DOCUMENT RESUME

ED 183 374		SE 029 960

AUTHOR	McCormack, Alan J., Comp.
TITLE	Outdoor Areas as Learning Laboratories, CESI Sourcebook. An Occasional Sourcebook of The Council for Elementary Science, International.
INSTITUTION	ERIC Information Analysis Center for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
PUB DATE	Dec 79
CONTRACT	400-78-0004
NOTE	219p.
AVAILABLE FROM	Information Reference Center (ERIC/IRC), The Ohio State University, 1200 Chambers Rd., 3rd Floor, Columbus, OH 43212 ($6.50)
EDRS PRICE	MF01/PC09 Plus Postage.
DESCRIPTORS	Class Activities; *Earth Science; Ecology; Elementary Secondary Education; *Environment; *Environmental Education; Interdisciplinary Approach; Natural Resources; *Outdoor Education; Pollution; *Science Education; Solar Radiation; Water Resources

ABSTRACT

This guide is intended to be a source of ideas for outdoor learning activities appropriate for youngsters in elementary, middle, and junior high schools. It may also be useful for those who work with children primarily in outdoor settings. Decisions as to which activities are appropriate for particular age levels are left to the teacher. Each activity includes title, focus, challenges, materials and equipment, instructions, further challenges, and references appropriate to the activity. Activities are designed to assist the teacher in using outdoor areas surrounding the school as a laboratory for effective instruction. (Author/RE)

OUTDOOR AREAS AS LEARNING LABORATORIES

CESI SOURCEBOOK

Compiled and Edited by

ALAN J. McCORMACK

Science and Mathematics Teaching Center
University of Wyoming
Laramie, Wyoming

An Occasional Sourcebook of
The Council for Elementary Science, International

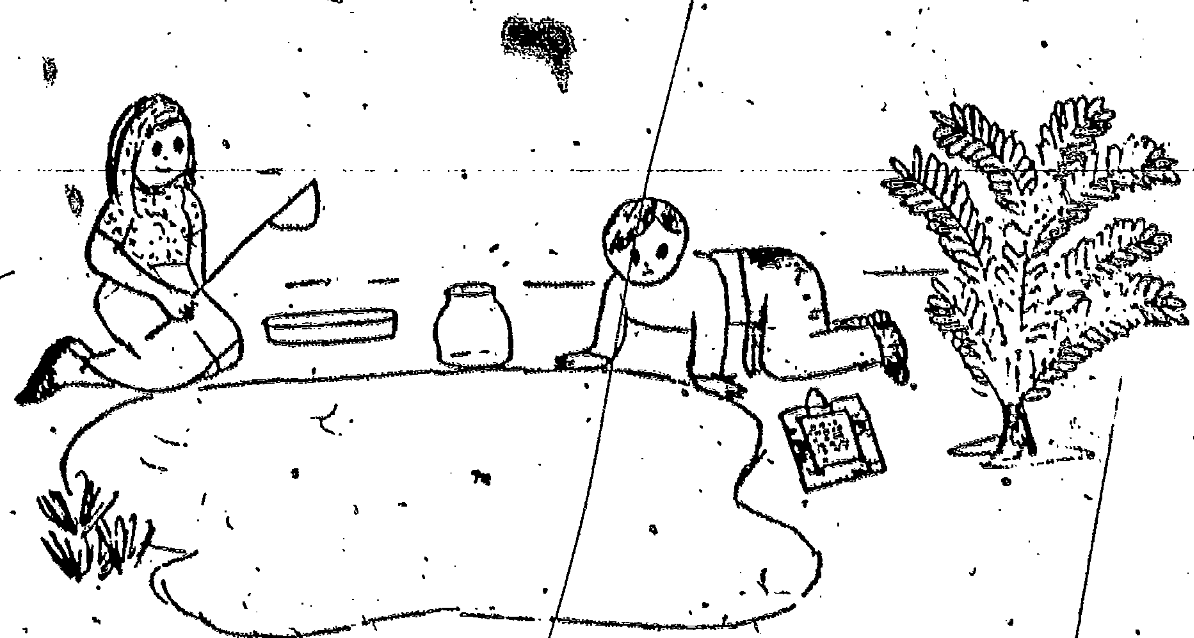
Published by

ERIC Clearinghouse for Science, Mathematics and Environmental Education
The Ohio State University
College of Education
1200 Chambers Road, Third Floor
Columbus, Ohio 43212

December, 1979

OUTDOOR AREAS AS LEARNING LABORATORIES

CESI SOURCEBOOK



Compiled and Edited by

Alan J. McCormack

ERIC Clearinghouse for Science, Mathematics, and Environmental Education

...an information center to organize and disseminate information and materials on science, mathematics, and environmental education to teachers, administrators, supervisors, researchers, and the public. A joint project of The Ohio State University and the Educational Resources Information Center of NIE.

The ERIC Clearinghouse for Science, Mathematics, and Environmental Education is pleased to cooperate with the Council for Elementary Science, International in producing this sourcebook. We believe that this publication will be of value to elementary and middle school teachers who wish to incorporate outdoor activities into their programs.

We invite your comments and suggestions for future publications.

Stanley L. Helgeson
Associate Director
Science Education
ERIC/SMEAC

Patricia E. Blosser
Research Associate
Science Education
ERIC/SMEAC

This publication was prepared with funding from the National Institute of Education, U.S. Department of Health, Education, and Welfare under contract no. 400-78-0004. The opinions expressed in this report do not necessarily reflect the positions or policies of NIE or HEW.

Preface

What kind of publication will be useful to a busy elementary or middle school teacher? That was the question that CESI's Board of Directors discussed in 1978. The answer, we concluded, would be a sourcebook describing practical and exciting activities to supplement and enrich science programs.

Here is our first occasional Sourcebook--we hope the first of many! This one focuses on using outdoor school sites as laboratories. "Occasional" rather than "annual" because we are committed to quality rather than to the pressure of an annual deadline. School site laboratories because right there, where you are, are opportunities to study the environment while practicing investigatory skills.

Chief organizer, editor, and author of many of the activities was Alan McCormack, who accepted the responsibility with grace and pursued it with vigor. We are grateful to him for his dedication to this project. Special thanks are due to Alan's wife, Susan, who drew most of the illustrations.

Without authors, there wouldn't be a book, and we appreciate the fine efforts of the twenty people who contributed manuscripts. Nor is there a book without a publisher. Stan Helgeson, Bob Howe, and Pat Blosser of ERIC/SMEAC made it possible. We offer them our sincere thanks.

Having completed our first effort, we are beginning to think about the next one. We need your ideas! Send us comments on this book, suggestions for themes of future Sourcebooks and offers to author activities.

Beth Schultz
President, CESI 1978-79

CESI (The Council for Elementary Science, International), an affiliate of The National Science Teachers Association, is an organization interested in improving the science education of children. It is an organization OF teachers, presenting conventions and publications BY and FOR teachers.

CONTRIBUTING AUTHORS

Joseph Abruscato
College of Education and Social Sciences
The University of Vermont
Burlington, Vermont

Dorothy Alfke
School of Education
Pennsylvania State University
University Park, Pennsylvania

Ronald E. Beiswenger
Science and Mathematics Teaching Center
University of Wyoming
Laramie, Wyoming

Mary K. Bowe
State University of New York
New Paltz, New York

Patricia Chilton
Kalamazoo Soil Conservation District
Kalamazoo, Michigan

Michael R. Cohen
School of Education
Indiana University
Indianapolis, Indiana

Elvin East
School of Education
Indiana University
Bloomington, Indiana

Lorraine B. Ide
Springfield Public Schools
Springfield, Massachusetts

Joanne Jones
Landon School
Bethesda, Maryland

Alan J. McCormack
Science and Mathematics Teaching Center
University of Wyoming
Laramie, Wyoming

G. Sue McCormack
The Magication Company
Box 4021
Laramie, Wyoming

Mildred M. Moseman
Lincoln School
South Sioux City, Nebraska

Beth Schultz
Department of Biology
Western Michigan University
Kalamazoo, Michigan

Vincent G. Sindt
Science and Mathematics Teaching Center
University of Wyoming
Laramie, Wyoming

Irwin L. Slesnick
Biology Department
Western Washington University
Bellingham, Washington

Hilma J. Smith
Outdoor Program Consultant
Girl Scouts of America
Dutchess County, New York

William Sorensen
Faculty of Education
The University of Western Ontario
London, Ontario Canada

David R. Stronck
Faculty of Education
University of Victoria
Victoria, British Columbia Canada

Audrey Tanner
Northwestern Elementary School
Kokomo, Indiana

Ellen Vande Visse
Kent Intermediate School District
Grand Rapids, Michigan

TABLE OF CONTENTS

CHAPTER I

HOW TO USE AVAILABLE OUTDOOR AREAS AS LEARNING LABORATORIES

WHAT THIS BOOK IS ALL ABOUT

by Alan McCormack

How much of the "real" world can be studied effectively in classrooms? In indoor school settings we often resort to vicarious learning by way of films, books, and just plain talk. We as teachers tend to forget that what is really interesting to youngsters is what they can directly touch, see and explore for themselves. To rephrase an old saying, "The real thing is worth a thousand pictures!"

To get to interesting "real" things you don't need a fat school budget and a nearby pristine wilderness. All you do is step outside with your class, and use whatever is there as a learning laboratory. And I really mean "whatever" is there--pavement, city streets, muddy schoolyard--any outdoor site can be used as a place for exploration and learning. All you need is a little courage, a lot of enthusiasm, and a few ideas about how to get started. Once you try out a few activities and see how easy the whole thing is, you'll be hooked! The trick is to find some interesting problems that kids can investigate in their local environment. Things like playground puddles, melting snow, and reflected sunlight beams can be fascinating to study. Common plants and animals, weeds, lawn grass, ants, and city pigeons can be approached in a genuine, scientific way. Make it a challenge for kids and you'll be surprised what neat learning activities can develop. In addition to learning some scientific principles, kids can also learn much about how to do investigations, solve problems, and make decisions. And, they just may develop a little better attitude about learning, more curiosity about everyday things, and a healthier respect for all environments.

The nice thing about the approach we are suggesting in this book is that we consider any science activity to be only a starting point, much like a small seed that can eventually grow into a huge tree. A scientific investigation of snow melting can easily move from the science of light, water, and heat into Eskimo culture (social studies), snow sculpture (art), or snow syntu poems (language arts). Any activity in this book can help kids develop a richer vocabulary and more interest in reading. When you get some genuinely challenging outdoor activities going with a group of youngsters, it soon becomes obvious, that "everything is connected to everything else." So, we strongly and enthusiastically endorse cutting across disciplinary lines. You might call it a "trans-disciplinary" approach.

This book is intended to be a source of ideas for outdoor learning activities appropriate for youngsters in elementary, middle and junior high schools. It also may be useful for anyone who works with children in outdoor settings: camp counselors, boy/girl scout leaders, park recreation specialists, nature interpreters. We have not attempted to "peg" most of the activities as being appropriate for any limited age group of children. We feel that most of the activities can be used over a wide range of age levels, so we leave decisions about what might be appropriate for any group of children to the teacher or leader of that group.

Chapter One of this Sourcebook presents a variety of general approaches to using the outdoors for learning. Also, strategies for developing schoolyards as learning laboratories are suggested.

The remainder of the Sourcebook is a collection of kid-tested activities good for outdoor settings. Many of the activities are suitable for use in almost any outdoor environment, even a paved parking lot. Other activities focus on the use of environmental sites that may be available near your school such as streams, parks, or vacant lots. Our attempt has been to describe activities that are exciting, widely usable, and designed strictly for outdoor use.

Where possible, activities have been cast into the following format:

Title: We have tried to invent titles that reflect both the fun of the activity and its learning focus. In many instances, our hope is that the title itself will pique a youngster's curiosity. For example, "Worm Grunt" is a good, solid, ecological sampling activity of worm populations. The "grunting," it turns out, is done by kids rather than the worms as kids need to expend quite a bit of physical effort to coax worms out of hiding.

Focus: This is a short description of the concepts and/or skills developed by the activity. It also provides a quick capsulization of the activity to assist the reader in rapidly understanding what the activity is all about.

Challenge(s): Using a challenge or problem-oriented approach to activities is one good way to stimulate youngsters' interests. We have tried to state one or more crucial challenges for each activity. These can be used by teachers as "bet-you-can't" motivators, or simply as succinct statements or problems to organize investigations around.

Materials and Equipment: A list of everything needed is provided with each activity. In cases where home-made apparatus is required for an activity, construction plans are provided in the Sourcebook's Appendix.

How-To-Do-It: These are suggestions for planning, organizing, and actually implementing the activities with youngsters. The authors provide tips regarding appropriate study sites, how to motivate youngsters, ways of collecting data, and how to "wrap up" the experience.

Further Challenges: One solved challenge always leads to new challenges (and those to new learning activities). Here can be found a few ideas for related, but different, learning activities. These challenges are entirely open-ended, and solutions are left to youngsters and their teachers.

References: Articles and books to give both teachers and students useful information related to the activity.

We hope you will give some of these activities a try. And, more than that, we hope you may think of the outdoors around your school as not a noisy and distracting place, but as a genuine laboratory for learning. One final warning: Caution--these activities may be habit forming!

HOW TO USE OUTDOOR AREAS AS LEARNING LABORATORIES—
A DOZEN DIFFERENT APPROACHES

by Elvin East

There are as many approaches to an outdoor learning experience as there are different classes going outside the classroom to learn. All approaches should be selected, developed and implemented according to the needs and characteristics of the class involved. Teachers, in making decisions about which approach to use, must consider the ages of students, their experience levels, and the control-ability of the class.

Following are twelve different approaches to outdoor learning. Descriptions are brief, but I hope sufficient to convey ideas about when and how to use each approach. Where possible, references are included to allow you to track down more comprehensive information about an approach.

The Thirty-Second Field Trip: This approach is very simple and involves a minimum of planning. The idea is simply to integrate short outdoor activities with usual classroom lessons. A teacher prepares a number of questions that are assigned to individuals or pairs of students. The students have approximately 30 seconds to go out on the schoolyard and visually find an answer to the question. The questions can be the same or different. Follow-up discussion of the questions gives all students an opportunity to report their answers. This activity may be repeated a number of times during study of a single science topic or it may be used occasionally as part of lessons in virtually any subject area.

Examples of this activity are: in language arts, ask students to find objects beginning with particular letters; in science, to spot something alive (in December); in social studies, to determine the oldest object in the schoolyard; in art, to locate a particular texture.

This approach is inexpensive and is an excellent method of introducing your students to outdoor learning. It works well with any age level and can build experience and positive attitudes leading to more extensive outdoor activities in the future. The teacher and the class can use these brief experiences to develop rules for acceptable behavior in outdoor settings.

References:

Barge, D. "Thirty-Second Field Trip." Connections, 3(4): 11, February, 1979.

Jones, O. E. and Swan, M. D. Discovering Your Environment. Danville, Illinois: Interstate Printers and Publishers, Inc., 1971.

The Ten-Minute Field Trip: The schoolyard or school neighborhood are home base for this approach. You adapt your activities to your grounds or immediate surroundings. Whether you have a well-landscaped yard or pavement, there are a multitude of activities you can undertake in ten minutes. Unlike the thirty-second trip, this approach requires considerable planning. The ten-minute limitation necessitates careful planning as does the group work involved. Students can be intensively involved in the planning, and these activities can be used to practice and develop skills that are required for a more extensive subsequent activity.

Also different from the thirty-second trip is the control aspect. A lot of attention should be given to development of control procedures and creation of good outdoor working relationships.

Examples of ten-minute topics might be: for a primary class--to draw, in chalk, the outline of a DC-10 on the school parking lot, or to stomp it out in the snow on the playground. A middle school class might go out weekly to make observations of a square meter plot. Daily weather measurements could be an activity for a fifth or sixth grade. A high school class might triangulate the height of the school or the width of a gully.

References:

Couchman, J. K. et al. Examining Your Environment Series. Toronto: Holt, Rinehart & Winston of Canada, Ltd., 1977.

Russel, H. R. Ten-Minute Field Trips. Chicago: J. G. Ferguson Publishing Co., 1973.

School Gardens: Many schools are reviving the school garden approach, partly due to recent popularity of cost-consciousness, health foods, and home gardening. This approach should involve students in both planning and implementation. It is a very easy area in which to fail, as any gardener can testify, so great care should be taken in planning. Students involved in maintaining a garden may develop a sense of responsibility and skills of group cooperative work since everyone must carry his/her load in order for a garden to succeed.

Many disciplines can be integrated in school garden activities. Soil studies can be done for geology, painting with food dyes for art, area calculations and production projections for mathematics, cultural and historical studies of specific plants for social studies, finding different names for the same plant for language studies, and nutrition and diet planning for health.

Reference:

Comstock, A. B. Handbook of Nature-Study. Ithaca, New York: Comstock Publishing Company, 1911. (Available in many reprinted editions and still one of the best sources of ideas for outdoor studies.)

Schoolyard Learning Situations: With a little imagination (and perhaps some perspiration) teachers and students can develop outdoor learning stations in almost any schoolyard. For example, weather stations can be built by kids, or may be donated to schools by local weather bureaus. Monitoring weather can be a regular part of a class' outdoor learning program.

Bird-feeding stations can be set up in virtually any schoolyard. Simple air pollution monitoring stations can also be developed. If unpaved land is available, small temporary ponds can be dug and studies of biological colonization of these ponds can be conducted. Temporary "blind-walk" trails can be set up in a schoolyard where blindfolded kids can follow a rope directing them through a series of sensory experiences.

Schoolyard flagpoles or jungle gyms provide ideal outdoor stations for shadow studies. School rooftops can sometimes be good sites for simple astronomy observatories. And outdoor puppet theatres and art-sketching "studios" can be pleasant places during warm weather.

References:

Couchman, J. K., MacBean, J. C., Stecher, A., and Wentworth, D. F. Examining Your Environment Series. (Astronomy, Birds, The Dandelion, Ecology, Mapping Small Places, Mini-Climates, Pollution, Running Water, Small Creatures, Snow and Ice, Trees, Your Senses.) Minneapolis, Minnesota: Mine Publications, 1972.

Impact and Environmental Action Projects: Impact studies, modeled after those done by professional ecologists, can be enlightening long-term projects. In some states, most notably California, laws require major land developers to have ecological impact studies done of future developmental sites. The impact study involves censuses of plants and animals living on the development site, water quality and drainage determinations, and predictions of ecological changes that may result in the site due to development. This information is then used in arriving at a decision as to whether permits will be issued allowing construction to take place.

Intermediate and higher level classes of youngsters can conduct impact studies in their own communities. When a new paved parking lot, housing development, or road is proposed for their locale, kids can do their own plant, animal and water surveys of the development sites. They can then grapple with the problem of trying to predict what ecological changes may result due to the proposed construction. Then they can try to decide whether or not the construction seems justifiable. They quickly will learn that a job of compromising goes on in the "real" world.

Another kind of impact study kids can conduct would be the after-the-fact type. Select some building, road, forest clearing, or other significant environmental change accomplished by human efforts. Then have kids survey possible environmental effects attributable to the particular "development" project.

Environmental action projects directly involve youngsters in trying to make improvements in their local environments. "Litter Brigades" of students can collect debris from roadsides or parks and try to get publicity calling attention to people's carelessness with trash. "Recycling Regiments" can be organized to collect and recycle aluminum cans, newspapers, or beverage bottles. "Pollution Patrols" can involve kids in putting some pressure on industrial and automotive sources of air and water pollution.

Reference:

Amidei, R. (editor). Environment: The Human Impact. Washington, D.C.: National Science Teachers Association, 1973.

Nature Trails: Nature trails can be set up on a schoolyard, in a nearby local park, or on public wilderness lands. Trails can be organized by a teacher or students; occasionally a prepared trail can be used. If a prepared trail is used, the teacher should preview it to be sure it will achieve the results desired. Some prepared trails are quite elaborate with booklets, station signs, even tape recordings; others are simple and are equipped only with a sheet of instructions. A nice quality of many nature trails is their self-guiding organization. Students can often follow the trails by themselves and benefit greatly from them. This takes careful planning by the trail builder, so novice outdoor educators may want to use prepared trails and practice producing their own trails. When making a nature trail, remember that a trail becomes permanent (right or wrong) very easily, so it should be carefully planned to cause little damage to the environment.

Many nature trails have a central topic, which is either extended, clarified, exemplified, or practiced at each stop along the trail. A very common, and sometimes overworked, trail is the blindfold trail where senses other than sight are stressed. Other good trail topics are estimations, calculations, animal signs and homes, poetry, history of an area, local insects, and trees. Nature trails can be distinguished from field trips in that a nature trail's stops are always specifically located and showcase permanent things to be observed.

References:

National Audubon Society, Inc. Trail Planning and Layout. New York: National Audubon Society, 1971.

Sharpe, G. W. Interpreting Your Environment. New York: John Wiley & Sons, Inc., 1976: Chapter 14.

Field Trips: Previously described approaches may or may not involve taking the class away from the school grounds. Field trips frequently do require this, and so additional problems need to be considered: transportation, expenses, and permission forms. Most schools have policies regarding procedures for field trips, and these should be carefully followed.

Where a nature trail consists of a series of interrelated stops, a field trip is usually a journey to a single location at which a number of activities may be undertaken. Though these activities may be interrelated by topic, they sometimes are not. Field trips require good organization and teacher control. A lot of pre-trip preparation and follow-up should be included.

Natural settings, such as farms, forests, or rivers are good destinations for field trips; so are museums and zoos. If a river is visited, some activities might be: plant and animal population counts, water tests, profile drawings, water speed measurements, water volume estimates, river history studies, erosion observations, and pollution tests. At a zoo, students might classify animals by geographic origin or biological taxonomy. Or they could examine cage construction, interview keepers or veterinarians, or do indepth studies of specific animals.

References:

Donaldson, L. and Donaldson, G. Field Trips--How to Plan and Use Field Experiences in Conservation and Resource-Use Education. Austin, Texas: Texas Education Agency, 1963.

Swan, M. Tips and Tricks in Outdoor Education. Danville, Illinois: Interstate Printers and Publishers, Inc., 1970.

Urban Studies: I am identifying this approach separately from field trips because it has been ignored for so long by outdoor educators. It is not necessary to visit a natural or pristine rural setting to have a good outdoor education experience. Urban settings have much to offer. This approach attempts to give students a different view of things they see around them every day in cities.

For an urban study trip you need not even leave your school. A trip to the boiler room for a study of how the school is heated can be an enlightening experience. Most government agencies and many private industries welcome well-planned visits from students. Many urban institutions have guided tours, but these should be supplemented with preplanning so students come prepared with questions and things to look for during the tour. Classes of older students might take trips in smaller groups, without a teacher, to a lawyer's office or to interview a chiropractor. Others might visit a bakery, a hardware store, or a pilot's school. Unusual occupations and everyday activities are equally interesting to look at very closely. Many of the activities in this Sourcebook can be done in urban settings.

References:

Wurman, R. S. (editor). Yellow Pages of Learning Resources. Philadelphia: Group for Environmental Education, Inc., 1973.

Hester, R. T. Neighborhood Space. Strousburg, Pennsylvania: Dowden, Hutchinson & Reed, Inc., 1975.

Day Camping: Similarities exist between this approach and the field trip approach. But, the stress of this approach is so different it deserves separate categorization. Teachers, in planning day camping activities, normally stress camping skills. Students take on responsibility for preparing meals, and organizing at least part of the day's outdoor activities. Social interaction and development of responsibility are main concerns for this approach. Students share with peers and teacher the daily functions they usually only experience with their families. This approach is often good for uniting a class into a more cohesive group or for preparing youngsters for overnight camping experiences.

The same types of activities may be used for both field trips and day camping. Some day camp programs, however, are quite unique. For example, some recreate a day in the life of a farmer or pioneer. Students might spend the day helping with chores on an old-fashioned farm or working in various stores in an old restored town and sharing a meal around a big harvest table. In the evening kids learn what it was like before television or electricity was invented. They learn how to quilt, whittle, tie knots, or enjoy songs around a campfire. Time spent in a teepee or in an old bunkhouse will be etched in students' memories for a long time.

References:

Van Der Smissen, B. and Goering, O. H. Nature-Oriented Activities. Ames, Iowa: Iowa State University Press, 1969.

Marks, V. Cloudburst: A Handbook of Rural Skills and Technology. Seattle: Cloudburst Press of America, Inc., 1973.

Outdoor Schools: An outdoor school usually lasts three to five days, using half or all of a regular school week. Students stay in some sort of permanent buildings or under permanently located canvas teepees or tents. All or most food and other services are supplied for them. Their schedule runs much like at school, with morning and afternoon activities balanced with recreational time. Unlike regular school, they are involved with evening and night activities.

A week's activities might be organized around a theme such as: "What does the future hold for us?" Interdisciplinary projects can be encouraged: design furniture that uses less wood, make a trail that does not damage the environment, study forest succession, look at the life cycle of a tree, calculate the amount of lumber in a forest, or play games that do not use materials or harm the environment.

