yellow bladderwort.



All too soon you will discover that the train trip is over, and you will realize how unusual and enlightening the exerience has turned out to be.

There are, however, other ways of experiencing the park - either by hiking or biking. In any case, no matter what your mode of travel, try to take time for a quiet stroll on the Bobcat Trail, a boardwalk close to the Visitors' Center. Just a mile or so from the parking lot you will experience an almost perfect escape from the noise and bustle of civilization. The silence is only broken by the rustle of the grass in the wind, the distant cry of a heron or the splash of feeding fish. The experience in solitude is a brief but a never-to-be-forgotten one.

Park rangers, trained guides, and other attendants are hoping that your visit will bring home to you the urgent need to save the Everglades. Just a few years ago, in 1982, the Everglades was designated as one of a scant eight World Heritage sites. This National Park is unique in that it is the only one ever to be established solely to protect and preserve an ecosystem

rather than a natural wonder.

This ecosytem is now an "endangered species", threatening the very existence of South Florida as a place of habitation, including not only the flora and fauna, but our own species - the human family - as well.

Your visit to Shark Valley is bound to inspire and motivate you. One of the Rangers put it this way: "We are racing against time. If we don't pick up the pace, what we lose is irreplaceable." Then he went on to say, "It is our hope that each visitor to Shark Valley will become an ally in the good fight."

Should you not already be part of that good fight, I guarantee that after your visit, you will quickly became a committed and spirited defender.

YOUR EXPEDITION

Shark Valley	Everglades National Park reached from Miami (30 mi W), or Naples (70 mi E), on the Tamiami Trail - Route 41
Open	7 days a week 8:30 A.M. - 6:00 P.M. for tram riders, hikers, or bikers
Entrance Fee	$3.00 per car; $1.00 for hikers or bikers
At the site	Parking space, modest visitors' center, small restrooms, protected areas for picnics, plus vending machines for snacks and soft drinks
Restaurant	Directly across from the park, hosted by Miccosukee Indians who serve traditional fare - frog's legs, catfish, fry and pumpkin bread
Tram Tours	(2 hours) Summer - 9:00, 11:00, 1:00, 3:00 Winter - Every hour on the hour 9:00 to 4:00. It would be wise to make reservations 305 - 221 - 8455. Show up about 45 minutes in advance.
Fees	Tram trip - $5.00 adults $4.50 seniors $2.50 children under 12 Bicycle ride - $1.50 per hour or bring your own
Tips	Sun protection for head and skin. Water - if you are a hiker or biker; possibly a rain slicker against sudden showers

Seek Efficiency and Solar Solutions

Robert & Sonia Vogl

Introduction

The Earth has supported a great diversity of life for billions of years. It has an enduring order which is practically immortal. It is self sustaining, and modifies its surrounding to ensure its survival. Humanity has benefitted from its bounty for thousands of years.

The last 100 years has been a time of great technological advancement and economic progress for much of the industrialized world. Energy use has been central to this progress. Most of the energy used was provided by fossil fuels.

Heavy reliance on fossil fuels places the global environment at great risk. Many scientists believe that elevated levels of carbon dioxide in our atmosphere caused by burning fossil fuels could result in global warming which would reduce agricultural productivity, cause ocean levels to rise, disrupt existing ecosystems, and cause widespread human suffering.

Other gases contribute to potential global warming. Methane, chlorofluorocarbons and nitrous oxides collectively contribute to global warming at the same rate as does carbon dioxide buildup.

The worldwide loss of forested areas contributes to global warming. Trees use carbon dioxide to produce food, thus removing it from the atmosphere for as long as trees live.

Many scientists believe that global warming is inevitable. If we act now, its growth can be limited. Immediate action will buy time for the world community to consider limiting human population growth and developing economic activities less destructive to the environment.

The immediate actions needed are straight forward. We must cut back on the use of fossil fuels and use energy more efficiently.

Chlorofluorocarbon (CfC) use must be dramatically reduced.

Global tree planting programs are needed to absorb atmospheric carbon dioxide.

More efficient energy use is a top priority. In industrialized countries such as the United States, overall energy use can be cut in half while the same energy services are provided.

Efficiency alone, however, will be insufficient to meet the world's energy needs if industrialization continues to expand.