References:

Hammerman, D. R. and Hammerman, W. M. Teaching in the Outdoors. Minneapolis: Burgess Publishing Co., 1971: Chapter IV.

Shoreline School District No. 412. An Interdisciplinary Outdoor Education Program. Seattle, Washington: Shoreline Public Schools, 1966.

School Camping: Teachers interested in stressing social aspects of outdoor education experiences often choose this approach. As the title "camping" implies, this experience usually involves sleeping under canvas or in handmade shelters. Students are responsible for their own meals and for putting up or constructing their own shelter. Many camp skills are taught and practiced, and care is taken not to damage the environment. Many activities similar to those of an outdoor school can be used, but the central theme of the week or weekend is the survival of the class.

Student responsibility is often extended to include most of the planning for a school camping experience. At a winter camp they might study animal tracking, camp cookery, snow profile studies, igloo building, snowshoe construction, snowshoe games, plant winter endurance adaptations, and hypothermia problems of people and animals.

References:

MacMillan, D. L. School Camping and Outdoor Education. Dubuque, Iowa: William C. Brown Co., 1956.

Thurston, L. A. Complete Book of Campfire Programs. New York: Association Press, 1960.

Adventure Programs: To many, this approach is the ultimate in an outdoor experience. The goal of this approach is to provide students with an exciting outdoor physical challenge or adventure. Expertise is required on the part of leaders of these activities. Many schools have developed their own adventure programs, but many others use expert-led "outward bound" type schools. A lot of pretraining is required for students and teachers, including emergency and first aid techniques. Very careful and detailed planning is required to ensure the safety of all involved.

Adventure programs vary in length from a vew hours to several weeks. Often, brief outdoor experiences are used to develop necessary physical and group participation skills before a major adventure is undertaken. Examples of this type of approach are canoe tripping, white water kayaking, extended backpacking, sailing, ski tripping, caving, and mountain climbing.

References:

Feam, G. Surviving the Unexpected Wilderness Emergency. Tacoma, Washington: Survival Education Association, 1975.

Osgood, W. and Hurley, L. The Snowshoe Book. Brattlesboro, Utah: Stephen Greene Press, 1975.

All of the various approaches to outdoor education I've described can provide exciting, worthwhile, and memorable experiences for kids. Activities included in this Sourcebook can be used with whichever approach you choose. The important thing is to get your youngsters outdoors and engage them in challenging learning episodes.

HOW TO DEVELOP YOUR SCHOOLYARD FOR OUTDOOR LEARNING

by Ellen Vande Visse

All too frequently schools are constructed on sites that have been leveled, drained, and denuded. Wetlands are filled, or massive erosion prevails. Finally, a few scrawny trees and a sparse lawn are planted. Indoors, there is design to maximize education. Outdoors, there is an ecological and educational desert. The vast expanses are only convenient for rows of lawn mowers. A few pieces of cold metal playground equipment are eventually plunked down in a precise row. Children are never asked what they would like to have on their playground.

Yet that site could be a vibrant learning facility, replete with pond, compost bin, nature trails, weather station, habitat plots, and arboretum. Enriching dull school sites can generate as much excitement as being the season's champion in football--and maybe more! If the undertaking truly capitalizes on the spectrum of resources a school community has, school site enrichment becomes a project to which everyone contributes. When students, teachers, administrators, parents, and community people team up to fashion play equipment or beautify a courtyard, a very real "school spirit" results. Planning, scrounging materials, hauling, planting, and building begin to spark a team pride that goes deeper than an athletic campaign.

Step 1--Initiating the Action: Anyone can initiate the action. A parent was the motivator at one school; the student council started action at another. Sites have been enriched because of a single teacher or class. Others have been initially triggered by an interested citizen or principal. This person simply needs to be someone with vision and interest. The important path to Step 2 is to share that vision with a wide circle of people. The initiator must see that a committee is organized.

Step 2--Set Up School Site Development Committee: Build on the notion of "The more involved, the better." Invite a wide representation of people to your first meeting. Include parents (mothers and fathers!), neighbors, administrators, teachers, students, groundkeepers, and other resource people. Explain the general vision of this site enrichment venture. A motivational film, filmstrip, or slide presentation can help at this stage. Then walk your group through your outdoor area. Assess what you have, good and bad. Brainstorm ideas and record them. Don't dwell on practicalities or problems just now. Encourage dreaming. List all ideas.

Two other things need attention. First, set a date for the next meeting of the committee. Second, determine who else should be involved in this potential enrichment project and how to involve them: e.g., resource people, staff, and students. Plan a procedure for enlisting their interest, support, and ideas before the meeting adjourns.

Step 3--Presentation: The entire school staff needs to feel a part of these beginning stages. They need to see potential benefits to their teaching. (For instance, more art studies if the courtyard is landscaped; more inspired writing after a walk on the nature trail.) Gear the staff presentation accordingly. Stress the educational values for students in such an undertaking.

Remember that the custodian and/or groundkeepers are part of the staff. Without their support, tree seedlings do not get watered and will probably get mowed down over the summer. Ask for their help and always involve them.

Step 4--Expand and Formalize the Site Committee: Initial meetings are just that! They never have all the people you'd like to have involved. For this next meeting, seek out resource people such as soil conservation specialists, local nature center personnel, environmental and outdoor education coordinators, Cooperative Extension agents, landscapers, landscape architects, foresters, Department of Natural Resources or Conservation biologists.

This stage assumes a rising level of interest and commitment. Projects and leadership have started to emerge. Choose a chairperson, secretary, treasurer, and photographer. Before adjourning, establish dates to tour other sites that are exemplary and to meet with an outside expert. Determine how to gather student ideas. Finally, set a date to establish priorities--after site visits and further brainstorming.

Step 5--Gather Student Ideas: The guiding principle is: remember students are the ones who play on the school grounds. They are the ones for whom any development is done. School site enrichment that is done strictly to look impressive to the adult eye completely misses the whole goal of schools: education for children. Children are rarely asked what they would like to have on their playground, yet they're expected to love and protect it. And as adults they're also expected to know something about land-use planning, public participation, realistic budgeting, etc.

Site enrichment projects can provide that training in the school's backyard. The planning process must involve the recipients of those plans if student interest is expected.

Gathering input can be done in various ways. Teachers can have individual classes submit ideas by drawings or lists. A film or filmstrip could be rotated to each class for reactions, discussion, and suggestions. The principal and staff could plan an assembly to introduce the idea of improving the site. Or, student representatives elected to the School Site Enrichment Committee could submit models, sketches, and master plans. In short, teachers simply need to ask what the students would most like to see on their school grounds.

The committee can then sort through them for common denominators and realistic projects. Expect that four basic requests will surface whether the school is urban, rural, or suburban: wildlife, water, contour, and trees/flowers. Among play equipment the most popular are the ones that move and have challenge.

Step 6--Tour Other Sites: Arm your committee with cameras, and go visit some other playgrounds. Watch your youthful members--see which equipment sustains intrigue after initial exposure. Take prints and slide photos if possible.

Arrange to have someone from that school or park meet you at the site. Find out their problems, costs, and maintenance. Ask what areas hold student interest the longest. Ask for his/her help in your planning. Report all this back to your school as soon as the photos are ready. Share your findings at the next meeting.

Step 7--Choose Priorities: At the next total committee meeting, sort through all the ideas submitted. Whittle down your idea lists. Choose the most feasible and popular suggestions to do first. Remember that momentum and credibility are at stake. It is wise to make your first project(s) short, highly visible, and easily reachable. Don't burn out the workforce on a three-season log cabin-raising on your first round. Choose one small project the group can do well. Assume that good media coverage and esprit de corps will propel your committee through your other priorities later.

Remember, too, that group decisions take time. Pond proposals trigger fears of safety and mosquitoes. Hand-made play equipment raises images of slivers and accidents. A broad-based committee represents a wide range of concerns. This group's debate and eventual resolution will determine the commitment for or against the above. Most groups finally decide that children are educated to watch for street traffic and should learn water safety too. The educational value of a shallow pond outweighs the hazards. Most groups usually decide that improvised play equipment can be sturdy and yet large enough to be challenging. Good hand-built structures are rarely less safe than swings from a catalog. Ultimately it is the group's decision that will determine the go-ahead and that will deal with any later complaints.

Step 8--Develop A Master Plan: First, find out what the future plans are for the site and immediate surroundings. Ask what is below ground, too. Second, assess the existing trees, contours, ball fields, and foot traffic patterns. Draw these into an existing land-use map. Call upon the talents of parents and resource people.

Now, try placing priority projects in various areas on the map. Discuss the alternatives. Choose the best and have your proposed site plan drawn up for further presentations, hallway display, and constant reference.

Include a maintenance plan for each project. Too many groups plant trees or dig ponds and then neglect them. They look horrible later. And all too often play equipment is erected and no one is responsible for replacing ropes or bolts later. Plan that each project will need repair. Enjoyable things are vulnerable but valuable. There is tremendous preparation, care, and hand labor invested, and such community cooperation deserves regular upkeep. It is better to plant one flowering shrub than a whole arboretum if that is the limit of the time and care that can be given. Simply designate who will maintain the improvement before you break ground. Master planning is often discarded in the haste to get started with a task. Master plans do take time and are frustrating. Yet plunging ahead with a school garden, for example, may prove to be right in the way of a future jogging trail or a new underground pipe route. The laboriously constructed play equipment may be precisely where the new classroom wing will be built. It may mean falling into the same traps cities do--lack of planning means constantly digging up and rearranging.

Furthermore, a sudden flurry of projects without planning and broad input makes administrators reluctant. A well-laid plan assures easier funding than impulsive hodge-podge.

Step 9--Design A Schedule: Put your master plan in a time frame. The top priority project becomes Phase One. The second one becomes Phase Two. Decide who is in charge of each. Work with a chart like this one:

Phase	Project	Project Captain	Target Date
1	Outdoor classroom	Leah Bernstein	May 1st
2	Tire tower	Dick Merritt	October 15th
3	Pond	Ralph Lazlo	Next Spring

Step 10--Identify the Resources Needed: Draw up a list of the kinds of people, materials, maintenance, and costs anticipated. Look for talents among your parents and community. Materials can often be found in your community. Publicize what you need donated. Scrounge! Follow up with thank you's every time. One school painted a giant "giving tree" for the hallway. Each new donation of time, materials, or money warranted another new leaf on the tree with the donor's name on it. Students who did any work on their nature trail could bring in a T-shirt or sweatshirt and have it silk-screened to read "Greenridge Trail Blazer" on a trail logo. The logo was also used on stationery to thank each contributor.

As stressed, plan on maintenance. List each long-range maintenance need anticipated. Establish who is in charge when the construction fun is over. Whenever possible, make structures permanent. Don't wait to see if posts will be pulled out of the ground; set them in concrete initially. Use treated lumber or plenty of wood preservative on wooden parts.

Estimate costs for materials. Good-sized tree saplings and treated lumber will probably be the most costly. Other materials can usually be afforded or donated.

Step 11--Design A Funding Plan: Note that this worry is at the bottom of the list. First decide what is wanted; don't get bogged down in "How do we raise money?" discussions.

Plan finances for each phase. Look for a variety of funding sources for the different components. Involve the children as much as possible. The more effort they invest, the more protective they feel.

Step 12--Present the Total Plan: Present all these components: educational value, costs, safety, materials, maintenance, funding plan, committee composition, procedures taken, master plan, etc. Good salesmanship means using graphics, practicing beforehand, and selecting convincing speakers. Emphasize how that group will benefit from the venture.

Present the plan to each group that grants permission and/or may contribute or cooperate: student council, school board, parent group, maintenance personnel, boy scout troops, etc. Solicit support, permission, and enthusiasm!

Step 13--Forge Ahead with Phase One: Planning and preparation for such a project as installing numbered nature trail posts or a play equipment complex may take months. A calling committee can be soliciting donations by telephone all winter while planning proceeds. Donated materials are stockpiled as they come in.

The actual construction party may only take a weekend or two. If the project captains are well-organized and personally line up their work crews and tools, structures take shape quickly. Often wives are hammering and sawing right along with husbands, or spreading a lunch feast for hungry (and thirsty!) crews.

Involve the children as much as possible. They can prune trails, spread woodchips, dig post holes, tamp posts, paint, haul materials, etc. The more sweat and involvement, the more pride in the finished product.

Following is a brainstormed list of some possibilities for schoolyard development. Does it give you some ideas?

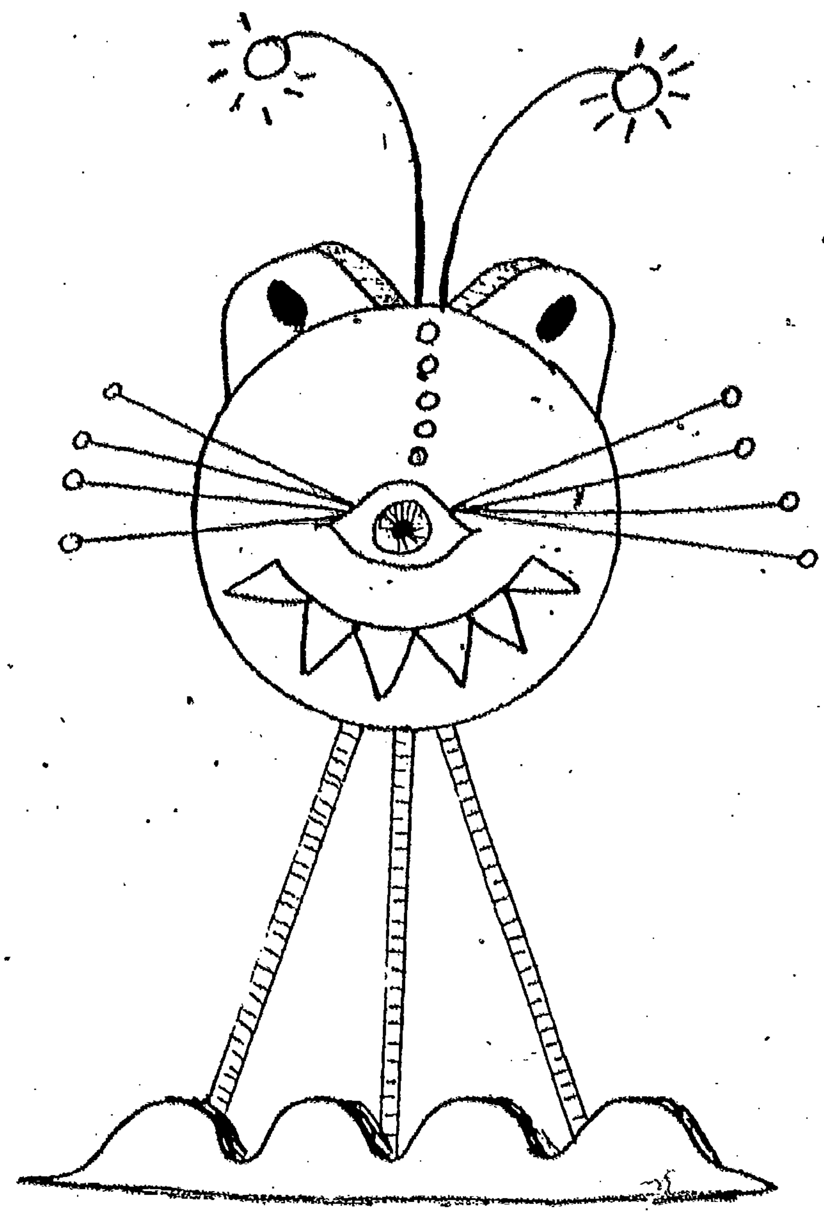
Possibilities for Your School Site:

- Brush piles
- Food plot for animals
- Weather station
- Trees
- Flowering shrubs
- Organic garden
- Compost bin
- Arboretum
- Sand box
- Nature trail
- Outdoor classroom
- Pond
- Glacial boulders
- Geology area
- Wild flower and natural field area
- Decaying logs and trees
- Stumps
- Graffiti boards
- Stage or amphitheatre
- Outdoor cooking and camping area
- Mounds and hills
- Bird feeders, baths, houses
- Footprint patio
- Windmill
- Soil profile
- Puppet theatre
- Telephone cable spool stack
- Obstacle course
- Log roll
- Tripod "crow's nest"
- Jogging course
- Tire swing
- Culverts
- Balance poles
- Paint on asphalt
- Adventure playground area
- Water wheel
- Christmas tree plantation
- Shrub nursery
- Old cabin cruiser
- Plant succession models
- Baseline, benchmark
- Shrub snow fence
- Solar system model
- Maple syrup tapping demonstration
- Hopewell Indian mound model
- Pioneer cabin and garden
- Old fire engine

Add your own ideas!

CHAPTER II

ANIMAL STUDY ACTIVITIES



Activity #1

THE GREAKLING GRACKUS AND OTHER ODD CREATURES

by Alan McCormack

Focus: Biologists believe that animal species have evolved through long periods of time to adapt to quite specific environments and ways of life. Specific characteristics of animals enabling them to get food, move, protect themselves from enemies, and survive adverse conditions are generally classified as biological adptations. You can approach the study of animal adaptations in two ways: 1) the conventional way--have students observe actual instances of animal adaptations; or, 2) the creative approach--have youngsters consider an environment and invent creatures with adaptations suitable to the situation. Both methods have merit, and both should be used. This activity is an example of a creative, interdisciplinary approach to the topic.

Challenge: Create imaginary creatures biologically suited to a specific environment. Write a short science fiction story about the creature.

Materials and Equipment:

Egg cartons
Toothpicks or twigs
Plasticene clay
Tempera paint and brushes
Rubber cement
Scissors
String, pipe cleaners, cotton, other miscellaneous construction materials (optional)

How-To-Do-It: Divide your class into 2-4 groups and assign each group a different outdoor study area. Each group should be instructed to carefully explore the assigned environment, and consider the following questions:

1) What might an animal use for food in this environment?
2) Where might it live?
3) How would an animal that lives here move?
4) How would an animal living here protect itself from enemies?
5) What sense organs might the animal have?

Now, each boy and girl is invited to build a model of a creature they feel would be suitably adapted to the environment. The only rule is that they should use some portion of an egg carton for the main body of the animal. Other pieces of egg carton, paper, small sticks, etc. can be quickly attached to the egg carton body with quick-drying rubber cement. Pieces of plasticene clay will also stick to the egg carton bodies, and can be molded into various shapes. Finally, the entire creature can be coated with tempera colors to make a finished creature.

When creature-construction is finished, and while cement and paint are drying, youngsters can write a brief story or poem about their creatures. A list of questions like the following will help them organize their thoughts:

1) What is your creature's name? (The "Greakling Grackus" was one name suggested by a youngster--thus the source of the name for this activity.)

2) What does it eat?

3) Where does it spend most of its time?

4) Favorite activity?

5) Best friend?

6) Unusual abilities?

7) How does it protect itself?

Now, kids can place their creatures in the environments they were "adapted" for. The entire class can tour each study area and share their creature stories. Or, you can invite another class to visit and see how many of the animal-models they can find. This would provide an idea of how well the "animals" were camouflaged.

<u>Further Challenges</u>:

1) Invent a home for your animal. Build it!

2) Now observe actual animals (or pictures) and list all the adaptations they exhibit.

WHAT IN THE WORLD IS THAT DOG DOING?

by Ronald E. Beiswenger

Focus: What in the world is that dog doing? If you have a pet dog you have probably said something like this more than once. Dogs have interesting behaviors and it can be challenging and fun to watch what they do and try to figure out why they are doing it. This is more difficult than it sounds. Dog behavior is really quite complicated. Some of the things that dogs do are a carryover of behavior which was important to their ancestors, the wolves. Other behavior patterns have developed during the longer period of time dogs and humans have been associated (at least 10,000 years). Humans have also deliberately produced breeds of dogs which are very different in appearance and behavior. The nervous, yipping Toy Poodle is quite a contrast to a calm, slow-moving Bassett Hound or a lumbering Saint Bernard. Some dogs are great hunters, while others are better at being watchdogs or playing with children.

Studies of dog behavior can be used to develop skills of observing, recording data, making inferences and experimenting.

Challenges: Find out if a dog can communicate with people. Observe dominant and submissive behavior of dogs. Study the behavior of a stray dog. Train a dog to do something. Compare the behavior of a dog in its home territory to its behavior in a strange territory. Give a dog an intelligence test.

Materials and Equipment:

Dog(s) to observe
Paper and pencils

How-To-Do-It: These activities are best done as independent projects by individual students or small groups working outside of formal school hours. Studies of dog behavior can be excellent "take-home" challenges for kids to use in extending a larger science unit on animal behavior. Here are ideas for investigations. If more extensive information is required, it can be found in the references included below.

1) Does your dog "talk"? Watch your dog carefully for a few days. Make a list of the things your dog "tells" you. For example, how do you know when it is afraid, happy, angry, sad, hungry, or when it wants to go outside? Describe how it "tells" you these things. Does it whine, bark, jump, wag its tail, lift its ears? Watch carefully and write down as many details as you can.

2) Who's the boss? Carefully observe your dog, and other dogs you see, and take notes describing what they do when they meet other dogs or people. Do they show dominant or submissive behavior? How does your dog react when you scold it? How does it react to members of your family, your friends or to strangers?

3) Stray dog study. Follow a stray dog. Take notes on where it goes and what it does (you may need a bicycle for this one). Alan Beck studied the behavior of stray dogs in the city of Baltimore. He wrote an article about some of his observations of a dog named Shag. (Reference is included below.) Kids may want to read it to get some ideas for their studies.

4) Train your dog. Read a library book to learn about dog training. Train your dog and take notes describing your training methods and how your dog reacts to them.

5) Home Sweet Home. Find out if your dog behaves differently on its home territory than it does in other areas. Arrange for your dog to meet another dog in a neutral area like a park. Have them meet again in your yard (your dog's territory) and in the other dog's yard (the other dog's territory). Observe how both dogs behave and take notes on what you see. Both dogs should be on a leash when you do these experiments. If your dog or the other dog is a known fighter, it might be wise to skip this activity.

6) Give your dog an intelligence test. Kathy Coon has developed an intelligence test for dogs (see References for a source of this test). The test is made up of ten separate tests to show how well your dog remembers, solves simple problems, and reacts to certain situations. Results can be compared with how well other dogs have done on this test (see list of References).

References:

Beck, Alan M. The Ecology of Stray Dogs. Baltimore: York Press, 1973.

Beck, Alan M. "The Life and Times of Shag, a Feral Dog in Baltimore." Natural History. 80(8): 58-65, October, 1971.

Coon, Kathy. The Dog Intelligence Test. New York: Avon Books, 1978.

Fox, Michael W. "Does Your Dog Talk?" Ranger Rick's Nature Magazine. 11(6): 35-37, June, 1977.

Fox, Michael W. Understanding Your Dog. New York: Bantam Books, 1977.

Kohl, Judith and Kohl, Herbert. The View from the Oak: The Private World of Other Creatures. San Francisco: Charles Scribner's Sons, 1977.

Lorenz, Konrad. Man Meets Dog. Baltimore: Penguin Books, 1964.

Roeder, Kenneth D. "A Dog's World View." Natural History. 82(7): 12-18, August/September, 1973.

COURTSHIP AND MATING OF BIRDS

by Alan McCormack

Focus: Many different types of animals exhibit complicated courtship and mating behaviors. Biologically speaking, the intent of these behaviors is to insure that healthy male and female members of the same species form reproductive pairs for conception, birth, and nurturing of a new generation of the species. Birds are ideal animals for the study of these reproductive behaviors. They are large enough to be seen easily and have well-developed courtship, nesting, and care-of-young behaviors.

Challenge: Observe and record the reproductive behavior of a pair of birds.

Materials and Equipment:

Binoculars or telescope
Notebook and pencil
Tape recorder and camera (optional)

How-To-Do-It: This activity must be conducted during the spring, the normal mating season for most birds in the United States. Very early in spring, have youngsters start looking for possible mating pairs of birds. Different species exhibit somewhat different behaviors, select different nesting sites, and establish territories of different dimensions. But whatever the species, the birds exhibit an unusually high level of activity and can be observed in the same location for several days. Most birds make themselves very conspicuous by loud, prolonged singing, chasing other birds and animals away, and in general "staking out" their own territory for nesting. You don't need to visit a pristine wilderness area to observe nesting birds. Trees of city streets, parks, and school yards are frequent nesting sites, as are the eaves and crannies of urban buildings.

When several reproductive pairs of birds have been located, a group of youngsters can be formed to study each bird couple. The observers should be cautioned to maintain enough distance from the birds so they do not frighten them. Each group of observers might make a rough map of the area where the birds are nesting, and try to estimate the size of the territory the birds have "staked out." Then, they can try to answer questions such as these:

1) When were the male and female first observed together? (Keep records of dates.)

2) Which is the male? The female? Do they behave differently or appear to have different roles?

3) Do these birds protect their territory? If so, how?

4) On what date did nest-building begin? What materials do they use to build their nests? Do both birds help build the nest, or just one of them? How long does it take for the next to be completed?

5) When were the eggs laid? How are they cared for? How long does it take them to hatch?

6) Do both parent birds bring food for the young? What kind of food is brought?

7) How long before the young birds leave the nest? Does the bird "family" stay together after the young can fly on their own?

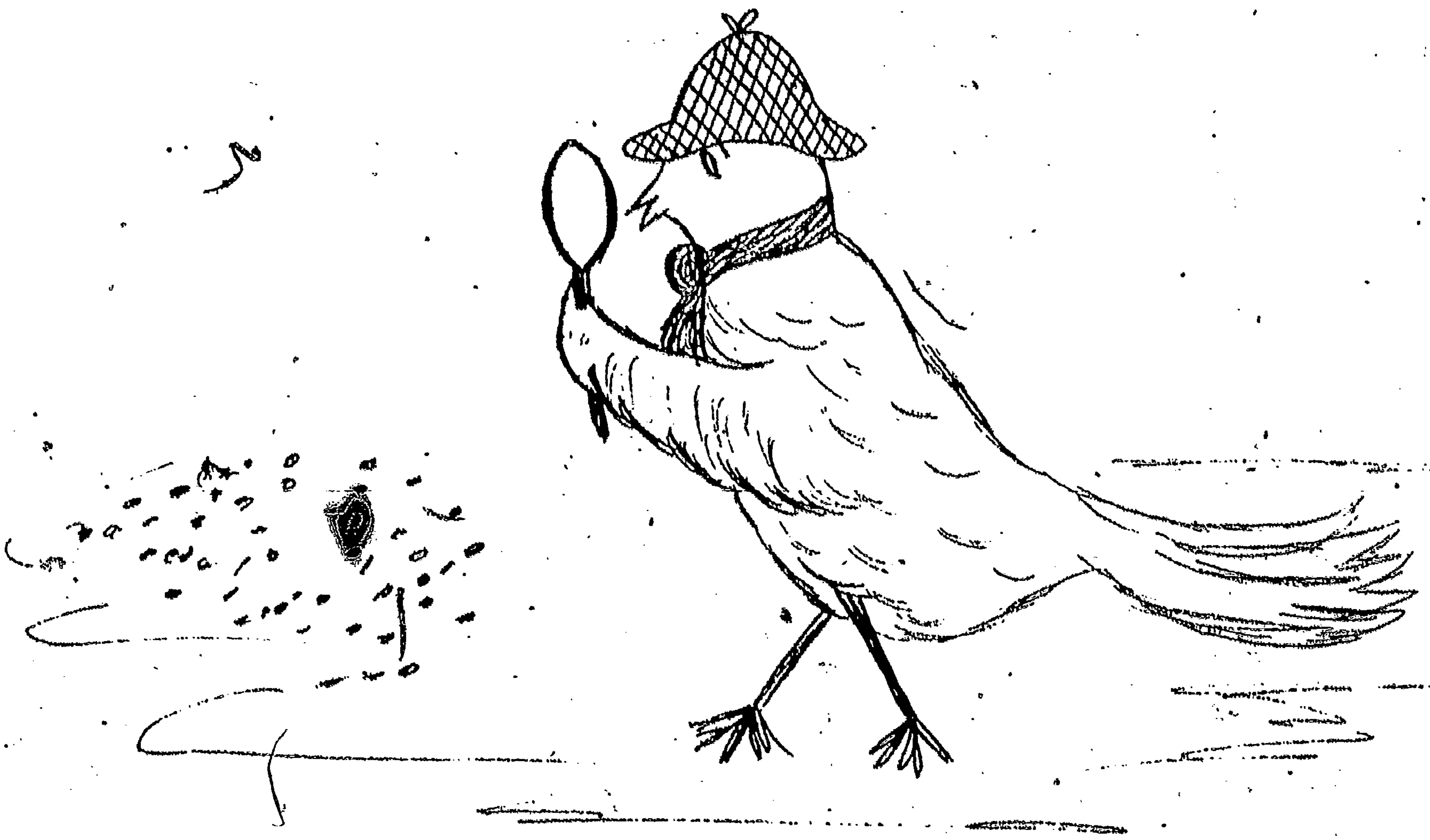
If each group of kids can borrow a pair of binoculars or a telescope for observations, their studies will be greatly facilitated. If equipment is available, kids might try to photograph various parts of the birds' reproductive cycle and tape record sounds made by the birds.

As a wrap-up for this activity, each group can present a report of their observations to the entire class, to another class, a parents' group, or even a local bird club.

Further Challenges:

1) How do bird's eggs develop? Try to incubate some fertilized chicken eggs in a home-made incubator.

2) Make a collection of birds' nests. (Do this in autumn after leaves have fallen,) Try to find out the type of bird responsible for building each nest.



THE MYSTERY OF THE COLORED BIRDSEED

by Alan McCormack

Focus: Do birds perceive colors? If so, are they more attracted by some colors than by others? This activity is aimed at finding answers to these questions by investigating the responses of feeding birds to colored birdseed.

Challenge: Find out if some of your local birds are attracted to specific colors of artifically colored birdseed.

Materials and Equipment:

Box of birdseed
Set of food coloring dyes
Old bed sheets or large pieces of cardboard
Several jars or tin cans

How-To-Do-It: You might begin this activity with a discussion of color vision and color preferences of people. Point out that people become accustomed to certain colors being associated with their usual foods. For example, mashed potatoes are always white, scrambled eggs are yellow, peas are green, etc. Suppose that mashed potatoes were suddenly green, scrambled eggs red, and peas were white! Would you still eat them? Or would your dietary preferences begin to change?

These interesting questions about the influence of colors on people's food choices can be equally interesting when applied to the behavior of birds. Do you think birds can see colors? Will their food preferences be influenced by colors? Try this investigation and find out.

1) Obtain a box of birdseed. Have youngsters sort the seed into piles of the same seeds. Keep only the two or three piles of the most common seeds, remove the smaller piles of uncommon seeds (to be fed to birds at some later time).

2) Place one or more old sheets or large pieces of cardboard in your school yard, a park, vacant lot or any other convenient place you know to be visited by ground-feeding birds. These sheets or cardboard will form feeding surfaces for the birds. Be sure to stake them down securely so they won't blow away.

3) Count out 100 of each type of birdseed you will use for the investigation. Spread the counted seeds over the feeding surfaces.

4) After one or two days, collect and count the seeds birds have left on the feeding surfaces. Record this information.

5) Now, repeat the experiment using dyed birdseed. For each 100 seeds of the same type, dye 25 blue, 25 red, 25 green, and leave 25 natural.

The seeds can be dyed by dipping them briefly into food-coloring dye. After the dye has dried, spread the seeds out on the feeding surfaces as before.

6) After the same time period as was used in the first part of this investigation has passed, again collect any seeds that remain on the feeding surfaces. Count and record.

Youngsters should then be encouraged to consolidate all data in simple bar graphs and interpret. Do the birds appear to select any color more than others? Do they tend to reject any color(s)? Do they prefer natural to colored bird seed?

Further Challenges:

1) Try a similar experiment using a bird feeder.

2) Try a similar experiment using dyed bread crumbs instead of birdseed.

3) Does the color of the feeding surface make any difference in attracting birds? Design an investigation to find out.

4) Does the taste of birdseed make a difference to birds? Coat some birdseed with honey, some with alum solution, and leave some uncoated. Do an investigation to find out if birds prefer or reject any of these birdseed types.


GREAT
RACE
TODAY!

Activity #5

THE GREAT INTER-ANIMAL SPEED RACE

by Alan McCormack

Focus: Which moves faster--ant or ground beetle? Can a centipede out-race a spider? Here is an enjoyable game-like activity suitable for any outdoor learning laboratory--even paved areas.

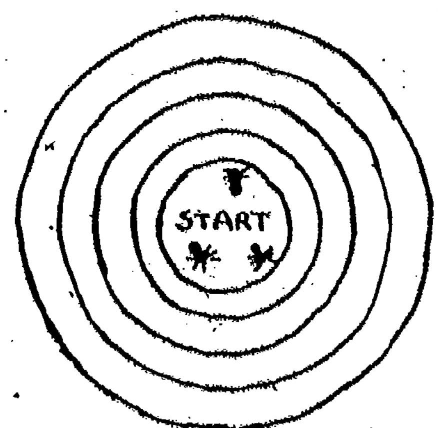
Challenge: Capture surface-moving small animals from your local environment, and race them to find which ones move fastest.

Materials and Equipment:

CESI Bug Catchers (see Appendix)
Sweep nets (optional)
String
Chalk or marking pen
Large cardboard (if pavement is unavailable)
Air-vented holding jars
Garden trowel for digging up earthworms (optional)

How-To-Do-It: Select an outdoor study area and have kids use CESI Bug Catchers, nets, or other devices to capture (without injuring) any small animals present (spiders, insects, worms, larvae). Temporarily store the captives in jars or other containers; be sure air circulation holes are made in the containers.

Now for the race. Make a race track by drawing a series of concentric circles with chalk and string on pavement or with a marking pen and string on a large piece of cardboard.



RACE TRACK

Tie one end of the string to the writing instrument and hold the other end with your thumb to draw the circles. For each race, place the small animal contenders at the "bull's-eye" center of the race track. The concentric circle arrangement of the track insures that each animal will travel the same distance to the finish line (outermost circle) no matter which direction it starts off. Set a time limit for each race--about three to five minutes is right. You might want to run several "heats" before having a "grand championship" final event.

Further Challenges:

1) Keep records of times for various animals to traverse the race track.

2) Determine speed-rates of the various racers.

3) Try to see if speeds can be increased by using bait, noises, or air currents to stimulate the animals.

Note: Return all animals unharmed to their natural habitat at the conclusion of the activity.

THE GREAT INTER-ANIMAL WEIGHT-PULLING CONTEST

by Alan McCormack

Focus: Which has more pulling power--grasshopper or cricket? Snail or earthworm? Is it really true, as some books insist, that an ant can carry a load 50 times its own weight? Kids love a good contest, and this one is almost certain to please.

Challenge: Find ways to compare the weight-pulling abilities of small animals that live in your locale.

Materials and Equipment:

Spool of thread
Pieces of cardboard (30cm x 15cm or larger)
Quick-drying epoxy cement
Watch or clock
Lettuce scraps
Metric ruler
Large supply of same-size paper clips
Sweep net (optional)
CESI Bug Catchers (see Appendix)

How-To-Do-It: Go to an outdoor learning area such as a vacant lot or park. Divide youngsters into groups of four or five. Have the groups capture small animals such as earthworms, snails, and various insects. A homemade sweep net might come in handy for capturing flying or jumping insects. Caution the youngsters not to injure any of their captives.

When each group has captured at least one contender for the weight-pulling contest, discuss how thread may be attached to the various creatures. Gently tie a thread loop around insects or worms (not on legs); use quick-drying epoxy cement to attach thread to shelled animals such as snails. Now you are ready for the main event.

Kids can place their thread-harressed animals on flat pieces of cardboard, and attach paper clips as weights to the threads. Lettuce can be used as an inducement for snails and vegetarian insects. Decide upon some minimum pulling distance (example: 5 cm) and time limit (perhaps 5 minutes) and have kids observe the animals pulling paper clip loads as shown:

Gradually increase the number of paper clips until the animal is unable to pull the load. Keep a data chart like the following:

Contender	Maximum # of paper clips pulled
Grasshopper	
Earthworm #1	
Earthworm #2	
Snail	
Ground Beetle	

If you have a scale sensitive enough to weigh the small animals, some kids may be able to calculate body weight/pulling power ratios. Or, they might estimate how much each of the animals could pull if they weighed as much as a 100-lb. person.

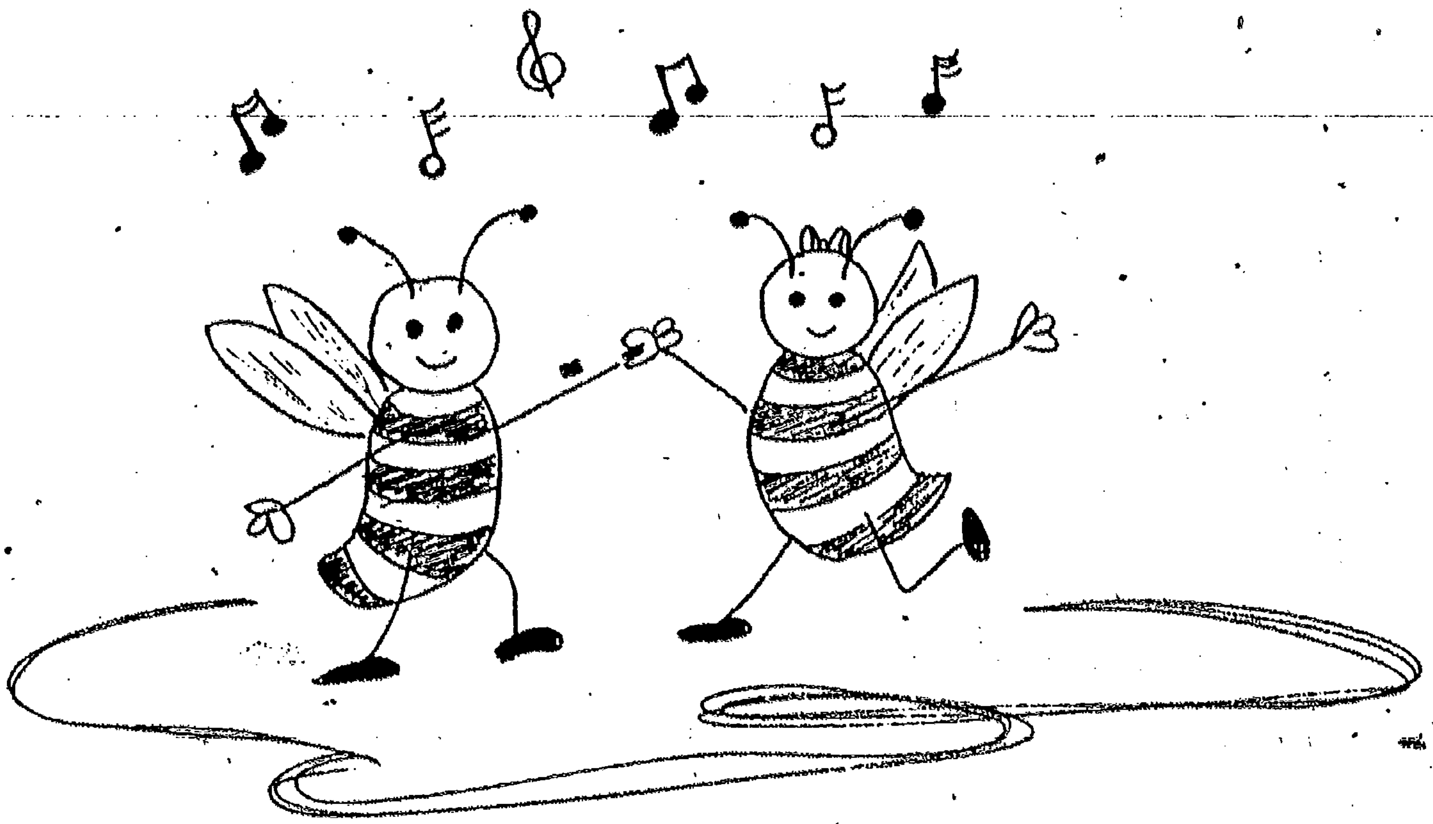
A follow-up discussion might be built around the question: "What makes small animals so strong compared to larger animals?" Or kids might write short science fiction stories with titles such as "What I Would Do if I had the Strength of a Snail."

<u>Further Challenges</u>:

1) Which animals are best at pulling weights up an inclined surface? Try to find out.

2) Have animal tug-of-war contests. Be sure you don't injure the animals.

<u>Note</u>: When these contests are finished, all animals should be placed back into the environment they came from.



TREASURE HUNTS OF DANCING BEES

By Irwin Sleznick

Focus: Communication plays an important part in any society--insect as well as human. Karl von Frisch, a European biologist, has done extensive studies of honeybee communication. He observed that bees communicate to each other through a series of dances. When worker bees find nectar-laden flowers, they return to their hive to direct the other workers to the food.

When the nectar source is near the hive, the bee does a figure-eight dance, with the middle straight "run" of the figure eight pointing in the direction of the food source. The scent on the bee's body informs the other bees what type of flower she has found.

If the nectar is some distance from the hive, the bee does a "waggle" dance in the straight run of the figure eight. (She "waggles" her abdomen from side to side.) The time taken in the waggle dance indicates how far away is the food source.

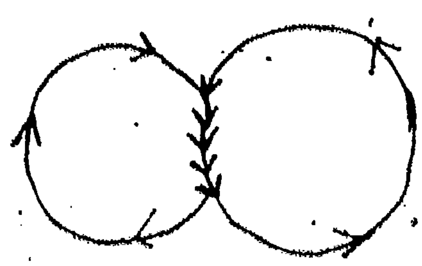
Challenge: Quickly locate a "treasure" of aromatic food by observing the dance of a "fellow worker bee."

Materials and Equipment:

Aromatic candy or gum (spearmint, peppermint, cinnamon or clove)
Food extracts of scents to match your aromatic candy or gum
Candy bowl
Dance music on cassette in portable tape player

How-To-Do-It: Begin by asking children how they would tell someone where to find a hidden treasure. Note that direction and distance from reference points are important parts of any communicated instructions. Then explain how a worker bee communicates the location of nectar to other worker bees by performing a dance in the hive. Demonstrate how the bee might communicate through a dance as follows:

a) Move in a large "figure eight."



b) Mark your middle run in a direction pointing to a "treasure."

c) Make as many short steps in the middle run as there are steps from the end of the run to the "treasure."

Have several kids try to see if they can understand your communication and find a previously planted "treasure" (piece of candy, gum, or Kool-Aid drink).

If you wish, you can make the communication dance more authentic:

a) Have the dancer "waggle" a number of times during the middle run to indicate how many treasures are to be found (i.e., two waggles = two pieces of candy).

b) The dancer might have scent of the treasure on his hand (peppermint extract).

c) The dancer can designate other "bees" to go find the treasure by tapping them with "antennae" (long pipe cleaners).

After some practice with basic rules of the dance, kids can try using it in a large outdoor area. The steps of the middle run can be used in a ratio of 1-10 or 1-20 steps taken in actually moving after the treasure. The teacher can have treasure hidden at various places with treasure locations written on cards to be communicated by the "dancing bees."

Children who are able to handle an additional variable may recognize that the dance of the bees is not performed in the open room or field in which the treasure is hidden. Bees waggle-dance on the inside walls of their hive. The location of the food is communicated with reference to the position of the sun in the sky. When the run is downward, workers must fly from the hive away from the sun. When the run goes up the wall, the food is on the sun side of the hive. The upward and downward angles of the run communicate the exact course a worker must fly after it leaves the hive.

To play the game with the sun and the hive as points of reference, proceed as follows:

1) Designate a point in the field as the door of the hive. This point may be an object such as a flag pole or first base in a ball field.

2) Hide the treasure. Notice how the sun shines on your body as you move from the hive to the treasure.

3) Set up the dance circle in the classroom. Assume that the sun is in one position in the room.

   a) If worker bees must fly away from the sun, make the run of the dance away from the sun.

   b) If worker bees must fly into the sun to find the treasure, make the run of the dance toward the sun.

   c) If the treasure is to the right of the sun about 30° (at one o'clock) make a run of the waggle dance equal to 30° to the right of the sun.

4) Keeping other factors the same as above, release students from the classroom hive to seek out the treasure in the field.

Discussion following these activities might examine differences between human and honeybee communication systems or children's ideas about how other animals communicate.

Further Challenges:

1) Observe ants, birds, or dogs and look for evidence of communication.

2) Find out what "triggers" a worker bee to sting another animal.

Activity #8

TAKE A FLY TO LUNCH

by Beth Schultz

Focus: We usually say "Ugh" when we see flies because we associate them with garbage and filth. They irritate us when they walk on our skin and they are known to carry germs on their hairy legs. We hate to have them walk on our food because they contaminate it.

But flies do have some ecological value as scavengers, and they can be fascinating to watch as subjects for study of insect behavior.

Challenge: Watch a fly lay eggs.

Materials and Equipment:

A small piece of raw liver, fish or other meat
Hand lens

How-To-Do-It: This is best done on a warm sunny day during warmer months when flies are prevalent. Find a quiet and undisturbed outdoor location. Put a piece of raw meat on a flat board or stone in a place where you can conveniently watch it. Check the setup every few minutes to see if flies have found the meat. When you see a fly on the meat, sit nearby and watch. Does the fly eat the meat? If so, how does it use its mouth in doing this? Does the fly lay eggs? If so, how? How many eggs are in a cluster? What color are the eggs?

After observing flies' behavior consider this question: What role do flies play in an ecosystem?

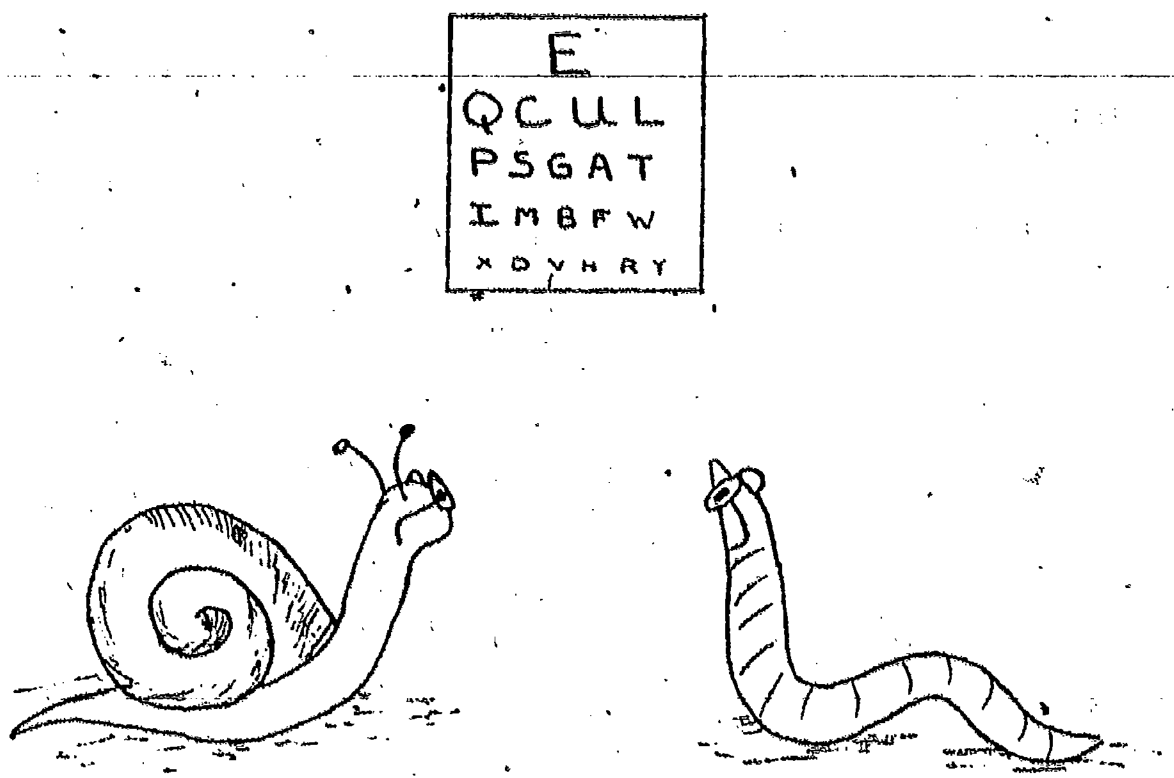
Further Challenges:

1) When a fly egg hatches, what emerges from it? Set up an experiment to find out.

2) Are flies attracted to certain food substances more than others? Set up an experiment and investigate this question.

Reference:

Dethier, V. G. To Know a Fly. San Francisco: Holden-Day, Inc., 1962.


E
QCUL
PSGAT
IMBFW
XDVHRY

SIMULATING VISION OF SLUGS AND WORMS

by Alan McCormack

Focus: Many invertebrate animals, like snails, slugs, worms, and many insect larvae, have visual systems quite different from those of vertebrates. Their "eyes" lack lenses and other complicated parts: they consist of a relatively simple group of light-sensitive cells. It is highly unlikely these simple "eyes" form images at all. Biologists believe they only function in giving the invertebrate animals information about relative intensity and direction of light.

Challenge: Experience what it might be like to have the limited visual abilities of slugs, snails, or worms.