If more natural gas is used and clean coal technologies are implemented, carbon emissions will be

reduced. However, continued growth in energy use will eventually raise carbon levels in the atmosphere.

Therefore, new energy sources are needed. The two choices most frequently mentioned are nuclear power and renewable energy. For nuclear power to emerge as the leading energy source for the future its advocates will have to resolve public concerns over safety, preventing the spread of nuclear weapons and safe disposal of nuclear wastes. For renewable energy to emerge as the leading energy source for the future, it will have to gain public acceptance as a reliable energy source of sufficient magnitude to meet emerging needs.

Relatively few people are aware of the progress being made in the use of renewable energy in general and solar electricity, photovoltaics, in particular. These technologies have been steadily improving since their emergence in the early 1970s. Advocates of solar energy insists its widespread adoption is within reach, if government, industry and citizens are willing to make major investments in it.

Solar advocates point out that this energy source is nonpolluting, poses few environmental risks, will lessen the world's dependency on fossil fuels, and will create many more jobs than other energy sources. The promise of solar energy is filled with optimism that stands in marked contrast to the generally gloomy assessment of global environmental conditions. As a source of optimism, it serves to buoy the human spirit and create a sense that the future is worth striving for.

The promise of solar electricity in particular is showing signs of fulfillment. Several market niches have developed which have allowed companies to expand production and lower production costs. Solar cells have been increasingly used to power consumer products. Solar electrical systems have gained acceptance as power sources for locations remote from the utility grid. Examples of these uses include:

Stand Alone Power Systems
Water Pumping
Telecommunications Systems
Refrigeration Systems for Clinics
Television Sytems for Education
Recreational Vehicles
Cellular Phones
Fence Chargers
Automobiles
Venting Fans
Golf Carts
Water Purification Systems
Cathodic Protection
Lighting Systems, Billboard and Area Lighting, Garden Lighting, Security lighting, etc.
Wrist Watches
Calculators
Radios
Toys
Railroad Signs

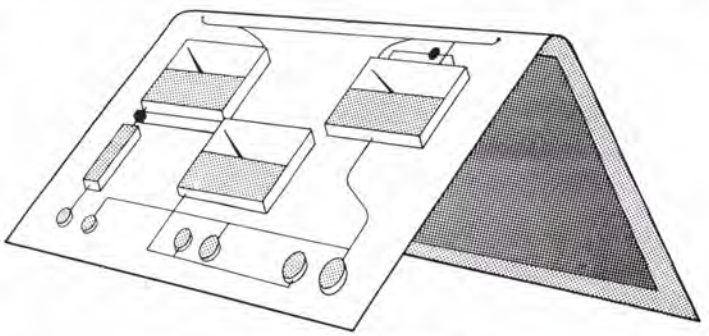
The commercialization of solar electricity would be greatly accelerated if government action were taken to provide market incentives for the industry.

If solar electricity is to gain public acceptance, people will have to become more familiar with the technology. Through better understanding, the public will be in a position to judge the relative merits of solar electricity, consider using solar powered devices in their personal lives, and advocate its wider acceptance in society.

Implications for Education

Environmentally friendly technologies are essential in order for environmental reforms to succeed. The deterioration of our environment results from a combination of large populations and destructive technologies. Creators of new technologies are often schooled in physics, chemistry, electronics, and materials technology. They often underestimate the adverse effects their actions have on the environment. It is increasingly important for them to understand how natural systems function in order to minimize environmental damage from technology.

Our advocacy for solar electricity is based on the premise that it is one of the least harmful techniques of producing electricity. The goal of solar electric education is to create environmental understandings in technologically oriented students and technological understandings in environmentally oriented students.



Solar Electric Education Kit Module

In our work with teachers, we focus on their own use of energy and its environmental implications. Participants in our classes consider ways in which they can use efficiency and alternative energy.

Through lectures, readings, slides, field experiences and discussions, teachers are exposed to various means of living more energy efficient lives. They then develop

and implement plans to make efficient use of energy and alternative energy sources.

The approach yields some satisfying results. New energy efficient homes contain ideas learned in class. Many existing homes have been made energy efficient. Participants have helped schools, churches, businesses, outdoor education centers and nature centers make efficient use of energy. They have created interesting teaching units to use with their own classes.