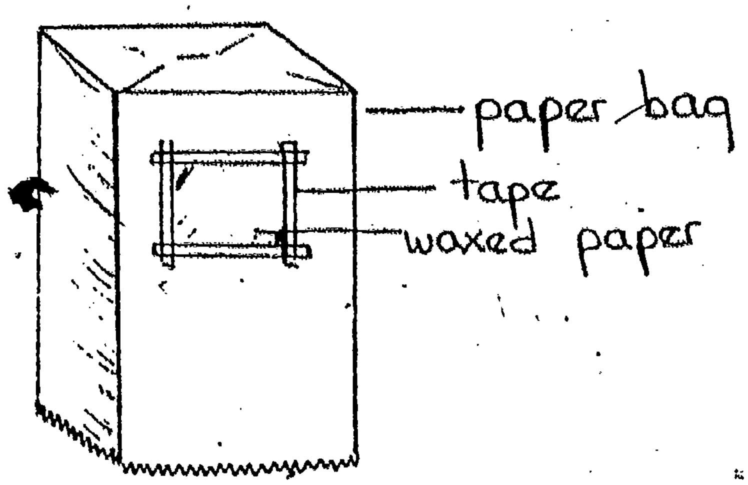
Materials and Equipment:

Paper bags (larger than pupils' heads)
Waxed paper
Masking or cellophane tape
Pieces of rough cloth (burlap)
Flashlight(s)

How-To-Do-It: A very good way to provide a simulation of the limited vision of simple-eyed invertebrates is to build a simple vision simulator as follows:

1) Cut a window in a paper bag approximately 15cm long by 10cm wide. This window should be placed on one side of the bag so it will be located at eye level of a child when the bag is placed over the child's head.

2) Tape a sheet of waxed paper over the window and you've got it— a vision simulator!



When this device is placed over a youngster's head you will be able to see his eyes and facial features quite clearly, but the outside world, to him, will appear as a blur of light and dark patches--very likely what a snail sees.

Moving and Finding Food: Pair children up and show them some small pieces of rough burlap (or other available rough-textured material) to be used to represent "food." Scatter the "food" around a lawn or other outdoor area. Then have the kids take turns being "slugs" and "safe buddies." The "slug" wears the vision simulator and tries to find "food" with his/her sense of touch and limited vision. The "safe buddy" simply stays by the "slug" to be sure he doesn't wander into some dangerous situation or away from the study area. If you wish, this could be made into a game with a team of "slugs" competing with a team of "snails" to find the most food.

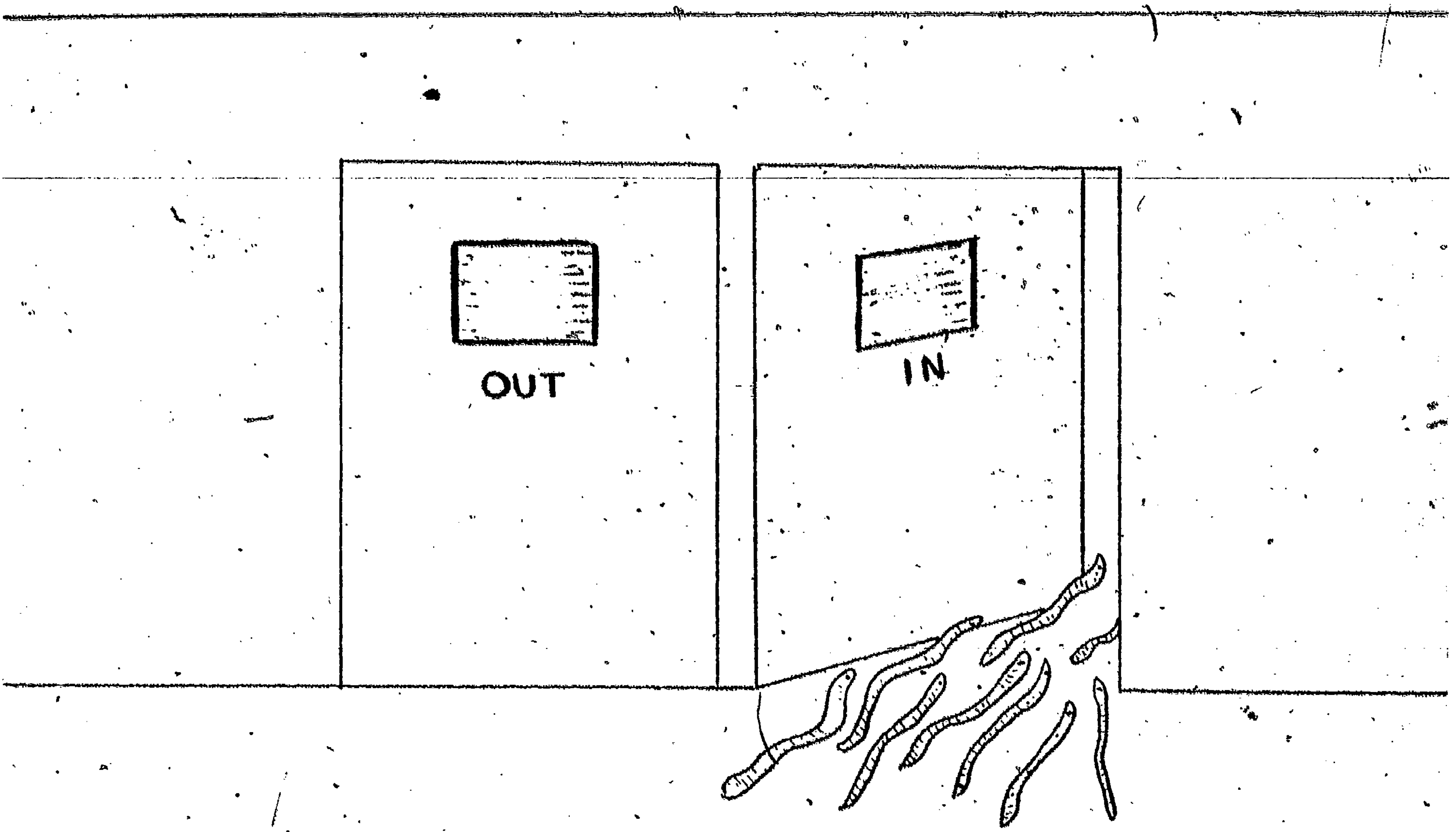
Telling Direction of Light ("Slug in the Center"): Do this in a shady or relatively dark area. Have kids form a large circle and sit on the ground. One youngster is placed at the center of the circle with a vision simulator over his head. A flashlight is then passed quietly around the circle. At a signal, one of the youngsters in the circle may turn the flashlight on and shine it directly on the paper bag vision simulator. The youngster wearing the bag then tries to point in the direction of the light. If he is successful, he takes the place of the child with the flashlight, and the youngster giving up the light becomes the "slug" in the center.

Moving Away From Light ("Worm in the Burrow"): Earthworms, slugs, and snails are photonegative--they are repelled by bright light. You can simulate this with another game. Do this in a shady or dark area, or in the evening after sundown. Ask for two pairs of kids to take part in a "Worm in the Burrow" game. Of each pair, one youngster elects to be the worm (wears the vision simulator) and the other is the light beam director. Identify a tree or some other object for each team as its "worm burrow." Both teams start in the same place; the light beam director tries to steer his worm to its burrow using the light beam alone (no verbal coaching allowed). Kids must keep in mind that the worm always moves away from the light beam. First worm to his burrow wins.

Further Challenges:

1) Invent other games using the vision simulator.

2) Replace the waxed paper window in the vision simulator with transparent colored cellophane or plastic. See what experiments you can use this for in the area of color vision.


OUT
IN

THE WORMS CRAWL IN ...

by Alan McCormack

Focus: Even apparently "simple" animals such as earthworms have built-in mechanisms for sensing and reacting to environmental cues. Activity #12, WORM GRUNT, provides evidence that earthworms are sensitive to mechanical vibrations of soil. The following activities encourage youngsters to explore mechanisms of earthworm movement and their reactions to touch, light, and moisture.

Challenges: Find out how an earthworm is able to move. Investigate how an earthworm reacts to touch. Demonstrate that earthworms are sensitive to light. Find out if earthworms prefer a specific amount of moisture in their environment.

Materials and Equipment:

Earthworms
Large sheet of rough paper or cardboard
Smooth sheet of glass or plastic
Shallow box with opaque covering
A long (2-3 meter) wooden or metal trough filled with sawdust, leaf mulch, or loose soil
Small transparent glass or plastic tubes or pill vials

How-To-Do-It: A number of interesting investigations can provide information concerning the senses and movement abilities of earthworms. Here are a few suggestions:

Earthworm Movement: Collect some earthworms and keep them in moist soil. Select a single earthworm and wash it off with clean, room-temperature water. Place the worm on a large sheet of rough paper. At first it will squirm about. After a few minutes it will begin to move forward. Have children observe the alternate contractions and extensions of each segment of the worm as it moves. Waves of contractions can be observed passing down the worm.

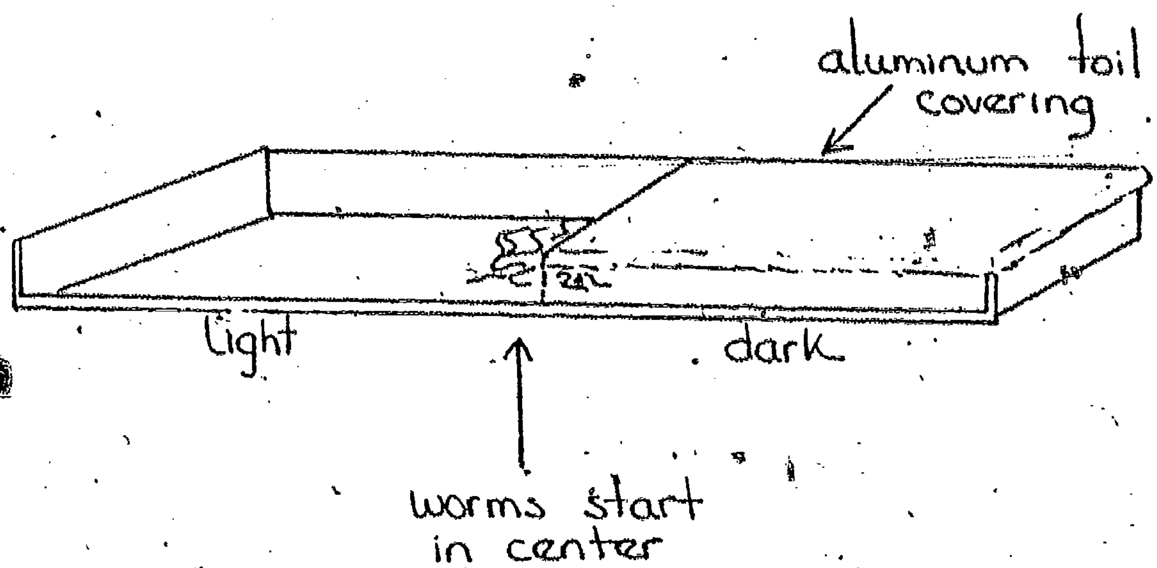
Children can listen closely and hear a faint scratching noise as the worm moves. Have the youngsters feel the worm's surface--they may be able to detect small bristles sticking out of each segment. These bristles act as anchors fixing one part of the worm to a surface while the other part is drawn up to it. A test of the importance of the attachment of the bristles to a rough surface can be done by placing a worm on smooth glass or plastic: the worm slips and cannot move forward.

Reactions to Touch: Kids can use a piece of stiff grass or a weed stem to stroke various parts of an earthworm to find where it is most sensitive to touch. They can draw a "reactions to touch" map on paper showing the most sensitive portions of the worm.

Then place a number of worms in an open box with some small, transparent containers (plastic tubes or small pill bottles, for example). The worms will be likely to crawl into them--they normally live in situations where their bodies are totally in touch with solid surroundings. Whenever they are not in maximum contact with their environment, they keep moving until they find a place offering maximum bodily contact.

Reactions to Light: Earthworms are very light-sensitive. Though they lack "eyes," their skin is studded with light-sensitive organs. These organs are most concentrated on the surface of the worms' front ends, and if a light beam is aimed at these regions the worms invariably make a quick retreat. Thus, earthworms are strongly photonegative--they tend to avoid light and seek darkness.

To investigate this light-avoidance behavior, place 5-10 earthworms at the center of a large tray or box. The bottom surface of the box should be rough and moist. Cover one-half of the box with opaque paper, aluminum foil, or some other material to form a light barrier. The idea is to set up a situation where the worms have a choice between distinctly light and dark areas.



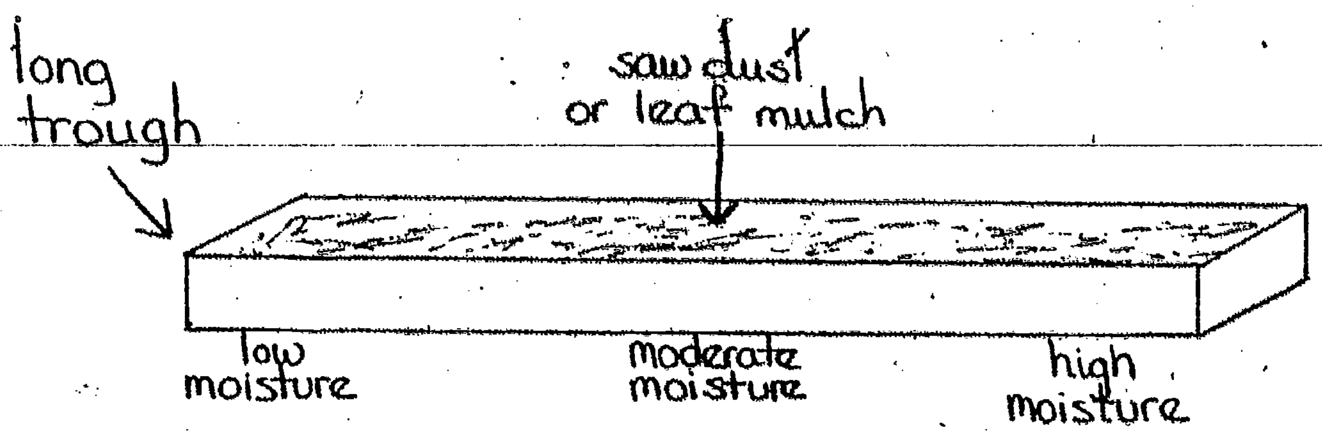
CUT-AWAY VIEW OF LARGE SHALLOW BOX

Observe the earthworms at five-minute intervals. Within 15 or 20 minutes they likely will all be in the dark area of the box where they will remain indefinitely.

Reactions to Moisture: Dead earthworms are often observed on the ground after a heavy rainfall. This happens because the worms begin to suffocate in their flooded burrows, and they squirm up to the surface. If the ground surface is also flooded with a layer of water, they die from lack of oxygen. To remain alive, earthworms must have at least small amounts of gaseous oxygen in contact with their moist skin. They "breathe" by taking in oxygen directly through their skin.

On the other hand, insufficient moisture also results in an earthworm's demise. If its skin is not sufficiently moist, oxvgen cannot be absorbed and asphyxiation occurs.

Because of these respiratory problems, earthworms tend to seek environments containing just the right balance of water and air for efficient respiration. To investigate this behavior, fill a long wooden or metal trough with sawdust, leaf mulch, or loose soil. Keep the material at one end completely dry, the other end totally water-saturated and the center slightly moist but not wet. Introduce a number of worms into the center of the trough. After one or two days, locate all the worms. You will very probably find all worms within a narrow section of the trough where the moisture level is optimal.



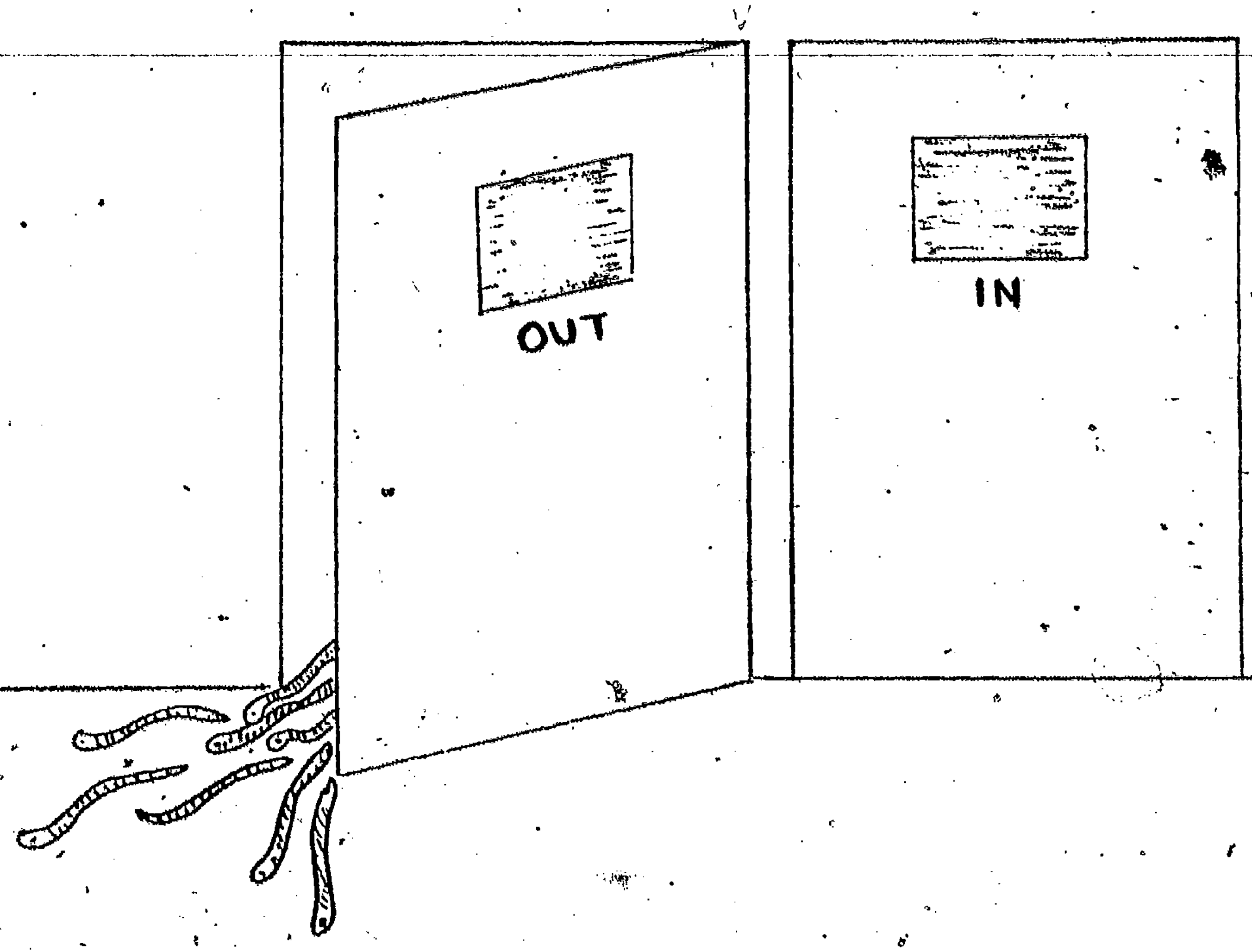
Further Challenges:

1) Are earthworms sensitive to different colors of light? Design a way to find out.

2) How fast can earthworms move? Conduct an investigation of their rate of travel.

3) Can earthworms detect air currents? Try to determine if they can.

4) Can earthworms climb an incline? Find out.


OUT
IN

THE WORMS CRAWL OUT ...

by Alan McCormack

Focus: Few people realize that earthworms do much of their feeding at night on the surface of the ground. The worms glide part way out of their tunnels at night, leaving their "tail" ends firmly anchored in their burrow openings. They then probe the surface in search of dead plant material. When worms find suitable food, they pull it down into the burrow. These dead plant fragments are then coated with a slime which helps decompose and lubricate them for ease of swallowing.

Challenge: Find evidence that earthworms feed on dead plant materials found on the surface of the ground.

Materials and Equipment:

Worm culture
Paper and pencil

How-To-Do-It: Culture some earthworms in a box or large bucket of soil. Use soil that does not contain discernible large fragments of decaying plants. Collect some partly decayed plant parts (leaves and stems) and trace outlines of these materials on a piece of paper. Then place the plant parts on the surface of your worm culture. Leave overnight. Observe in the morning. Retrace remaining plant parts and compare with original tracings. Also, look for evidence of slime on the plant parts.

Further Challenge:

Do worms prefer one type of plant part to others as food? Devise a method to answer this question.

WORM GRUNT

by Alan McCormack

Focus: Earthworms are an important link in the natural balance of nature. One professional soil ecologist maintains that earthworms do more to constructively alter the nature of soil than all other soil animals combined. These master excavators create thousands of miniature mine shafts, allowing air to circulate in the soil. These shafts also allow water which would otherwise be lost as runoff to enter the soil. The famous biologist Charles Darwin was much impressed by the materials-cycling activities of worms. He estimated that one acre may contain as many as 50,000 earthworms and in one year these may bring 18 tons of soil to the surface. Thus, if earthworms ever stopped burrowing, the top layers of soil might become exhausted of certain minerals essential to plant growth.

In which types of soil are earthworms most common? In which soils are they absent? Sampling populations of earthworms can be fun and an instructive experience.

Challenge: Sample a population of worms without harming them.

Materials and Equipment:

Hammer
String
Meter stick or tape
Old automobile leaf spring or a one-meter-long rigid wooden stake

How-To-Do-It: To sample populations of earthworms in different soils, borrow an old fisherman's technique called "worm grunting." This approach is based on earthworms' extreme sensitivity to soil vibrations; low-pitched vibrations tend to make them uncomfortable and send them wriggling to the soil's surface.

An idea tool for providing worm-annoying low-pitched vibrations is a long leaf from an old automobile's rear wheel leaf spring. You can obtain one of these from a junk yard or auto repair shop. (Be sure to remove and use only the longest leaf from the spring--don't use the entire four- or five-leaf spring.) If you cannot find an automobile spring, substitute a strong wooden stake about 1-1½ meters long.

Now for the grunting: Hammer the spring into the soil you wish to sample for earthworms. About 30 cm (1 ft.) of the spring should extend downwards into the soil. Now, take a wooden stick and repeatedly pull the upper end of the spring, causing a series of regular vibrations in the soil below. These vibrations will cause any earthworms within about a meter's radius from the spring to rise to the surface.

To do a quantitative sample, use string and a meter stick to make a one-meter square area with the spring embedded at the center of the square. Do several samples of a large soil study area, calculate the average number of worms per square meter, and then calculate or estimate the number of square meters in the total study area. Simple multiplication will then give you a good estimate of the total number of worms in the entire study area.

Compare dry and wet areas, grasslands, lawns, forest floors, denuded land, etc., to find which soil types are best for worms.

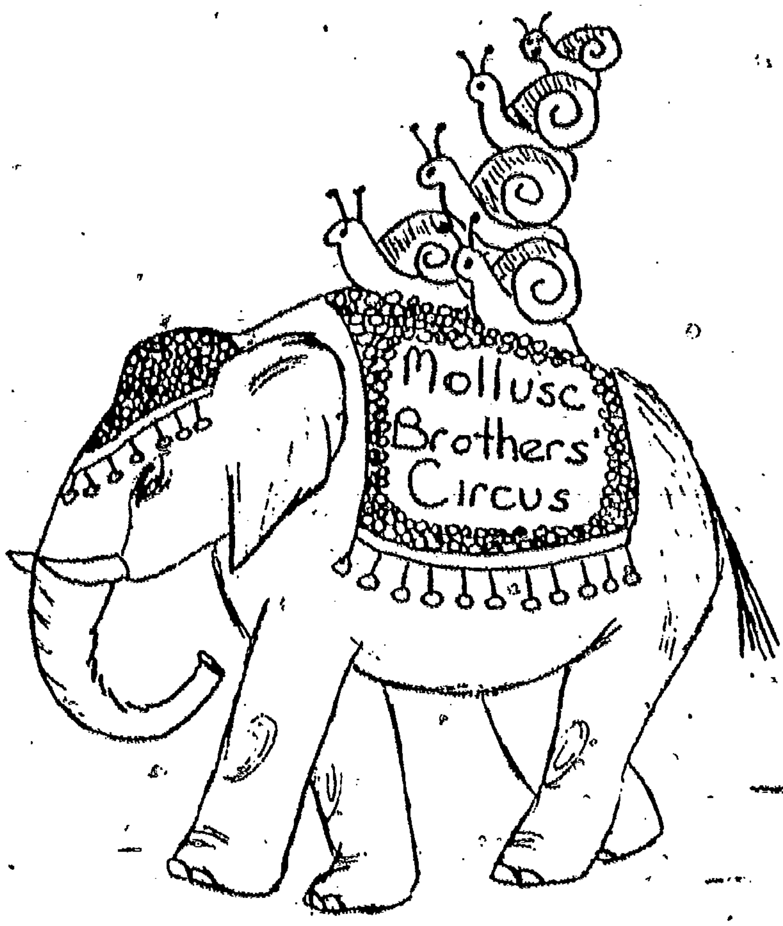
Further Challenges:

1) Invent another technique to bring earthworms to the soil surface. (Hints: try water or electricity from an automobile battery.)

2) Earthworms sometimes leave deposits of digested soil on the ground near openings to their burrows. These are called "castings." Organize a "treasure hunt" for worm castings. Have teams of youngsters map the location of castings in an area, and estimate the number of worms present from the number of castings found.

3) How does application of manure or inorganic fertilizer to a study area affect the size of the underlying earthworm population? Design an investigation to find out.

4) How does application of pesticides affect populations of earthworms? Design an investigation to find out.


Mollusc
Brothers'
Circus

SNAIL AND SLUG STUNTS

by Alan McCormack

Focus: Snails and slugs are Molluscs--a diverse group that also contains oysters, clams, and octopi. Both have soft bodies supported by a single muscular "foot." And, they both have two long stalks on their heads that are used as feelers. Slightly behind these are two shorter stalks which each bear an eye. Other sensory organs are lodged at various places in the skin of these animals. As a result, they are sensitive to light, sound, and smells. The only major difference between snails and slugs is that snails have a shell and slugs do not.

Challenges: Find out if snails have a home territory. Observe how snails and slugs are able to move. Observe the feeding behavior of snails and slugs. Determine the responses of these animals to different surfaces.

Materials and Equipment:

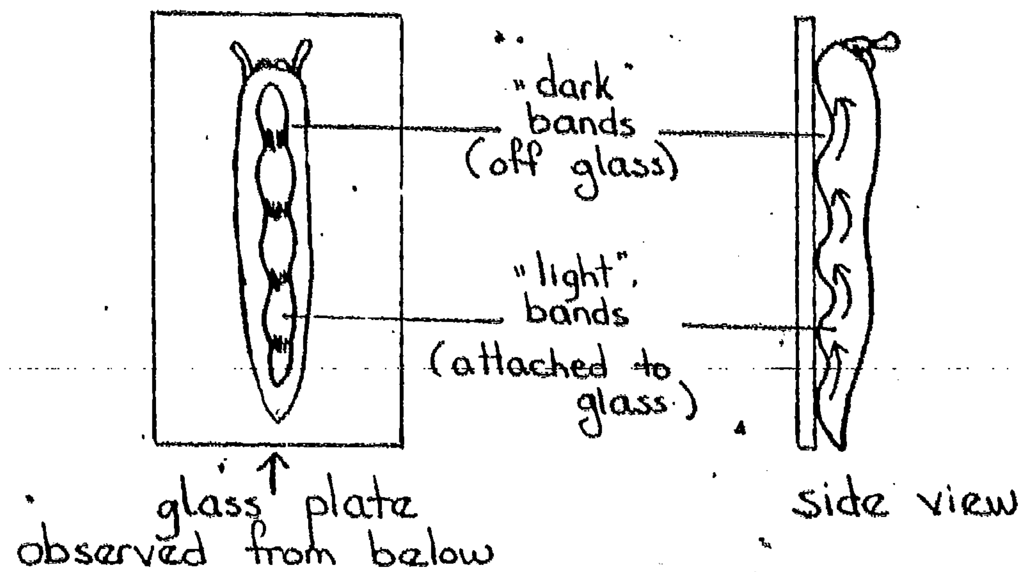
Nail polish or oilpaint with small paint brushes
Large paper for a map
Cardboard
Glass jars
Lettuce, minced meat, chocolate, onion or other foods
Materials for surface textures--rough sandpaper, smooth cloth, rough gauze, plastic, etc.

How-To-Do-It: Snails and slugs are common in most damp areas of North America. Since they are most active at night, however, they may not be obviously apparent during daylight hours, so kids will have to hunt for them under rocks and rotting logs and other damp nooks and crannies.

Snail and Slug Hunt: You might begin by simply having kids map a study area and note on the map the locations of all snails and slugs they can find. Look for relationships between where the animals are found and environmental factors such as dampness, darkness, decaying vegetation, etc.

Next consider the question: "Do snails have a home territory?" You can investigate this problem by marking shells of snails with numbers applied with oil-based paint (nail polish is ideal). Place snails back in exactly the same spots they were found, and note their locations on your maps. Return several times to relocate the snails on subsequent days. You will be likely to find your snails in the same locations. Snails tend to establish "home" areas where they remain for life.

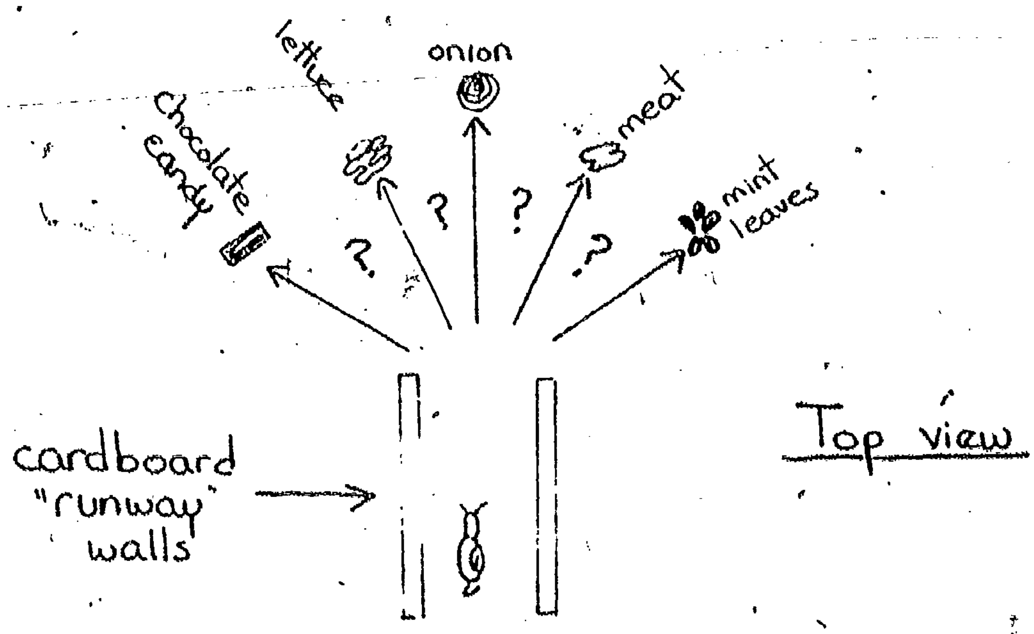
Molluscan Movement: Snails and slugs move by using the large, muscular "foot" at the base of their bodies. This can be observed by watching one of these animals creep along the inside of a glass jar. Watch the movements of the foot from the underside. Ripples of contraction can be seen moving from back to front. Where the animal's foot is attached to the glass it appears pale. In between the pale areas are dark-appearing areas which are arched up and pushed forward.



Feeding Behavior: Snails and slugs are normally vegetarians, but various types are known to eat just about any edible material imaginable. They usually move about at night in search of suitable food. When they find some, they eat by scraping the material with a rasp-like tongue (the radula) attached to the bottom of their mouths.

Feeding can be observed by placing one or more of these animals in a jar with some lettuce. Observe in a shady or dark place as light tends to irritate snails and slugs.

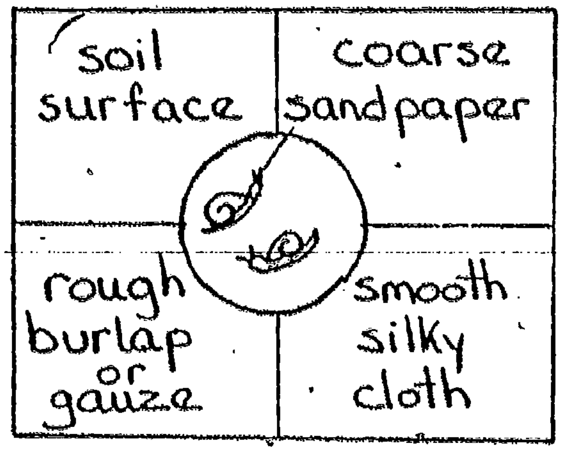
A food preference experiment can be done as shown below:



Be sure to conduct several trials with different subjects in experiments like these. Results of any one trial might happen simply due to chance.

Responses to Surface Textures: These land-dwelling molluscs have a slime-secreting gland at the front of their bodies. They glide on a slime layer which prevents abrasion by the underlying surface.

Is the slime protection system effective enough that slugs and snails can move over any textured surface, or do they prefer certain surfaces to others? To find out, kids can set up an investigation as shown:



You can, of course, vary the selection of surface textures according to what you have available or would find interesting to use.

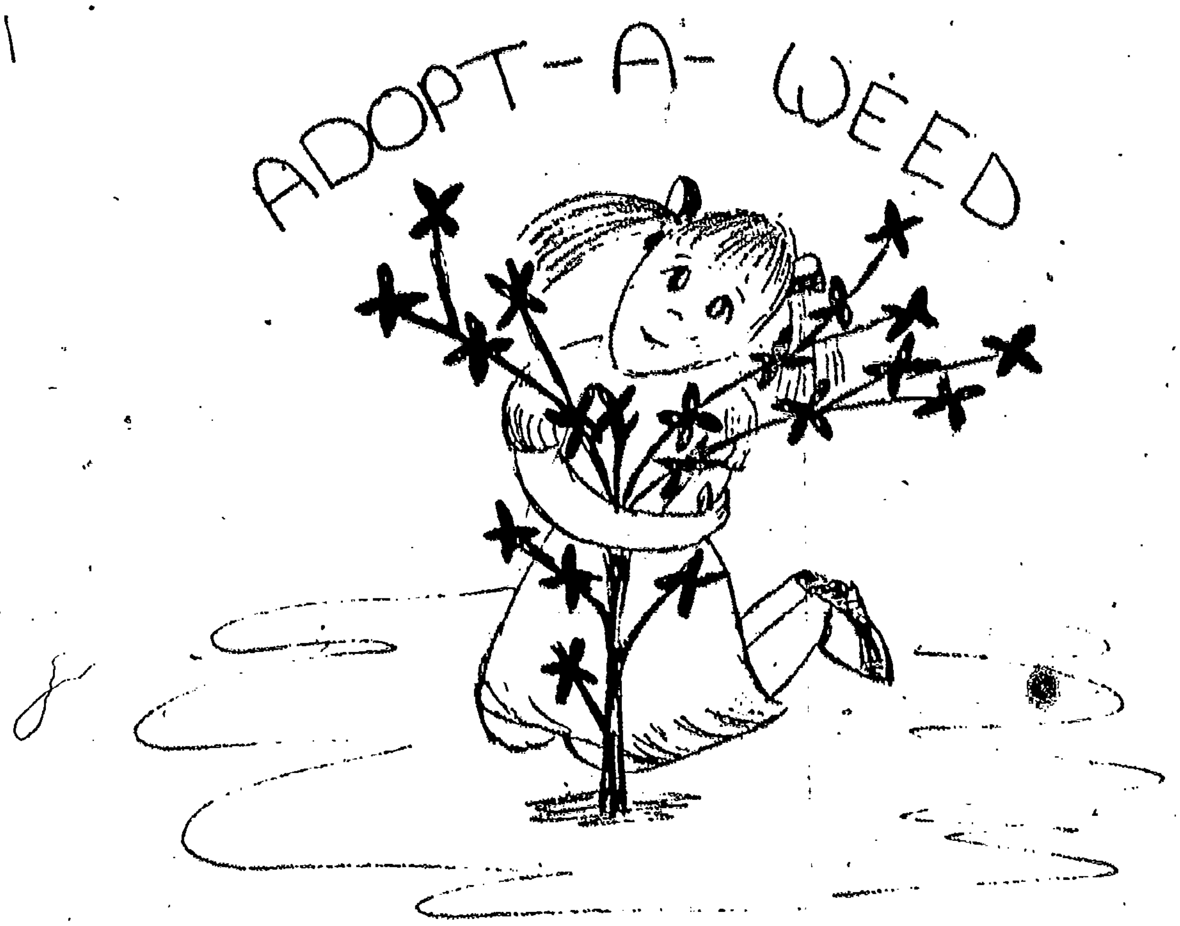
Further Challenges:

1) Devise a method to determine snail and/or slug responses to light.

2) Try to measure how fast slugs and/or snails can travel.

CHAPTER III

PLANT STUDY ACTIVITIES



ADOPT-A-WEED

by Alan McCormack

Focus: Wild plants, often referred to as "weeds," can be found most anywhere. When they happen to grow on a manicured lawn or in someone's flower garden, they are considered pests--something annoying to be destroyed. If you take a more comprehensive view of nature, however, you begin to realize that the gardener's weed may play an important part in a meadow or forest ecosystem. Wild plants form links in food chains, prevent erosion, provide habitats for small animals, and even beautify natural areas. Many wild plants are every bit as beautiful and interesting as the gardener's prize rose bush--if you take the time to really observe them.

Challenge: Select a wild plant and learn as much as you can about it through direct observation.

Materials and Equipment:

Tape measures
Notebooks and pencils
Paper and crayons for rubbings (optional)
Cameras--instant or standard (optional)
Hand lenses (optional)
Masking tape and indelible marking pen for plant labels

How-To-Do-It: This is a good long-term outdoor activity best started in the early spring. Take your class to visit a vacant lot, a weed patch behind a parking lot or service station, or an uncultivated field. Try to find a site not likely to be mowed, tilled, paved or otherwise interfered with during spring months. You may have such "wild" areas on the borders of your schoolyard and be able to arrange with your school maintenance department to leave them untouched for a month or two.

Have each youngster select one wild plant to adopt as his/her "very own" for close study. Provide masking tape and an indelible marking pen so kids can place tape labels bearing their names around stems of plants they adopt.

First Observations--Encourage kids to start a notebook or diary about their adopted plant. They might make entries regarding the following questions:

1) Describe the plant as it appears today (color, shape, location, injuries, general health).

2) Measure everything you can with a tape measure (height, greatest width, dimensions of leaves, circumference of stem, etc.).

3) Count all plant parts--stems, leaves, buds, flowers, etc.

4) Does the plant have any odors?

5) What textures can you find on various parts of the plant? You may be able to record textures by making crayon rubbings.

6) Does the plant make any sounds?

7) What other plants are the nearest neighbors of your plant?

8) Do any animals live on or visit your plant?

You may want kids to sketch or photograph their plant.

Subsequent Visits: You will find it worthwhile to have kids visit their adopted plants every two to three weeks and repeat their initial observations. They can then consider questions such as:

1) How much has the plant grown?

2) Has it changed in appearance?

3) How does it reproduce? If it has flowers, how are they pollinated? How are seeds or spores dispersed? How many offspring might this plant potentially have?

4) How long does it live?

5) How does it affect other plants and animals living nearby?

6) How do other plants and animals affect your plant?

7) In which ways has the plant remained the same?

8) What is good about this plant? Bad?

Now drawings or photographs can be made at each visit, so eventually kids might develop "This Is Your Life" posters or storybooks about their plants.

Further Challenge:

1) Predict what your plant may be like in one year. Then return after a year and check to see how close your prediction came.

2) Try to find out the official scientific name of your plant.

Reference:

Palmer, E. Laurence. Fieldbook of Natural History. New York: McGraw-Hill Book Company, 1949.

Activity #15

BAG-A-BRANCH

by Dorothy Alfke

Focus: Plants give off large quantities of water into the atmosphere. Most of this water leaves through minute openings in the leaves. These openings are called stomates and, for many common plants, they are located on the under surface layer of the leaves. This process of water loss is called "transpiration." Most of this water was originally absorbed through the roots from the soil. The soil water contained dissolved minerals which are used by the plant for growth and other metabolic activities. The quantities of water released by a plant are so great that botanists have not been able to completely explain why and how it all happens.

Challenge: Find evidence of water given off by trees. Make inferences about this process.

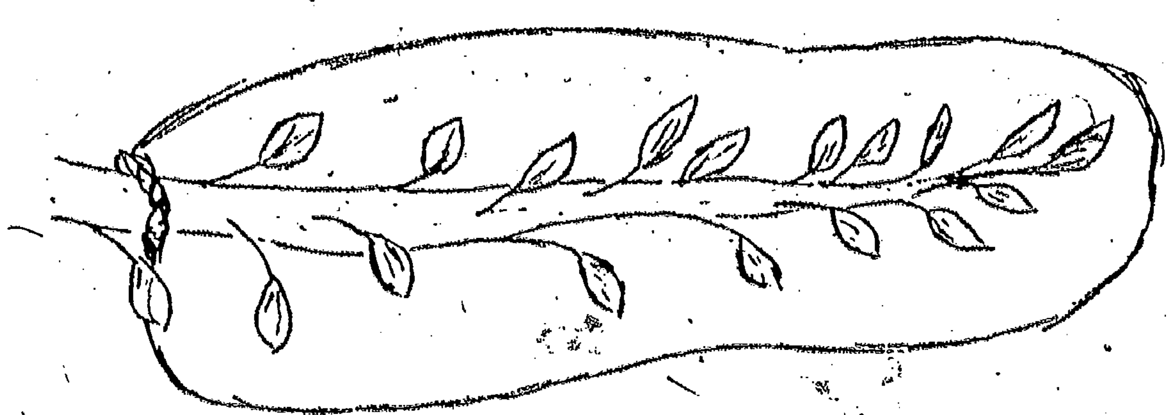
Materials and Equipment:

Large plastic bags (one-gallon capacity or more)
Cord or heavy string
Measuring cups
Heavy paper for tags

How-To-Do-It: This activity is appropriate in late spring when leaves are well-developed, throughout summer, and in early fall before leaves begin to change color.

The possibility of vandalism or mischief to the project should be considered, so either locate the bags inconspicuously on the trees, or prepare tags for the bags indicating an experiment in progress.

Take the class outdoors to an area where leafy trees can be found and where the branches of the trees are low enough for the children to reach. Show the youngsters how to carefully enclose part of a leafy branch in a plastic bag. Tie the open end around the branch with some cord, enclosing branch, leaves and air.



After the demonstration, divide the class into groups of four to five children. Provide each group with a bag and string, and have them bag-a-branch. Encourage them to select varied kinds of trees. (If possible, include Norway or sugar maple, and ash, as these produce good results.) Leave bags overnight--or longer if necessary to collect water.

When water has collected, have the children <u>carefully</u> remove the bags so as not to lose any liquid. Empty the liquid into measuring cups. (As much as half a cup has been collected from one bag overnight.)

Have the kids try to answer questions that may come up:

1) Where did the water come from?

2) Is it water or something else? (Have them feel it, and if you are <u>sure</u> no sprays are involved, taste it.)

3) Did the water collect during the day or night, or both?

4) Did the water come from the air or tree?

5) Does the water come from the leaves or twigs?

6) Does temperature make any difference in moisture collection?

7) Does the water come from the top part of the leaf, the bottom, or both?

8) Would more water collect when it is rainy and the ground is soaked?

<u>Further Challenges</u>:

1) Find out if water comes from leaves or twigs by doing an experiment: tie one bag around a branch with leaves and one around a branch from which you've removed the leaves.

2) Vaseline smeared on a leaf seals the stomates. Using this idea, devise a method to determine whether the water comes from the top part of a leaf, bottom, or both.

3) Devise your own experiments to answer some of the questions posed in this exercise.

LIGHTBEAMS AND LEAVES

by Alan McCormack

Focus: Green plants constitute the basis for all life on earth due to their ability to capture light energy and convert it to chemical energy. This process, known as photosynthesis, provides the food for the first link in all food chains. Without green plants, all animals would eventually die off.

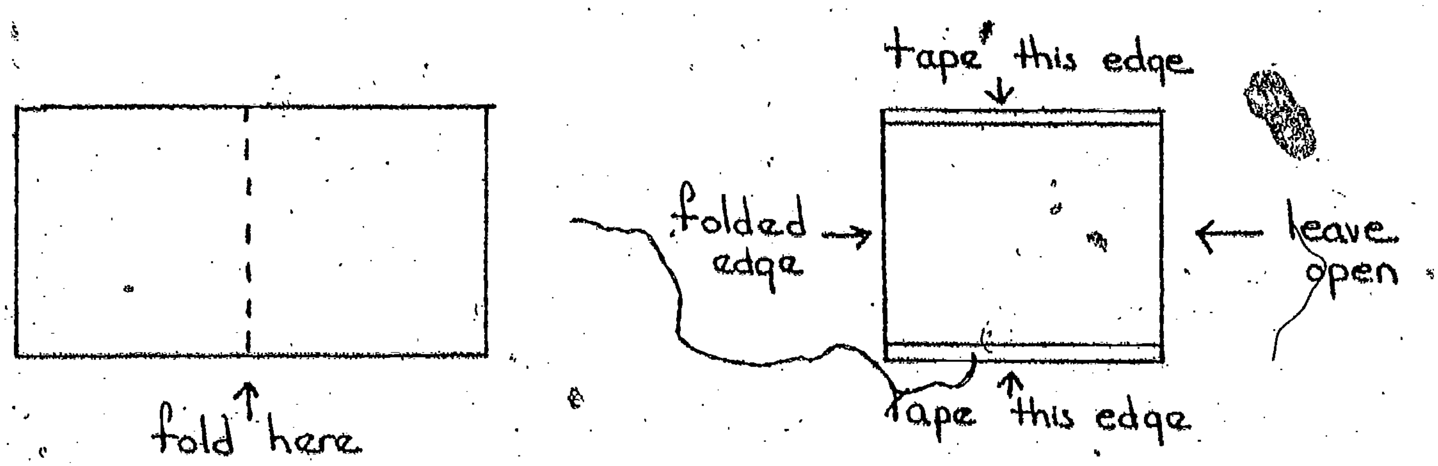
The white light that falls on green plant leaves is actually a mixture of all colors of light. And not all of these colors can be used efficiently in photosynthesis. Red light is strongly absorbed by plants for photosynthesis, while green light is reflected by the leaf and essentially cannot be used for photosynthesis. When white or red light is available, green plants stay green and photosynthesize. When light is absent, or only green light is available, these plants tend to turn white, become weak and spindly, and cease photosynthesizing.

Challenges: Find out what happens to green tree leaves exposed to white, red, green, or no light for one week. Compare these leaves with those kept in darkness for the same time period.

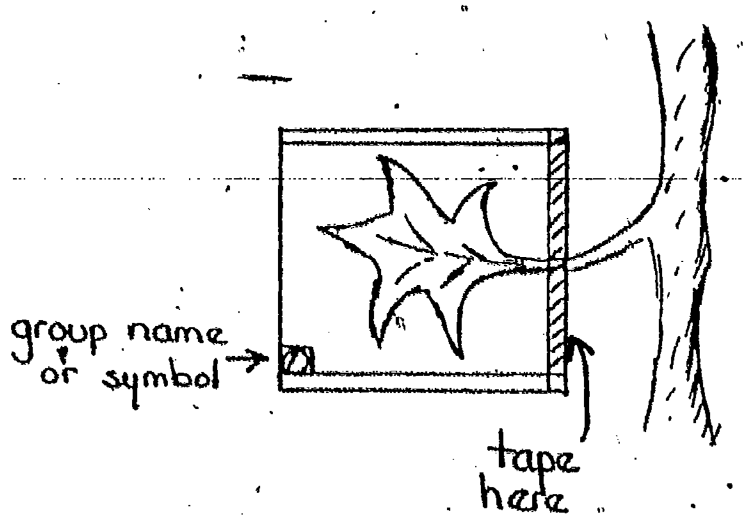
Materials and Equipment:

Transparent cellophane or plastic in the following colors: red, green, clear (colorless)
Opaque cellophane or plastic
Masking or cellophane tape
Paper and pencils
Scissors

How-To-Do-It: Select one or more trees with large leaves children can easily reach. Organize youngsters into groups of about three or four members. Show kids how to make small envelopes out of cellophane by folding rectangular pieces over and taping the edges together as shown:



Each cellophane envelope should be large enough so a leaf from your selected tree can easily slip inside. Have each group make four envelopes: 1 each of red, green, colorless, and opaque. They then can attach a small identifying symbol on each envelope so they can later tell their group's envelopes apart from the others. Now, have each group select four leaves of about the same size and vigor. Do not remove these leaves from the tree. Slip one envelope over each leaf and tape in place as shown:



After 7-10 days the groups can return, remove the envelopes, and observe the leaves. A record chart such as the following can be completed:

Leaf Treatments

Leaf Characteristics	colorless envelope	red envelope	green envelope	opaque envelope
Color				
Size and Shape				
Stiffness of tissue				
Other				

It is likely the leaves in green and colorless envelopes will be nearly normal, while those in green and opaque envelopes will be light green or whitish in color. Have the youngsters analyze their findings and relate to the process of photosynthesis.

Further Challenges:

1) Try the same experiment with other colors.

2) Try this type of investigation on weed leaves.

Activity #17

PATTERNS OF GROWTH IN TREES

by David R. Stronck

Focus: Observations of some differences in the sizes of trees can be used to interpret growth patterns.

Challenges: Measure the ratio of the height of a tree divided by the circumference of the same tree. Explain the growth pattern among trees of the same species. Interpret the pattern of growth when trees are growing closely together.