Finding interesting ways to present alternative sources of energy is challenging. Solar heating applications are easy to locate; related teaching ideas are easy to develop. The simplicity of earth tube applications amaze participants. Solar electric installations have intellectual appeal, but the lack of moving parts and their silent operation fails to sustain interest. Teachers also find it difficult to develop adequate lessons on solar electricity.

Participants can view a few consumer products such as yard lights and illuminated addresses, but generally solar electricity remains an esoteric, non-participatory learning experience.

Recognizing these problems, we felt it was necessary to create a solar electric education kit to allow participants to become actively involved with the technology. Over a two year period, we played with solar electrical devices in our home and with teachers. We developed three prototypes before settling on the current kit design. Early and continued encouragement came from Larry Slominski of United Solar Systems Corporation. He introduced us to Chuck Thomas of Applied Energy Technology who helped us improve the kit design. Mr. Thomas' firm manufactures the kit for us.

The kit is lightweight, portable, self-contained, easy to use, and stands alone. It demonstrates principles and uses of solar electricity. It includes a solar panel, voltmeter and ammeters, lamps, motors, buzzers, diodes, resistors, visible wiring, and both student and teacher guide books. The student guide includes over 30 activities which are written as challenges for students to meet. They encourage students to work in small groups and use the equipment to learn how solar electricity is produced, what affects power production, and how solar electricity can be used.

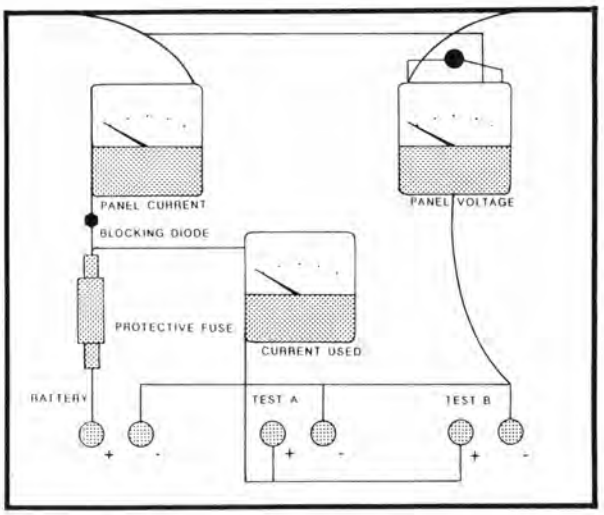
The kit and activities are designed to provide hands-on experiences to help students learn through direct exploration and experimentation. Students are challenged to develop simple, practical applications for use in their own lives. The kit has been used successfully with people from grade four through adults.

An unbreakable amorphous silicon panel which produces six volts and 250 milliamps serves as the power source. It can power portable radios, games, and tape recorders, which appeals to students. It can also be used to recharge AA batteries commonly used in such products. Batteries can be used as a backup power source for the unit so its use is not limited to sunny days.

With solar electricity's promise of solving global energy and environmental problems, the kit is timely and relevant. It serves to link classroom learnings to major events occurring outside the classroom.

Our basic objectives in developing the solar electric education kit includes:

- To remind students that efficiency remains our top energy priority;
- To consider solar electricity as a renewable energy source which can decrease the adverse environmental impacts of energy use;
- To present an optimistic view of the energy future in which solar electricity provides sufficient energy for comfortable lives with minimal environmental impact;
- To provide direct experiences with solar electricity for students so that they can make informed judgements regarding its benefits and limitations;
- To provide students with a hands-on and minds-on approach to understanding solar electricity;
- To link solar electricity with students' daily lives by using it for charging batteries and as a power source for entertainment devices including radios and games;
- To present information in a simple, straightforward manner to facilitate teacher and student understanding;
- To meet science, mathematics and technology goals in an integrated, interesting manner;



Solar Electric Education Kit - Back Panel

- To stimulate student creativity by encouraging them to design their own simple solar electric devices based on their learnings; and

- To link use of the kit to current educational reforms in social science.