Materials and Equipment:

Tape measure (or string with lengths marked)
Masking tape
Height measuring instrument (hypsometer)--see Appendix

How-To-Do-It: The study site requires several trees, preferably of various sizes and ages. Ideally only one species will be considered in the initial measurements. Tell the youngsters explicitly the area and the species of tree which will be studied. You may mark the boundaries by setting up stakes with flags.

The basic assignment is to measure the circumference and the height of three different trees. Ideally, the study site will allow measuring a big, medium, and small tree of the same species. Have the youngsters describe briefly each of the measured trees with a few descriptive words for clear identification. A descriptive statement may be "the old giant with only branches near the top and located near the stone gate." After each descriptive statement, tabulate the circumference and the height.

The youngsters should work in pairs or, if necessary, in groups of three. Each member of the pair or group should take each measurement. If the measurements differ greatly (by 10 percent), they should take new measurements. If the measurements are similar (within 2 percent), they may be averaged.

First measure the circumference of each selected tree by running the tape measure around the base of the tree. If the trees are small, you may instruct the youngsters to place the tape measure one foot or 30 cm above the ground level while measuring the circumference. If all of the trees are large with broad bases, you may need to measure the circumferences one yard or meter above the ground level.

The hypsometer is used for measuring the height of a tree. The youngsters should understand that they will be working with a right triangle having one angle of 90° and two angles of 45° each. The shape of the triangle can be illustrated by folding a square piece of paper. Fold the paper along a diagonal line from opposite corners of the square. Have the youngsters recognize that two sides of this triangle are of the same length just as all sides of the square are of the same length. Using the protractor, they may observe the degrees of each angle. Explain that they will be using the hypsometer to create such a triangle. The right angle of 90° will be formed by the tree trunk and the ground level. The child can walk away from the tree trunk until he/she can sight the top of the tree through the drinking straw while the weight hangs the string across the 45° line of the protractor. The distance from this point to the base of the tree is equal to the height of the tree.

The data from this activity will usually demonstrate the following patterns in the growth of trees:

1) Older trees tend to grow taller without the same relative growth in the circumference of the trunk.

2) Trees growing in groups tend to grow taller without as much relative growth in the circumference of the trunks.

Younger children can observe these patterns in their tables. Representing the measurements on histograms will help them to visualize the patterns. Older children should calculate ratios by dividing the circumference into the height of each tree. These ratios allow an easy comparison.

Discuss with youngsters the patterns in the tree growth which they have discovered. Ask some of these questions:

1) As trees grow older, what happens to the lower branches? Describe the usual shapes of trees of one species as they age from young, to middle-aged, to old.

2) When trees grow closely together, what happens to their branches?

3) What type of tree is in greatest danger of being blown over by a strong wind? How do some trees protect themselves from being blown over? Does man sometimes remove protections from trees?

Further Challenges:

1) Compare trees of different species or different types, e.g., conifers contrasted with broad-leaf deciduous trees.

2) Using a tree borer, remove a sample core from each tree of the study. By counting the tree rings, tabulate the age of each tree. Interpret the growth pattern of the trees according to their ages. Discuss which locations favor the most rapid growth of the trees.

Reference:

Knapp, Clifford E. Outdoor Activities for Environmental Studies. Dansville, New York: Instructor Publications Inc., 1971.

TAKE IT OR LEAF IT!

by G. Sue McCormack

Focus: Somewhere near your school there is probably at least one tree. And, where there are trees, there are leaves. If you've ever watched young children walking home from school, you'll know that conveniently low branches are irresistible to kids--they strip the leaves or tug on them as they go by. In late fall, kids shuffle and scuff through piles of leaves. Leaves seem to have a natural attraction for kids.

Challenges: Arrange leaves by hues. Make clay leaves using real leaves as guides. Make leaf boats and have a contest. Learn to identify local trees by the shapes of their leaves. Classify leaves according to shapes, edges, and arrangement.

Materials and Equipment:

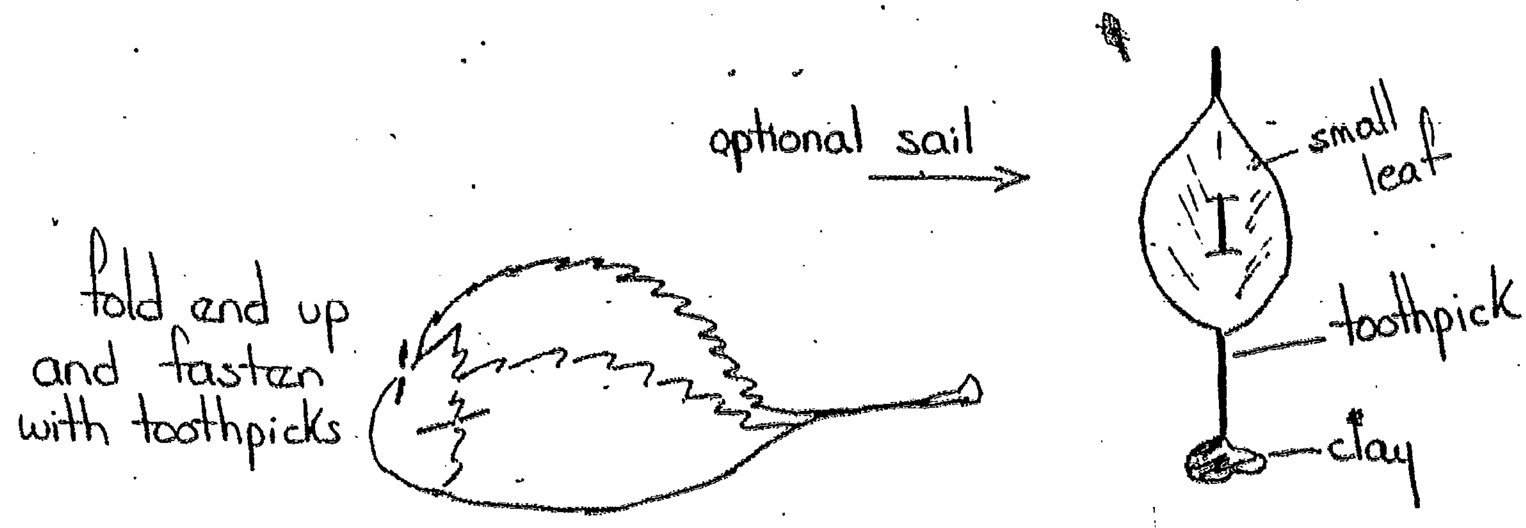
Any clay that will harden well
Old rolling pins or heavy sticks with bark off
Fairly sharp knives
Toothpicks
Small pieces of clay

How-To-Do-It: If you live in an area with deciduous trees, fall is a treat for the eyes. (This is also a good opportunity to discuss chlorophyll, leaf pigmentation, and photosynthesis.) An interesting activity with art overtones is arranging leaves by their hues. Have children gather many leaves--encourage them to get browns, reds, oranges, yellows, and greens. This can be a big project, so perhaps several groups doing the same thing would work better than trying to involve the whole class. Arrange the leaves in a line (indoors, if it's windy!) starting with the greens and ending with the browns. Each leaf is placed in sequence according to hue...teacher arbitrates artistic disputes!

To make clay leaf models, first roll a malleable piece of clay about one-third of an inch thick. An old rolling pin or a heavy stick with no bark works well. Place a leaf vein-side down on the clay; roll over it. Remove the leaf. Cut around the impression with a knife. Let the clay dry and you have clay leaves from different trees in your area.

I'm sure there are many teachers who spent their early childhood "TV-less." It was amazing the simple things you could find to occupy time. Leaf boats were a favorite activity in my neighborhood.

After a rain, when the sidewalk gutters are running full, or the schoolyard streams are trickling, try making leaf boats and having contests. Have students choose their own leaves and make toothpicks and clay available. The kids can experiment with sizes and styles; one example follows:



The race can be simple: choose a start and a finish and see which boat makes it. Not as easy as it sounds--many run aground or capsize. Perhaps different size or type boats could run in different "classes."

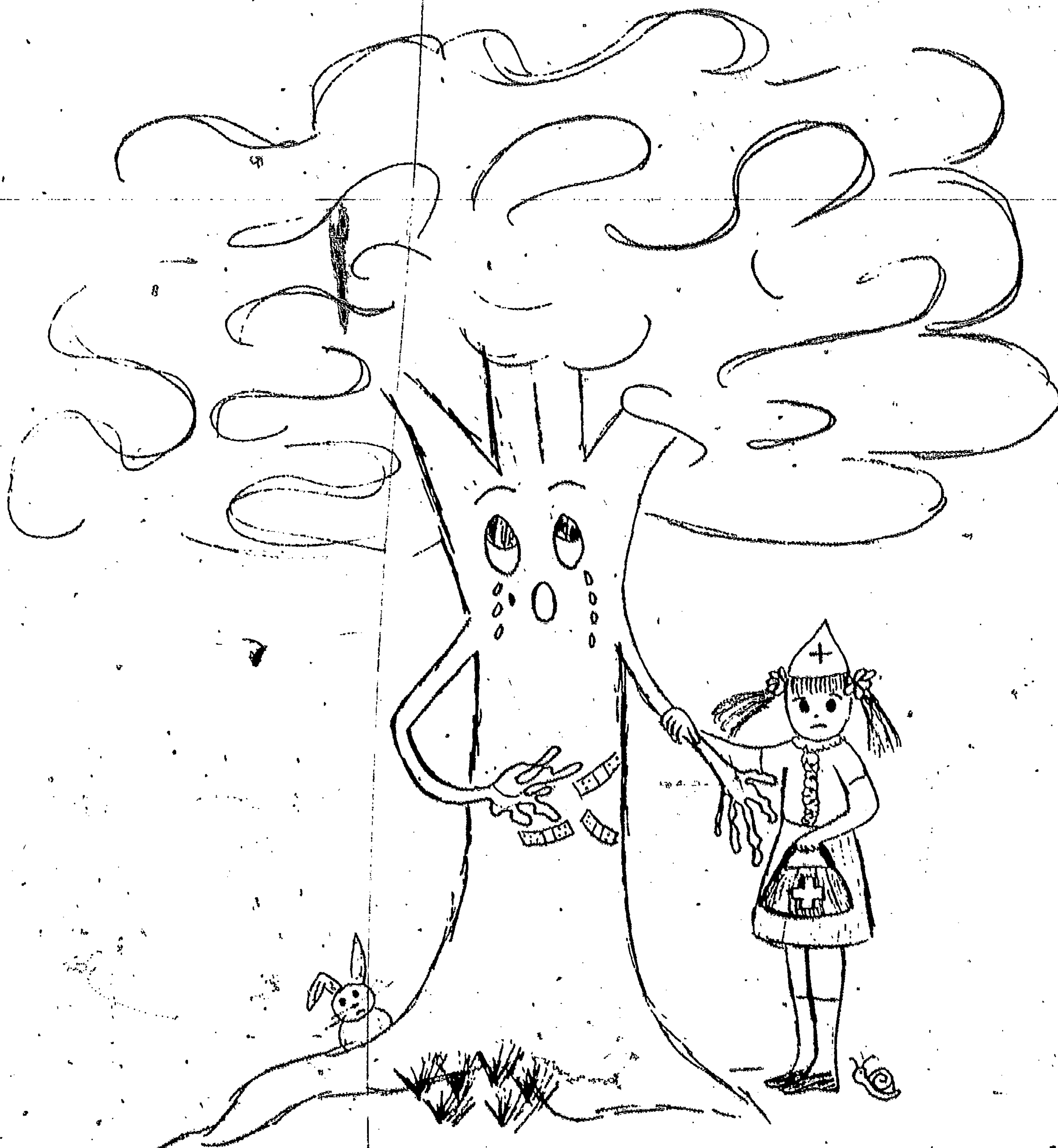
Leaves are fun, but informative ideas can be discussed during these activities. Teach children to recognize local trees by their leaves. Leaves are quite distinctive and can be classified by shape, edges, and how they are attached to the branch.

Have students collect various leaves. Hold each leaf up and ask for a one-word description of its shape (leaves such as hard maple are usually classified as "round").

Examine the edges of a variety of leaves. In what categories are they? (Smooth, lobed, etc.) How many different kinds can you find?

Point out leaves still attached to trees. Are they on exact opposite sides of the branch? Alternating--one above the other? All around the branch? What advantages are there to leaf placement?

Further Challenge: Learn to wax leaves or dry them properly for decorative purposes.



WHERE DOES IT HURT?

by G. Sue McCormack

Focus: Although there are such things as "tree doctors," they don't usually go around forests treating trees unless hired to do so. Therefore, in most treed areas you will be able to observe injuries and scars on the trees. They may be mechanically made, results of storms, or the work of animals (remember, "animals" includes insects and humans). When young trees are badly injured, they may keep growing due to their resilience, but the growth pattern may be greatly altered.

Challenge: Locate injured trees and make inferences about the causes of their injuries.

Materials and Equipment:

Sketch pads and pencils
Instant cameras (optional)

How-To-Do-It: Take the class to an area with a variety of trees. Divide the youngsters into groups of four or five and instruct them to sketch the injuries or scars they see on trees, and discuss what could have caused them. Perhaps you could point out a few injuries and scars to get them started.

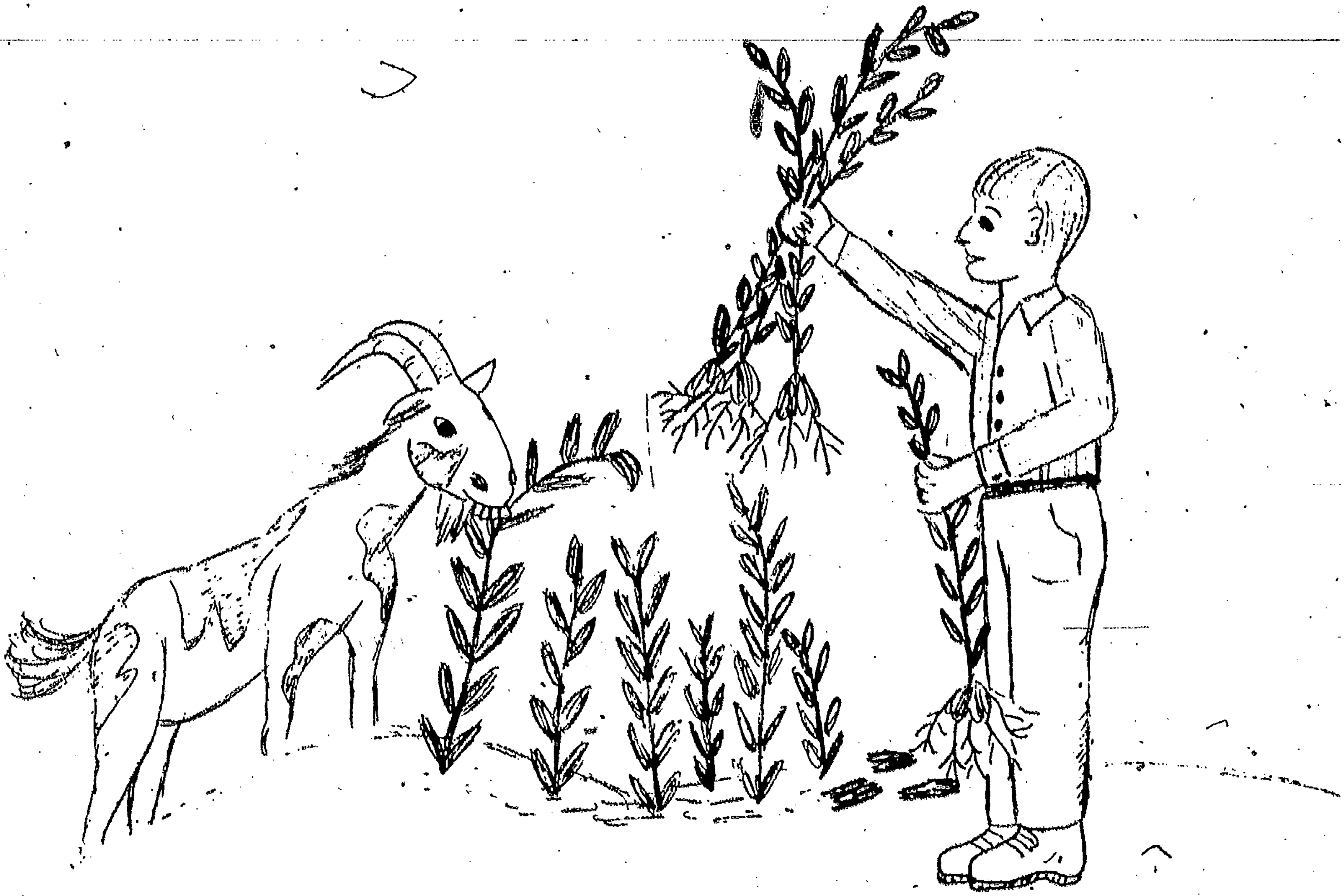
Trees often heal themselves by producing a sticky liquid, much as a human reacts to a cut and forms a scab. Have the children look for evidence of the healing process in trees. Why would the sticky substance around the wound help to heal it?

Have each group show their sketches to the rest of the class, and put forth their theories on the injuries and scars.

Further Challenges:

1) Invite a "tree doctor" or forest conservation expert to your class. Show him your sketches, and ask him to comment on tree injuries and healing.

2) Heal trees yourself. With the permission of the property owner, locate injured trees and apply tree sealer.



Activity #20

USEFUL OR USELESS? IT ALL DEPENDS ...

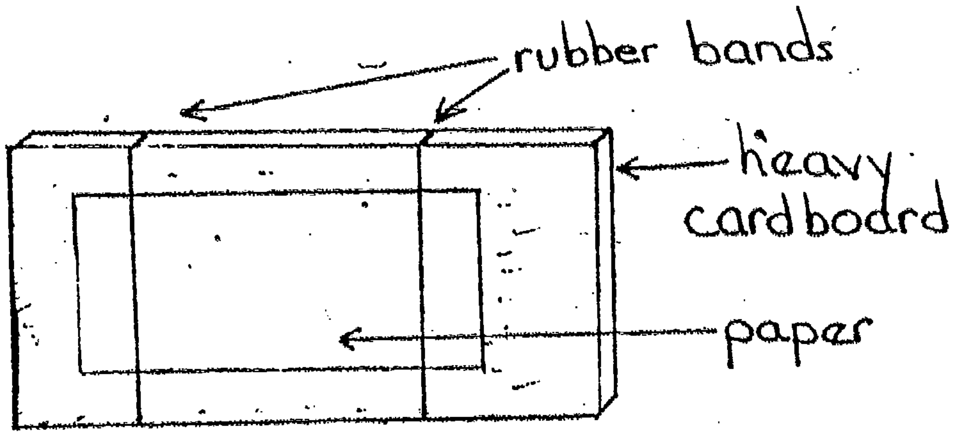
by Audrey Tanner

<u>Focus</u>: The Weed Society of America defines a weed as "a plant growing where it is not desired." Thus, the same plant could be useful to some and useless to others. A man with a well-kept lawn would be trying to stamp out something that would be gourmet fare to grasshoppers or goats. Deciding what's what can utilize the following skills: observing, classifying, describing, collecting and ranking information, and drawing conclusions.

<u>Challenge</u>: Classify plants as useful or weeds according to the needs a person or animal has for them.

<u>Materials and Equipment</u>:

Meter stick
Colored markers
Large sheets of white paper
Resource books for lawn plants, weeds and herbivorous animals
Portable writing surfaces using heavy cardboard and elastic bands (as shown below)



<u>How-To-Do-It</u>: As a class, decide what your working definition of "weed" will be. Divide the class into small teams and provide each with a portable writing surface, paper, and various colored markers.

Each team should choose an area about three meters square at the site to be studied. On a sheet of paper, have the team draw a map of the area; use symbols for plants or groups of plants (e.g.,  - goldenrod;  - thistle;  - daisies).

Now imagine that you are a:

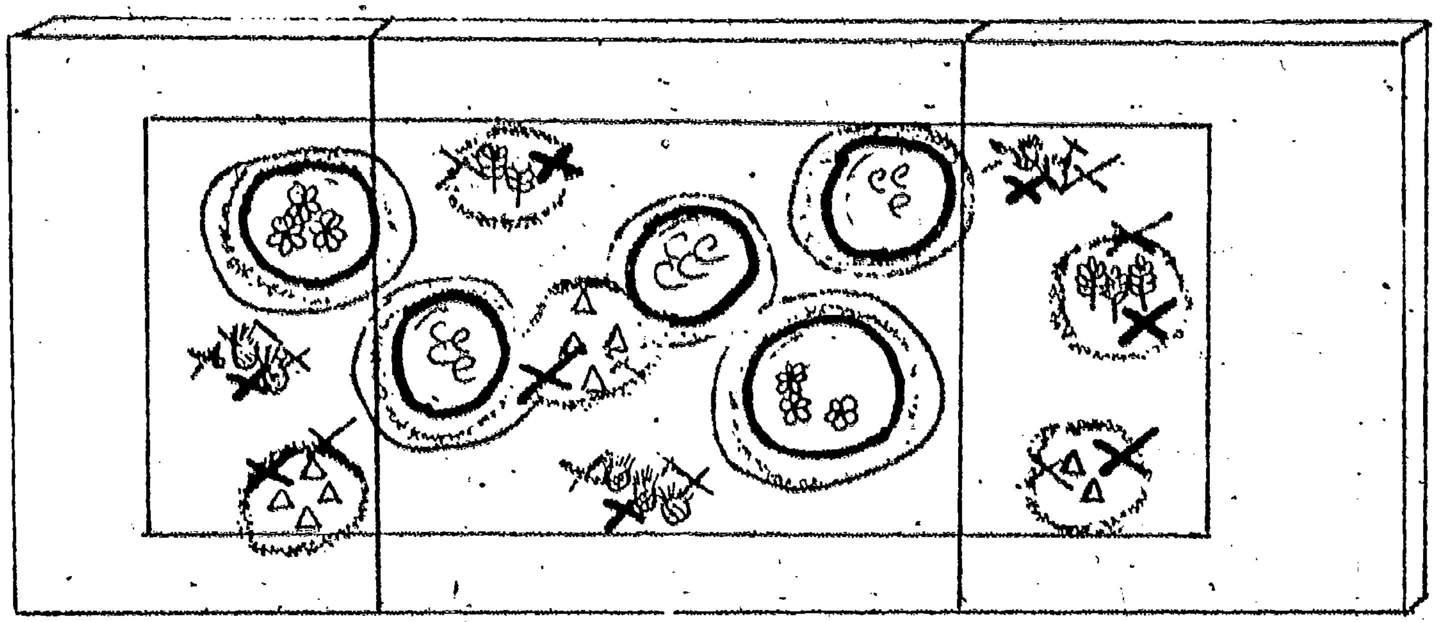
1) lawnkeeper--circle in red plants useful to you; make a red "x" on weeds.

2) goat--use blue marker for circles and x's.

3) bee--use yellow marker for circles and x's.

4) a human or animal chosen by each team--use a green marker.

Make a color key for each map and identify the symbols used.



Further Challenges:

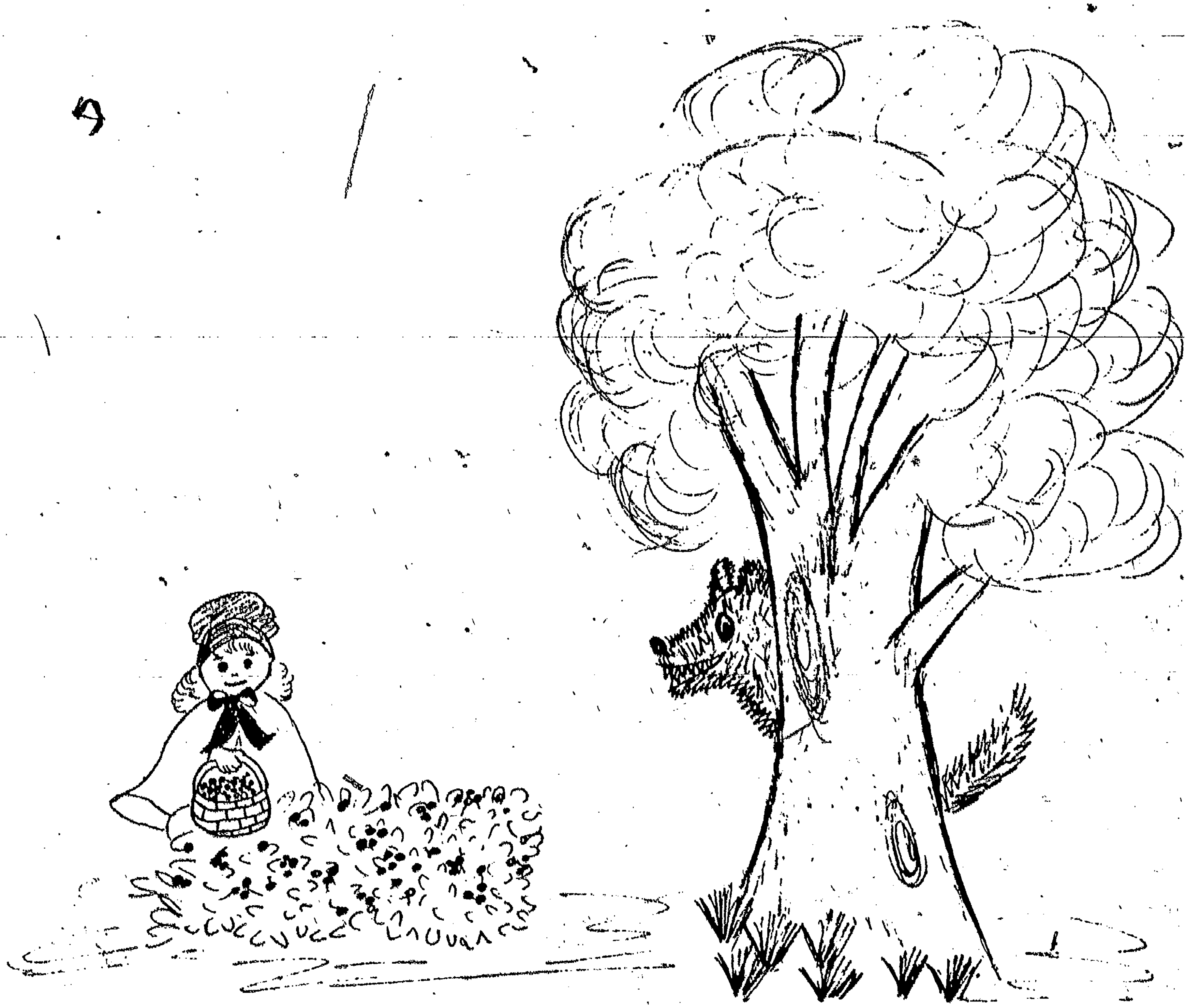
1) Identify species of plants in the area mapped. Use an edible weed chart to determine if any are edible. Research recipes for edible weeds. Prepare and eat them. (Caution: the teacher must be final authority on what to eat and what not to eat.)

2) Ask a local soil conservation person to speak to the class about weeds--their pro's and con's and the effect of weed killers on the environment.

References:

Bernath, Stefen. Common Weeds Coloring Book. New York: Dover Publishing, Inc., 1976.

Martin, Alexander. Weeds. New York: Golden Press, 1972.



Activity #21

IT'S THE BERRIES!

by Hilma J. Smith

<u>Focus</u>: The phrase "It's the berries!" at one time meant that something was really neat, wonderful, the best. Berry-gathering also used to be something really great for kids to do. Now it seems that most children consider berries something that are frozen, come in a can, or are little things that grow on bushes that your mother doesn't want you to touch. If you know what you are doing, berries are still just as neat as they used to be ... and kids may find things to do with them that their parents never thought of.

<u>Challenges</u>: Learn to identify the safe sumac berries and make a drink from them. Gather berries for, and cook, an old-fashioned "slump." Dry berries to use at a later time.

<u>Materials and Equipment</u>:

Pans or pots for collecting berries

<u>First activity</u>:

Cheesecloth and large rubber band
Paper cups or do-it-yourself cups (instructions included)
Large spoon
Sugar
Water

<u>Second activity</u>:

A cooking source (stove, fire, hot plate)
Large pot with lid or foil to cover
Mixing bowl and spoon
Serving bowls and spoons
Ingredients as necessary to make "slump"

<u>Third activity</u>:

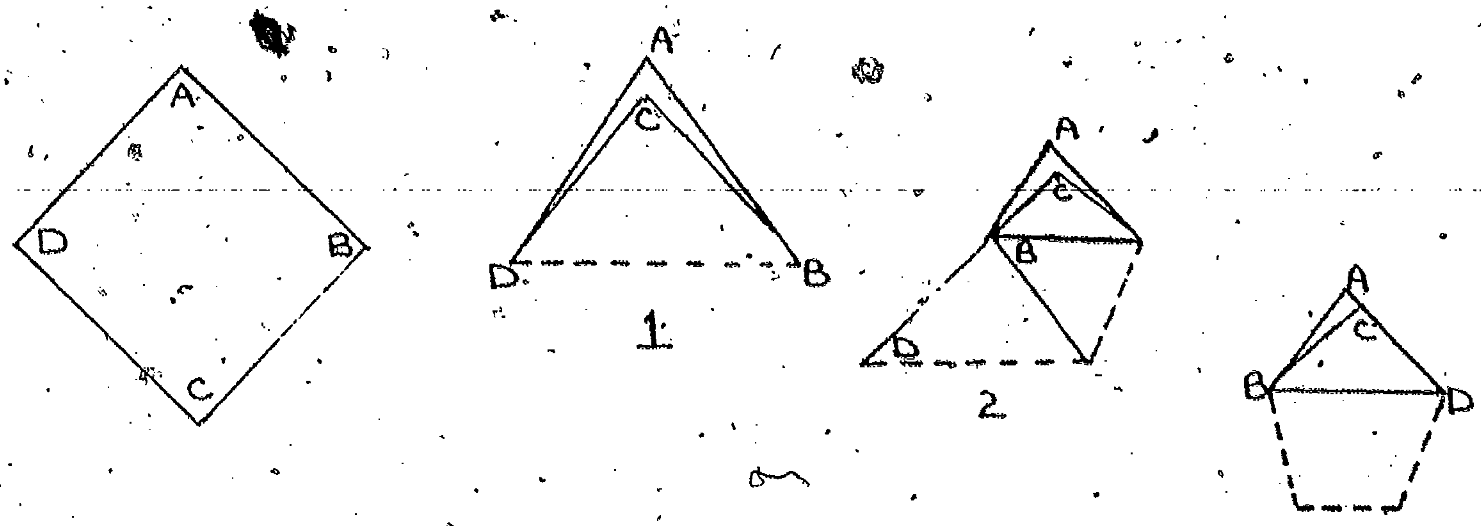
Large screen or tray
Cheesecloth

<u>How-To-Do-It</u>: Sumac berries are a good source of vitamin C. Non-poisonous sumac berries are red. Teacher: MAKE SURE YOU KNOW YOUR BERRIES! Staghorn sumac berries are better than those from the Smooth sumac as you need fewer of them. Gather a large amount of berries for your class. You are now ready to make "Sumac-ade!"

1) Pull berries apart, removing largest pieces of stems and the obvious bugs. <u>Don't wash the berries.</u>

2) Cover the berries well with water. Stir and mash them frequently while the berries soak; at least one-half hour, but the longer, the better.

3) Need cups? Make your own while the berries are soaking. Take a square, clean piece of paper (typing paper works well). The piece must be at least seven inches square. Follow the diagrams and directions:



Step 1 - Bring C up to A and crease.

Step 2 - Bring B across, making an isosceles triangle at the top.

Step 3 - Bring D across to the right.

Step 4 - Fold C into front "pocket." Fold A to the back.

4) Fasten cheesecloth over an empty container with a rubber band. Then strain the berries and water into that container.

5) Add sugar to taste. If too weak, find more berries. If too strong, add more water.

"Slump" is the name given to a dessert made by dropping sweet dumpling dough on top of boiling fruit and sugar mixes. Louisa May Alcott, author of Little Women, reportedly was so fond of a particular dessert, that she named her Concord, Massachusetts home: "Apple Slump"!

Children will have a fine time gathering, and "snitchin'" berries to make this old New England favorite. The recipe calls for black raspberries, but almost any berry can be substituted. You will need:

½ cup of berries per person
sugar to sweeten
biscuit mix with a recipe for dumplings (and anything that recipe calls for)
a little lemon juice is nice but not essential

Wash and sort berries, then place them in a large pot with a small amount of water. Mash berries to bring out juice. Cook five minutes, then sweeten to taste. Mix the dumplings as directed and drop on top of boiling berries. Cook according to package directions. Cool slightly before eating. (Can also be served with cream, whipped topping, or a sauce made with milk and confectioner's sugar.)

Berry season is short but a yen for berries isn't limited to several weeks in late summer. Why not dry some for later use?

Simply spread a single layer of berries on a screen or tray. Cover with a layer of cheesecloth to discourage hungry birds and creepy-crawlies. Place in the sun to dry. If your climate is not dry and warm enough to dry the berries outdoors, dry the berries in a gas oven with just the pilot light on or in an electric oven set as low as possible. If a dehydrator is available, use that.

Further Challenges:

1) Indians used berries as dyes. Experiment with different berries to make dyes of various colors and strengths.

2) Make your own dehydrator, using the following materials: cardboard box, foil, porcelain fixture with lightbulb, a few dowels, paper clips and rubber bands.

3) Make hot sumac tea by steeping the safe sumac berries in boiling water.

4) Dry sumac berry bunches (stems too) in paper bags in a dry place where air can circulate. Use at a later time for tea and Sumac-ade.

WINTER WHEAT STUDIES

by Patricia Chilton

Focus: Winter wheat is an important grain crop in northern agricultural regions. It is an unusual crop in that seeds are planted in fall and harvested the following summer. In regions where winter wheat is grown, it can be used as an ideal crop for small school gardens. It can be grown in a small plot, requires little care, and can be used as the basis for learning in a number of school subjects.

Challenge: Plant and harvest a small crop of winter wheat. Use the winter wheat plants and seeds for a variety of interdisciplinary studies.

Materials and Equipment:

Winter wheat seeds
Garden tilling tools
Small (1 meter square) garden plots
Fertilizer (optional)

How-To-Do-It: Dig up a one-meter square area in a place that won't be trampled or mowed. If you wish, a handful of garden fertilizer can be mixed with the soil to help promote better growth. Sprinkle winter wheat seeds over the soil so they are about six to eight cm apart. Cover with three to five cm of topsoil. Plant the seeds between October 1-15 for best results.

After planting, little care is required. In winter, keep the garden plots covered with snow. This insulates the seeds and keeps them properly moistened. During spring and summer, watering is required only during a drought. The wheat takes care of itself!

Farmers harvest the wheat in July. They look for signs that the wheat is ripe: wheat kernels get hard and they turn light brown and begin to droop. At school you can wait until early fall to harvest your crop. Cut the grain-bearing parts from the plants and rub the seed heads between the palms of your hands. Lightly blow across the wheat and the chaff should blow away leaving only the kernels.

The experience of planting wheat helps youngsters learn about the life cycle of plants, requirements for seed germination, and the "fruit" produced by mature plants. But lots of other learnings can occur in many subjects as indicated below.

Further Challenges:

Science

1) Plant 2 plots of wheat in different areas (i.e., different soils, light conditions or moisture conditions). Compare results.

2) Plant 2 plots of wheat together so they are affected by the same conditions, except keep one plot free of snow and leave the other plot alone. Compare.

Mathematics

3) Measure wheat plant growth from the time it can be seen until harvest. Graph.

4) A farmer plants about two bushels of wheat on an acre. Mark off an acre on the school site. Show what two bushels of something would look like.

Language Arts

5) Research and write papers on the origin of wheat, methods of planting, and/or uses.

6) Keep a journal on the progress of the wheat.

7) Use the following words as part of a vocabulary lesson: crop, harvest, chaff, grain, kernel, germinate, fertilizer, herbicide, thrash, straw, disk, plow.

Art

8) Have students make drawings or take photographs of growing wheat.

9) Use harvested wheat in winter flower bouquets.

10) Use the collected grains to make seed mosaics. You can color grains in different hues by soaking them in food colors. Make mosaics by gluing these colored seeds on to cardboard.

Career Education

11) Invite a farmer to talk to the class.

12) Think about all the ways people are involved with the production and use of wheat. What careers does this suggest?

Home Economics

13) Study the nutritional value of wheat.

14) Make bread out of wheat flour. Grind your own flour, if possible.

Social Studies

15) Study the economics of wheat farming. What expenses does a farmer have? What profits can a farmer expect?

16) Find some reasons for the decrease in small farms in favor of larger farming operations. What does this mean to us?

17) Look at an aerial photograph of your community back in the 1930s and compare it to one taken in the 1970s. What changes can be seen in the use of the land?

TREE TWIG PUZZLES

TREE TWIG PUZZLES

by Ellen Vande Visse

Focus: Twigs of various trees are very different. They can be used to identify tree species much like fingerprints can be used to identify people. Matching "mystery" twigs with schoolyard trees can be good fun, and an excellent winter outdoor activity encouraging children's observation and inference skills.

Challenge: Dissect and learn the parts of a "mystery" twig. Find a tree having branches that match your mystery twig. Learn the names of your schoolyard (or local) trees.

Materials and Equipment:

Twigs from schoolyard or local trees
Hand lenses (optional)

How-To-Do-It: Before your class is ready for this activity, collect some ends of branches from a variety of nearby trees. Use broken or fallen branches where possible, but a few cuttings from tips of living branches can be taken without harming trees. (Gardeners call this procedure "pruning.") Be sure you have enough twigs so every student can have one to work with.

Proceed as follows:

1) Provide each student with a twig. Ask him/her to observe it carefully, noting buds, leaf scars, color, texture, and branching patterns. Provide hand lenses if available. After careful "outside" inspection of the twig, kids can "go inside" by dissecting away bark with their thumbnails. They might look for interior characteristics like odor, texture, bark layers, and colors.

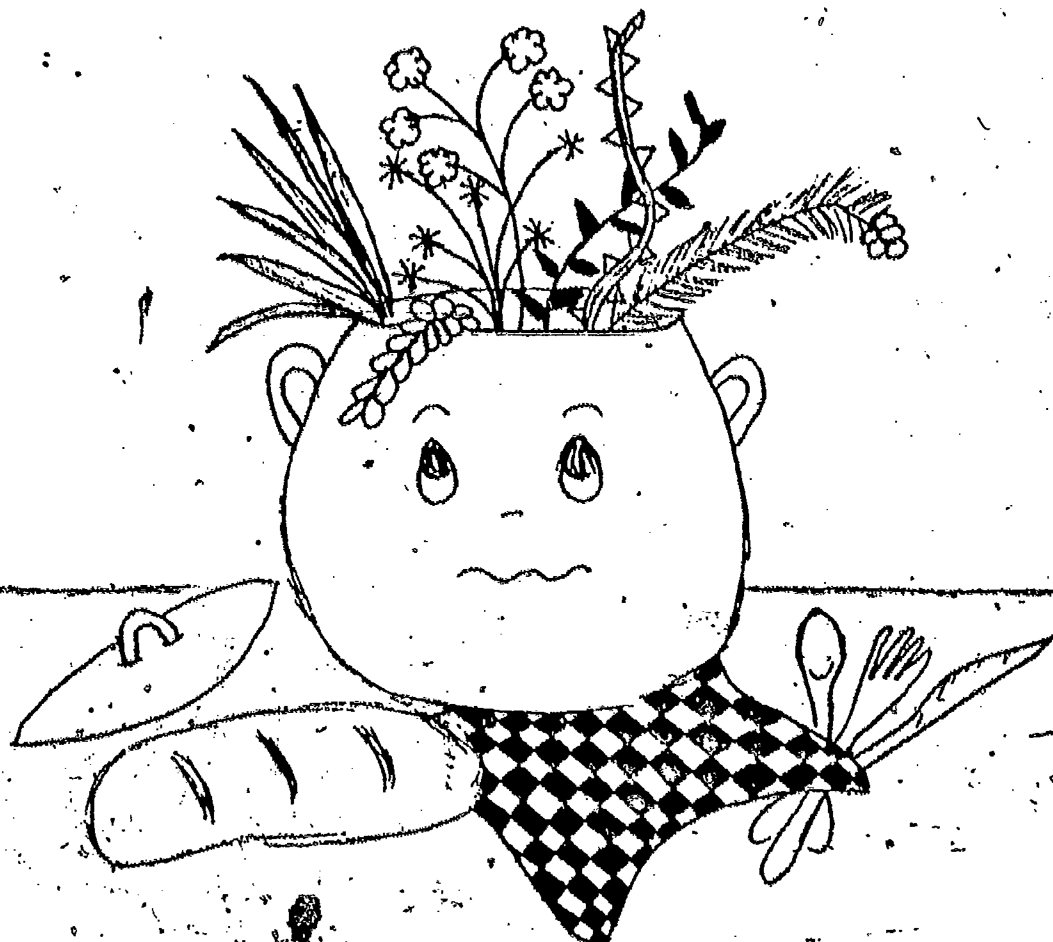
2) Now you can challenge kids to find a tree with branch-tips matching their twig. It's a good idea to specify boundaries within which kids should hunt for their tree.

3) When most youngsters have found a parent tree for their twig, reassemble the entire class and visit each tree. At each stop, have a "twig detective" hold up a twig next to a tree branch to show that they match. You might then present the name of the tree and any other information about it to the class.

Further Challenges:

1) After completing this activity, have kids try to match twigs with names of trees.

2) In the spring, do a "mystery leaf" activity using leaves from the same trees studied in this activity.



Activity #24

GUESS WHAT'S COMING TO DINNER?

by Mary K. Bowe

Focus: Many wild foods are nutritious and tasty; they have meant the difference between death and survival to knowledgeable people lost in the wilds. However, some of these edible plants have look-alikes which could cause discomfort and possibly death if accidentally eaten.

Challenge: Learn to identify, cook, and eat wild foods.

Materials and Equipment:

Books about identifying wild plants
Recipes using wild plants
Duplicated copies of plant appearances (optional)
Coleman stove and fuel
Pots, preferably enamel
Water
Seasonings
Paper plates, plastic utensils

How-To-Do-It: There are two ways to go on this exercise: arm the students with the appropriate identification books, some words of caution, and then turn them loose to see what they can find (you have final say on what they cook); or, you scout the area ahead of time, find what's out there and select the safe plants--then duplicate pictures of what they look like and allow the students to bring back only those plants.

More words of caution: find out if the area has been sprayed for pesticides; and, do not use any mushrooms--even experts run into difficulties identifying them.

Some common and easily recognizable plants are arrowroot, bracken fern, bull thistle, burdock, cattail, dandelion, Indian cucumber, Jerusalem artichoke, milkweed, sassafras, and yellow dock. There should be an attempt to gather enough of each variety so everyone may have a taste. Put one type in each bag as you collect--it will avoid sorting them later. Some will need to be cooked, others just washed or peeled. The key to full nutritional value is to avoid overcooking.

Further Challenge: Learn to identify and find (don't pick!) some poisonous look-alike plants or other harmful plants.

References:

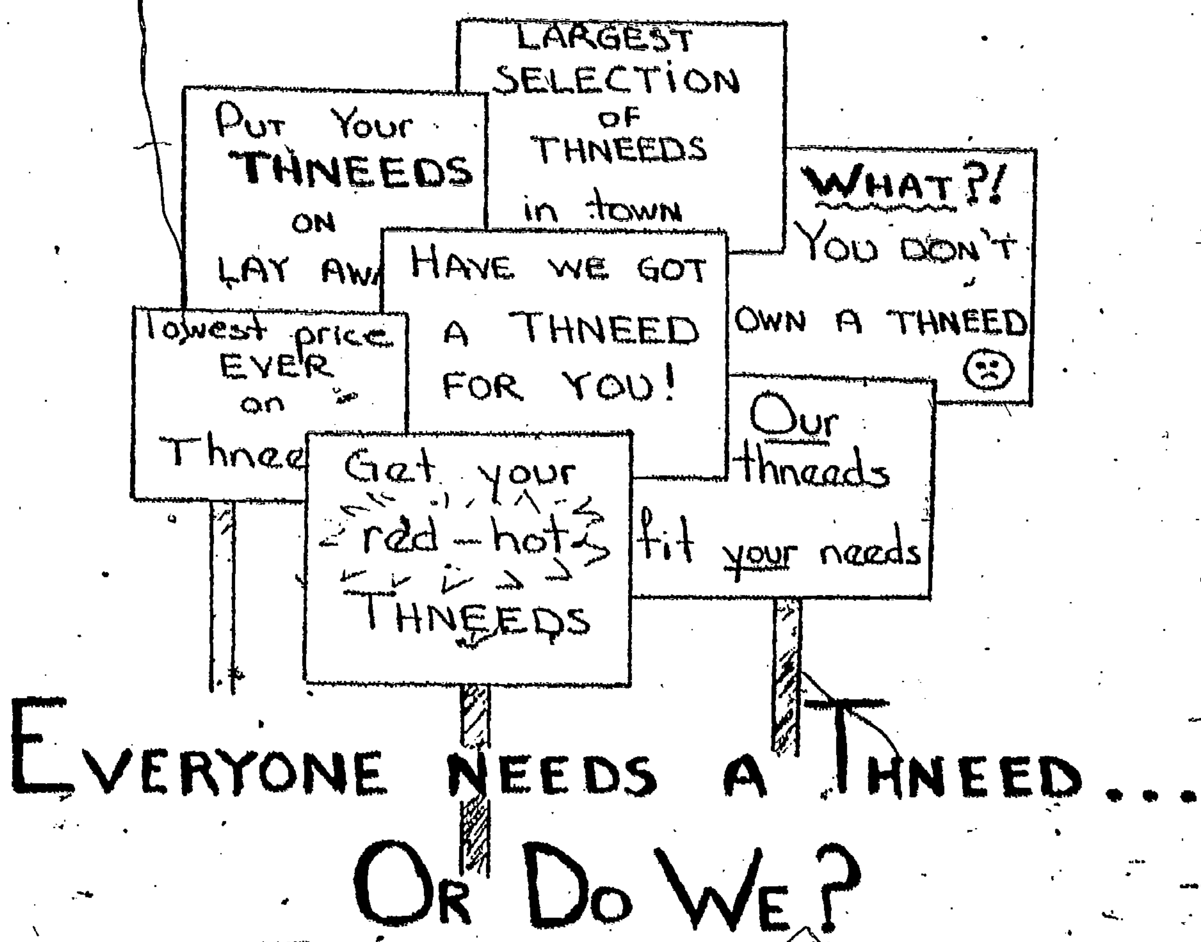
Angier, Bradford. Feasting Free on Wild Edibles. Harrisburg, Pennsylvania: Stackpole Books, 1969.

Gibbons, Euell. Stalking the Healthful Herbs. New York: David McKay Co., Inc., 1973.

Gibbons, Euell. Stalking the Wild Asparagus. New York; David McKay Co., Inc., 1970.

CHAPTER IV

ECOLOGY ACTIVITIES



EVERYONE NEEDS A THNEED ... OR DO WE?

by Ron Beiswenger

Focus: This activity is based on the Dr. Seuss story, The Lorax. The story is available in book form, and in a movie made for television. Some teachers have developed their own slide-tape presentations based on the book.

The story describes the growth of an industry which uses Truffula Trees and makes Thneeds (which everyone needs). A thneed is a sweater-like garment that can be used as a sock, shirt, glove, hat, carpet, pillow, sheet, curtain, or cover for a bicycle seat. An industrialist, the Once-ler, begins cutting Truffula Trees and uses them to make Thneeds in a factory he has built. His factory pollutes the air and water and he destroys the habitat of the wildlife of the Truffula Forest (Brown Bar-ba-loots, Swomee-Swans, and Humming-Fish). All the while this is going on, a strange creature called the Lorax is imploring the Once-ler to stop his destructive activities. The Once-ler finally cuts down the last Truffula Tree, the factory closes and a barren, devastated landscape is left behind.

A ring of stones, one bearing the word "unless" imprinted on it, also remains among the ruins. The story ends with the Once-ler telling a boy of middle school age the meaning of the word "unless": "Unless someone like you cares a whole awful lot, nothing is going to get better. It's not." He then tosses the last Truffula Seed to the boy and tells him to plant it and grow a new Truffula Forest. Students are usually impressed that a young person is given the opportunity to start over and correct past mistakes.

Teachers use the story as a starting point for a number of activities. Dr. Seuss' word usage provides wonderful opportunities for language arts activities, discussions of the role of industry in our society and studies of environmental issues in general. Students can be challenged to invent machines like the Super-Axe-Hacker and other Seussian creations. Some teachers ask their students to classify the animals in the story. The possibilities are endless--limited only by the creativity of teachers. One of the more popular activities using The Lorax involves retelling the story so that it has a "better" ending. This is often done with colored markers and butcher paper. Students suggest ways to avoid environmental problems, have fun, and learn a great deal about how we can manage our environment more intelligently than the Once-ler managed his.

Challenge: A Truffula Forest has been discovered near your town. The Once-ler wants to build a Thneed factory one block from your school. Should he be allowed to do it? What rules and regulations should he have to follow? Plan an environmental study to decide these things.