We are introducing teachers to the kit through workshops. We encourage the workshop approach since teachers seldom find time to introduce themselves to new materials such as these. Since we created the kit, we know why it was developed as it was; we know how to use it correctly; we have useful expertise for answering participant questions or finding answers. Workshops provide us with a direct means of gaining feedback from participants on improving the kit.

Workshops also serve to link people interested in solar electricity to each other. We are developing a communications network to facilitate continued interaction for both teachers and students as the use of the kit expands.

Our workshops are limited to 90 minutes for large international, national, regional, and state meetings. We combine a slide presentation of existing energy efficient and solar electric installations in various parts of the country along with the hands-on experience with the solar electric education kit. We also provide full day and weekend workshops. These include a wide variety of concepts and activities related to efficiency and renewable energy sources.

We and many others firmly believe in the efficient use of energy and renewable energy sources. They can dramatically cut environmental damage from our use of energy in economical and socially responsible ways. Using this approach allows us to feel good about making the world a cleaner, safer place for ourselves and future generations.

Consider sponsoring a workshop in your area and sharing some of those feelings with others.

Drs. Robert L. Vogl & Sonia Vogl Associate Professors Outdoor Teacher Education Lorado Taft Field Campus Northern Illinois University Oregon, IL

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MEET OUR EDITOR AT PEEC

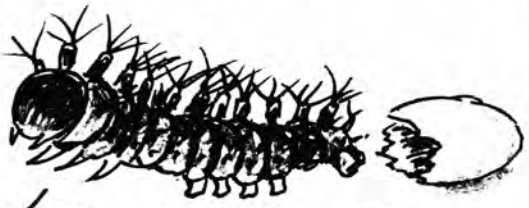
Dr. Helen Ross Russell, long-time editor of NATURE STUDY, is the author of "Ten-Minute Field Trips", a book of nature study teaching tips which has been out of print for several years. A newly revised, expanded edition is now being released, and in celebration of that event, Dr. Russell will conduct workshops for teachers and naturalists at the Pocono Environmental Education Center (PEEC) on the weekend of April 3-5, 1992. Assisting will be several experienced nature educators. Sessions will begin Friday evening and end Sunday afternoon. Cost for room, board and instruction is $100/person. To register, write: PEEC, R.D. 2, Box 1010, Dingmans Ferry, PA 18328.

Workshop presenters Betty McKnight in the white cap and Baiba Woodall, facing the camera, led a ten minute field trip at the workshop of that name at PEEC in April. A TV crew filmed the walk as part of a program featuring Ms. Woodall, New York State Elementary Science Teacher of the Year, aired on PBS.

Naturalist's Notebook

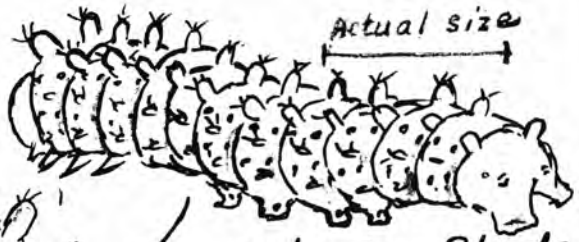
Growth and Change: Metamorphosis of a Cecropia Moth

June 6 - a Cecropia moth lays a fertilized egg - one of more than 100 - on a wild cherry. Actual size of egg →



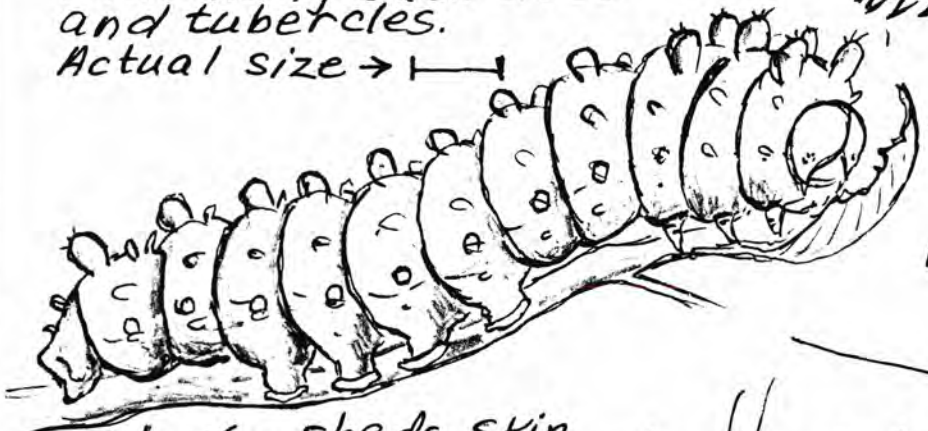
June 20 - egg hatches. Tiny caterpillar is black, with many bristling spines. Actual size →

June 27 - week-old caterpillar sheds skin. Now it is bright yellow, with many black dots and tubercles. Actual size →



July 2 - Sheds again. Now pale yellow-green, with warty knobs of red, blue and yellow.

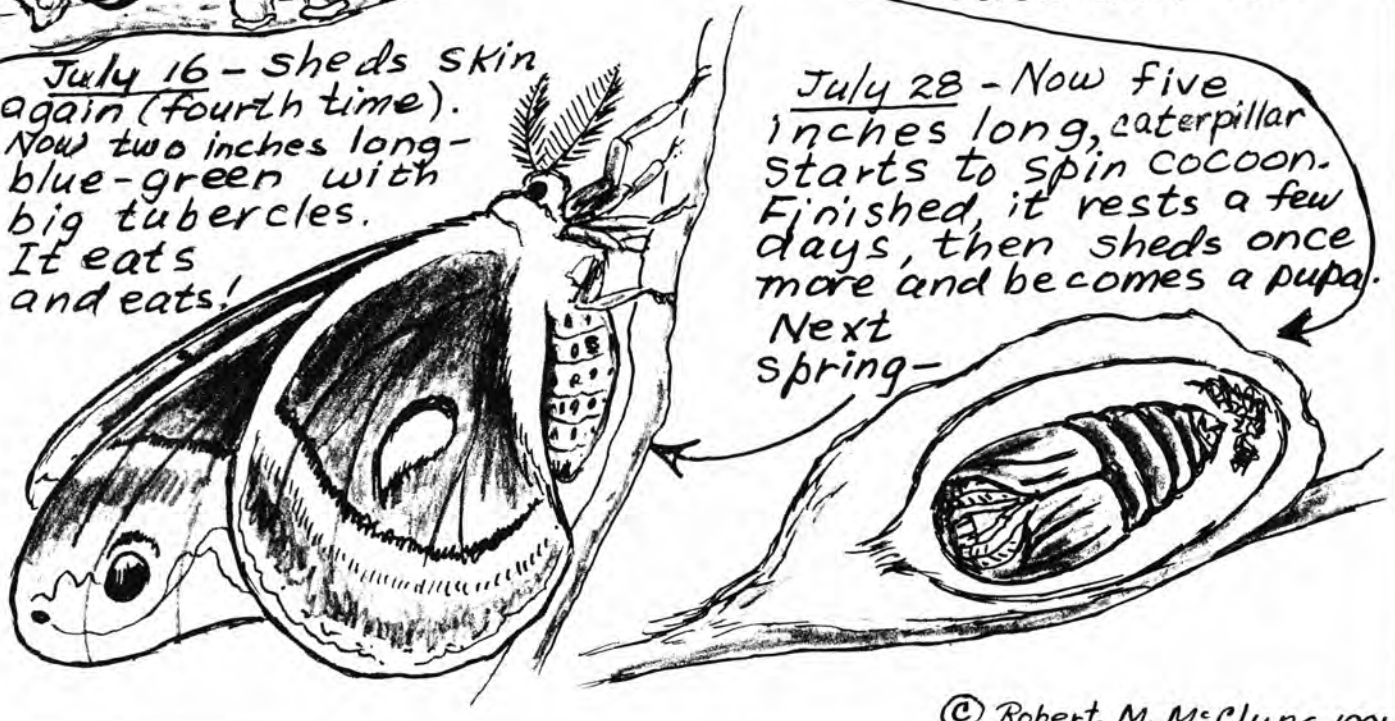
July 9 - Sheds skin again. It eats and eats.



July 16 - sheds skin again (fourth time). Now two inches long - blue-green with big tubercles. It eats and eats!

July 28 - Now five inches long, caterpillar starts to spin cocoon. Finished, it rests a few days, then sheds once more and becomes a pupa.

Next spring -



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