Materials and Equipment:

The Lorax story
Paper
Pencils or colored markers

How-To-Do-It: There are several ways to develop this activity. To answer the question about building the factory, students could begin by examining the effects of cutting the forest. How will it benefit or harm people? How will it affect the Bar-ba-loots, the Swomee-Swans, and the Humming-Fish? What could be done to avoid these effects? A summary chart such as the one shown below could be used to help the students organize their analysis:

Living things affected by cutting trees	How the living things are affected by cutting the trees	Ways to avoid the bad effects of cutting the trees
Humans		
Truffula Trees		
Brown Bar-ba-loots		
Swomee-Swans		
Humming-Fish		

Another aspect of the challenge involves the building of a factory near the school. Students could carry out an environmental study of a hypothetical site for the factory. This could range from a general discussion of a selected area, to an elaborate study involving field trips to the area to take environmental measurements. Some of the things that might be included in an environmental study are outlined below.

I. Description of the site selected for the factory

   A. Present land use (housing, vacant lot, etc.).

   B. Biological and physical environment

      1. Ground cover--soil, grass, concrete, etc.
      2. Terrain--flat, hilly, etc.
      3. Vegetation
      4. Animals

II. Environmental Impact

A. Benefits resulting from the project

B. Problems caused by the project

1. Pollution
2. Effect on plants and animals
3. Changes in human usage--increased traffic, loss of a park, etc.
4. Other effects

This outline would have to be expanded or modified to correspond to specific areas.

Reference:

Geisel, T. (Dr. Seuss). The Lorax. New York: Random House, 1971.

Activity #26

MAPPING THE GREAT OUTDOORS

by Joseph Abruscato

Focus: The earth sciences bear a considerable relationship to that portion of the social studies called geography. Children studying earth science are typically expected to become aware of distinctive features on a portion of the earth's surface, make careful observations of such features (i.e., streams, hills, valleys, mountains), and in some cases represent in a graphic manner that which they see. The construction of maps is an activity that integrates the earth sciences and geography.

Challenges: Learn the meanings of various symbols found on road maps. Learn to estimate distances on maps. Draw a simple outdoor site map to scale. Learn to find directions using a compass and communicate to others directions for getting from one place to another.

Materials and Equipment:

A road map of your region per group of two or three students
A package of crayons or colored pencils per group
Package of blank paper
A compass per group

How-To-Do-It:

1) Prior to the class expedition from the school to an outdoor study area, have groups of children study road maps to establish the actual "as the crow flies" distance between school and the outdoor area and compare it to an estimate of the distance to be traveled using roads. Children should also make estimates of the time it will take to get to the outdoor area and retain these estimates to compare with the actual elapsed time for the journey.

   This use of a road map prior to the outdoor activity will provide you with an opportunity to have children learn the meaning of "scale" as well as the multiple symbols listed in the legend of the map. The directions North, South, East, and West on the map should also be discussed with respect to orienting the map properly.

2) An excellent initial activity to do at the outdoor site is to have each child create a map of the area. By constructing a map at the beginning of an outdoor experience, the entire group of children can potentially grasp the "big picture" and will hopefully gain an appreciation of the many and diverse land features they can study.

3) At the site teach the children how to use a compass. Then have them draw the compass direction points on their maps.

After initial activities, you might consider some of the following extensions:

1) Have each group of children draw a scale map of a very small portion of the outdoor site. Ask all the groups to use the same scale. The culmination of this activity can be the full class experience of taping maps created by the respective groups together so as to create a giant map of the area.

2) Treasure hunting can be done by having one group hide a treasure (a pretty stone, the day's snacks, etc.) somewhere at the site. Then the group doing the hiding can create a list of directions for finding the treasure from an agreed-upon landmark. The directions may be stated in this manner: "Go 15 steps west from the dead oak tree. Then go 30 steps south, etc."

A variation of this activity is to place each direction at a different location--then the children discover a new location when they successfully follow a given direction.

Further Challenges:

1) How can people tell directions without a compass? Try out your ideas.

2) Devise a way to make a map that shows how high various places are.

3) Find out what the "grid" of a map is. How could you use the grid of a map to tell someone where a place is located?

LIFE IN A MINI-HABITAT

by Mary K. Bowe

Focus: Most people are aware that animals and plants form associations so that groups of living things live in certain habitats. For example, squirrels and deer live together in broad-leaved forest habitats.

Unfortunately, it is not normally possible for school groups to study at first-hand the typical habitats of larger animals and plants. But observations of plant-animal associations can still be made near almost any school. Vacant lots, edges of parking lots, and lawns all have small areas--mini-habitats--which are homes to small plants and animals. And, observations of these small areas can be just as instructive as observations of the more impressive large habitats.

Challenge: Estimate the numbers and variety of organisms populating a square meter mini-habitat.

Materials and Equipment:

Sticks
Meter sticks or measuring tapes
CESI Bug Catcher
Hand lenses
Transparent plastic bags
Garden trowels or old spoons
Plant and animal identification references (optional)

How-To-Do-It: Have youngsters stake out square meter study areas in as many different lawn, vacant lot, or schoolyard areas as you have available. Sticks can be used to mark the corners of the plots.

Students should try to remain outside their study plots as much as possible, but try to observe as many different plants and animals as they can that live in the plot. CESI Bug Catchers may be helpful for capturing insects and other small animals without injuring them. These small organisms can be kept in a clear plastic bag for temporary observations, but should be released unharmed back where they were captured. Encourage kids to make a catalogue of every living thing found in their square meter. Where names of organisms are not known, have kids simply invent names to describe creatures they find. If hand lenses are available, they can make close-up viewing of the organisms that much more interesting. Garden trowels or old spoons are good for digging in to the study plot to search for underground organisms.

Have students estimate:

1) What is the total number of living plants in your plot?

2) What is the total number of animals (insects, worms, centipedes, etc.) in your plot?

3) How many <u>different</u> types of animals are there?

4) How many <u>different</u> types of plants are there?

Some students will want to make a map of their plots showing the distribution of organisms. Others may want to consult reference books to try to find scientific names for the creatures they observe.

As a culmination for this activity, kids can compare catalogues for the various plots. Which types of areas have mini-habitats richest in life? In which types is life scarcest? What factors may account for these observed differences?

<u>Further Challenges</u>:

1) Try to figure out food chains or food webs for your mini-habitat.

2) How could the number of living things in your mini-habitat be increased? Do an experiment to see if you can bring about an increase in plant and/or animal populations.

References:

Any references on common weeds, grasses, wild flowers, insects, and invertebrate animals will be useful.

CLOD CREATURES

by David R. Stronck

Focus: The roots of plants hold soil together in clods which include various small animals.

Challenges: Identify some of the plants and animals in soil clods. Classify roots as tap or fibrous. Observe the contents of the soil.

Materials and Equipment:

Clods dug from lawns or weed patches, approximately 25 cm square and 15 cm deep
Cardboard box or other container for each clod
Shovel or garden trowel
Jars or cups for storing animals
Magnifying lens (or low-powered microscopes)

How-To-Do-It:

1) At a convenient study site area, dig up enough clods to provide one for each pair of students. Ideally, the soil should be dry enough and not muddy although the clods could be stored in open boxes for a few days to dry out excessive moisture. If the soil is somewhat sandy, it will allow easy examination. If the sampled soil is too hard, it may require soaking with water on previous days to allow use of a shovel and to increase the numbers of larger animals near the surface.

2) Youngsters should work in teams of two or three in observing each clod. Some teachers will prefer to give each student a small clod of only a few inches in a large plastic cup.

3) Each youngster must have the opportunity to break up at least part of the clod in order to examine how the roots hold the soil together. The teacher should demonstrate how the fibrous roots bind the soil together as if they were a tangled mass of strings.

4) Ask the students to find different kinds of plants in the clods. Scientific names are not important although common plants may be easily identified, e.g., thistle, clover, and dandelion. Help the youngsters to recognize that each of the plants has a green top and white or brown roots. There are two types of roots: tap roots and fibrous roots. Tap roots are long and large, usually without branches, as in dandelions and thistles. Fibrous roots are small but form tangled masses as in grasses.

As the kids examine root systems, they may suddenly begin to find animals which will probably quickly distract them. These earth creatures may include worms, slugs, isopods (sometimes called pill bugs or wood lice), millipedes, and spiders. Encourage the youngsters to place these animals in a jar for observation. A magnifying lens will assist in studying details of small animals. Older students may wish to use low-powered microscopes.

The students should begin to recognize that the green leaves and stems of plants above the ground are only a part of the life in that area. In the soil, these are roots, decaying plants and animals, and living animals. The underground world of life has the means by which dead animals and plants are broken down to provide water-soluble nutrients which will be absorbed by roots. The fertility of the soil depends greatly upon this process of decomposing materials.

5) After examining the clods, have kids return all the materials of the clod to the place where it came from. There may be sufficient interest to dig up new clods at this site or to take clods from a different site. Additional new diggings should be done by the youngsters themselves.

Some appropriate questions for discussion are:

1) What happens to the soil on a slope if plants are removed from its surface?

2) What happens to that part of a lawn where people often walk? Why did this happen?

3) Where will you find most of the animals in the soil? What type of soil has the most number of animals by weight?

4) What do the animals in the soil eat? Do we find healthier plants growing in the soil where there are more animals? Why?

Further Challenges:

1) Using a shovel, carefully extract an entire tap root from a dandelion or thistle. Usually the long tap root is broken in the process of digging out a clod.

2) Soak an area with water to note differences in wet clods as opposed to dry clods. Examine clods at different times of the year to compare the numbers of animals, growth of plants, etc.

3) Set up funnels and fill them with soil. Add water until it drips through into a dish below the funnel. Examine the drippings for very small animals.

Reference:

Outdoor Biology Instructional Strategies (OBIS). Lawn Guide. Berkeley, California: Lawrence Hall of Science, 1974.

SHORELINE LIFE ZONES

by David R. Stronck

Focus: Observe the zones of different communities of plants and animals which live near and at a shoreline of a sea, river or lake.

Challenges: Identify the species of plants and animals which are most characteristic of specific zones near and at the shoreline. Observe variations in the water levels which create these zones.

Materials and Equipment:

Paper and pencil
Modeling clay
Yard or meter sticks
Drinking straws
Large plastic cups or small pails
Magnifying lenses

How-To-Do-It:

1) The study site must include some shoreline area where the water level changes periodically. Ideally the study site will have the rocky tidepools of a seashore. Nevertheless, many lakes and even broad rivers have seasonal variations which will allow a study of the same important concept: as the quantity of available water greatly changes, the types of plants and animals will radically change.

At ocean seashores the variations in water level depend on the tides which are well predicted. By consulting the local tide tables, one can plan to visit the area at the lowest convenient water level. Before going to a seashore, the youngsters must understand that the water level may rise rather rapidly while they are visiting the site. They must not become trapped on islands created by rising waters. Safety precautions at rocky seashores require that the youngsters always work closely together in pairs. Some important rules are the following:

Never turn your back to the waves while looking down at a rocky area. If hit by a strong wave, try to lie face downward and to grasp the rocky surface tightly. Beware of slippery surfaces, especially where there is much seaweed. Wear strong boots or shoes which can withstand the very sharp abrasive surfaces of barnacles or coral.

Some lakes and broad rivers may have shorelines where the water level has great seasonal variations. Such fresh water areas will demonstrate different zones of life depending upon the duration of high water levels. Seek a study site where there are obvious gradations from the usual highland vegetation to shrubs needing much water to plants which live exclusively in the water. Usually dams do not provide adequate "living" shorelines because their levels change too frequently.

2) It is dangerous at seashores to allow a youngster to wander off alone. Establish limits to the study site by setting up poles with flags. Require the students to remain within an area where you can easily see them. Because the study sites are stretched along shorelines, anticipate that some youngsters will be interested in exploring beyond the defined boundaries. Clearly explain to them that the goal is to interpret the life in the study site; this study will require their attention to small plants and animals.

3) Older youngsters can use yard or meter sticks with drinking straws to measure the height above the water line for the various zones of life which are observed. Begin by holding the meter stick loosely between thumb and index finger. The full length of the meter stick should be allowed to hang downwards as if it were a weight at the end of a plumb line. Set the stick on the ground level at exactly this angle, i.e., vertical. An assistant will be needed to guide the setting correctly. Then place the drinking straw on top of the edge of the meter stick. Sight through the straw to the nearest high ground. The assistant will walk to this point and mark it. The elevation of this point will be one meter higher than the original location. If the shoreline area is steep, several such measurements can be made. If the area is relatively flat, elevations of less than a meter can be similarly measured, e.g., by using a foot-long ruler.

The modeling clay may be useful for making impressions of interesting hard plants or animals. At the seashore, clams and snails will provide good subjects for such impressions. The impressions in the clay may later be filled with plaster of Paris to give models of the outside shape of these shells.

A second use for modeling clay is to build temporary dikes around some animals or plants. The area may then be flooded within the dike by using a cup or pail. In tidepools, the barnacles will extend their feathery feet and the anemone, their tentacles when they are under water. These animals are relatively drab when they are protecting themselves from the drying effect of air. Dikes built at freshwater spots may encourage worms and isopods to leave their hiding places.

4) The youngsters should observe sharp changes in zones of living organisms at shorelines. The plants and animals on the high ground beyond flood or tidal waters should be recognized first, preferably before making a trip to a shoreline. This study concentrates on identifying some organisms which are rarely covered with water and others which are usually covered with water.

At seashores, these is usually a "dead" area of almost no conspicuous life forms at the upper end of tidal washes. The upper limits of sea life are restricted severely by the physical environment which allows drying out during long periods of time. The lower limits of species are constrained by predators and biological competition for the same ecological niches. Usually the tidal communities of plants and animals are in distinct zones or bands which can be easily noted at low tides. The youngsters should concentrate on the most common organism(s) of each zone. Have them draw and map these organisms.

Along freshwater shorelines, many shrubs and trees often flourish where their roots can obtain abundant water. These species usually differ from the plants of the highland. A third type of plant is found exclusively growing in the water. At least these three freshwater zones should be noted and identified by their most characteristic or common species.

5) Leave all organisms undisturbed at the study sites. Using drawings, maps, and clay impressions made by youngsters, discuss some of these questions:

   a. What causes the water levels to rise and fall?

   b. What is the total height of the intermediate zone(s) of organisms where the water levels fluctuate?

   c. Which zone(s) supports the greatest amount of life by weight of organisms per square meter? Which support the least?

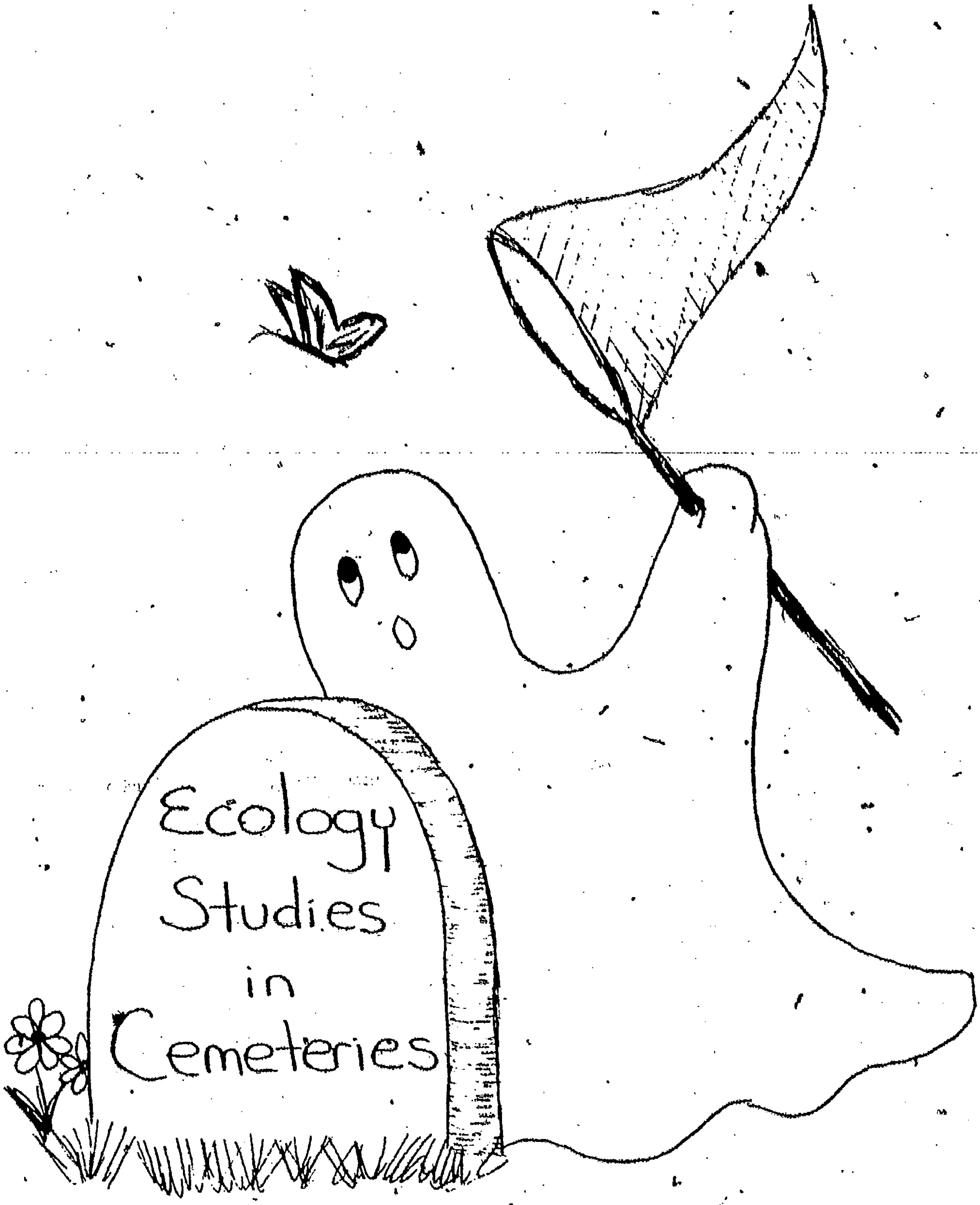
   d. Name the most common species which characterize each zone.

Further Challenges: Visit the study site repeatedly to measure changes in water levels. Take a relatively large rock, weighing at least 15 pounds, from the highland area to the low-water level. After a few months, record changes in the organisms growing on the surface of this rock.

References:

Outdoor Biology Instructional Strategies (OBIS). Pond Guide. Berkeley, California: Lawrence Hall of Science, 1974.

Zim, H. and Ingle, L. Seashores. New York: Golden Press, 1955.


Ecology
Studies
in
Cemeteries

Activity #30

ECOLOGY STUDIES IN CEMETERIES

by Beth Schultz

Focus: Cemeteries are open green spaces. Sometimes they are the only open spaces in a city neighborhood. Many kinds of plants and animals live there. People also use them as parks and even playgrounds. Why not use a nearby cemetery for ecology activities?

Challenges: Explore a cemetery near your home or school. Find out how many different plants and animals live in the cemetery or use it some of the time. How do these organisms use the area? How are they able to survive there? How do people use the area?

How-To-Do-It:

1) Make a map of the cemetery. Divide it into small areas so that groups of youngsters can explore one area at a time. This will help kids keep more accurate records of their observations.

2) Notice plants growing on or near the stone markers. How many kinds of lichens, mosses, or other small plants do you find? Do they grow on all stones or only on some kinds of stone? Compare plant growth on stones in shady, damp places with that in other areas.

3) How many different kinds of trees and shrubs are growing in the area? Which look as though they were planted by people? Which look as though they grew naturally? What is your evidence? (Expected discoveries: You may see some berry-bearing shrubs growing at the base of a head stone. They probably were "planted" by birds. Speculate: Were the largest trees there when the cemetery was new? Look at dates on markers near the largest trees. Are any of the markers tilted by pressure from the roots?)

4) Compare condition of trees along the roadways with those several feet from the road. (Hint: Look for injuries on the trunk which may have been caused by trucks.) Compare width of roadways in the old part of the cemetery with that of roads near the newer parts. If there are differences, what can you infer?

5) Look for birds and their nests (Caution: DO NOT disturb nests during spring and summer). In spring you may hear more birds than you see. How many kinds do you hear or see? In fall, when the leaves have dropped, you can find nests more easily. Try to identify the birds that you see. What kinds stay in the area all year?

6) Look for mammals. If there are large trees, watch for squirrels. Do people feed the birds and squirrels? If not, try to find out what they are eating.

7) Find insects. There must be many kinds there because insects live wherever plants grow. Observe their activities.

8) Finally, notice how people use the cemetery. In one old cemetery in a city, observers noticed that people use the open space to walk their dogs, to eat their lunches, or just to sit in the sun on warm days.

Further Challenges:

1) Estimate the age of your cemetery. What evidence could you use?

2) Estimate the numbers of various plants and animals living in your cemetery.

References:

Hulsart, Mary J. and Vivian, V. Eugene. Cemeteries and Environments: A Humanistic Approach. Browns Mills, New Jersey: Conservation and Environmental Studies Center, 1974.

Thomas, J. W. and Dixon, R. A. "Cemetery Ecology." Natural History, 61-67, March 1973.

PUDDLE POPULATIONS

by David R. Stronck

Focus: Organisms within a puddle go through a series of successional changes during the spring months.

Challenges: Identify several different species of plants and/or animals which will appear, flourish, and disappear in a large puddle during the spring months. Compare the variety of species in a polluted puddle with those in a relatively clean one. Measure some of the environmental conditions which may favor the growth of populations.

Materials and Equipment:

Shovel
Large plastic sheets, e.g., from garden waste bags
Cupful of any fertilizer
Small paper or plastic cups
Thermometer
Magnifying lenses
Rulers
White-bottomed pans (optional)
Microscope with glass slides and coverslips (optional)

How-To-Do-It: The study site may consist of small naturally-occurring ponds (puddles). If none are conveniently located, dig out a couple of small holes in the ground. The suggested size of the holes is about three to six feet in diameter and one or two feet deep at the deepest point. Line both holes with plastic from a large garden waste bag. The purpose of the plastic is to keep the water from seeping into the earth.

Encourage older children to help in digging out the holes. Ideally, the holes will be located within a courtyard of a school where they can be easily observed and protected. Even young children should assist in covering the bottoms of the holes. One puddle should be relatively clean with only rags, rocks and pebbles added to the bottom. The other puddle should have a muddy bottom and a cupful of any fertilizer added to the water.

Organize the youngsters into teams of at least three or more persons. Each team should keep a log of developments in each puddle. The log should record the following data:

1) date

2) time of day the observation is made

3) general state of weather on that day (cloudy, rainy, sunny)

4) temperature of the water

5) color and odor of the water

6) turbidity.

7) general appearance of a cupful of water from each puddle

8) a count and identification of one or more species characteristic of the sample taken from each puddle. (For example, ten mosquito larvae may be found wriggling in a cup of water removed as a sample from one puddle.)

The members of each team should accept various responsibilities for gathering and recording data from both puddles.

Turbidity is measured by lowering the tip of a ruler into a puddle and recording the point at which the tip disappears in the muddy or cloudy water. For example, the tip may no longer be seen when the ruler is inserted ten inches into the water. This depth of ten inches is recorded as the turbidity measurement.

Samples taken from each puddle should always be taken with the same size cup, to allow direct comparisons. Observations of the sample may be done by simply looking into the cup and noting the larger plants and animals. More detailed work can be done when the contents of the cup are poured out into a large white-bottomed pan. Using magnifying lenses, youngsters may then see many small animals which may be more easily counted. If microscopes are available, a wet mount will allow the study of minute organisms which otherwise would remain beyond visibility.

Both puddles will probably contain a wide variety of plants and animals during the late spring. The youngsters will be able to observe the pattern of succession by which one type of dominant species is gradually replaced by another. For example, mosquito larvae may flourish for a time but later entirely disappear. In the later stages, backswimmers may appear and increase in numbers.

The fertilized puddle will support a more concentrated population of algae and other water plants. In this environment, we may anticipate that most small animal populations will also be relatively higher. The data may also support the hypothesis that higher temperature and greater sunshine favor larger populations.

The numerical data of this study can easily be represented on graphs or histograms. Using the data, the youngsters should be able to answer the following questions:

1) When did the population of recorded species begin to increase rapidly? When did these populations stabilize or begin to decline?

2) What temperatures favored the most rapid growth of populations?

3) What weather conditions favored growth?

4) Contrast life in the fertilized puddle with that of the unfertilized puddle. What comparisons can be made to fertilized and unfertilized lawns?

Further Challenges:

1) Contrast measurements made in artificial puddles with those from naturally occurring ponds.

2) Maintain data on the same puddles during a complete year and for several years. Note the annual fluctuations of populations.

3) Contrast samples from puddles with those from flowing streams.

Reference:

Outdoor Biology Instructional Strategies (OBIS). Pond Guide. Berkeley, California: Lawrence Hall of Science, University of California, 1974.

PLAY IN THE DIRT!

by William Sorenson

Focus: Soil that has been undisturbed for long periods of time tends to form distinct layers called soil horizons. These layers vary in color, thickness, and composition in different natural habitats. For example, soil layering in a grassy meadow is quite different from that found in a deciduous forest.

Small samples of soil also form mini-habitats for populations of plants and small animals.

Challenges: Find out if the soil is layered in your schoolyard and in other nearby study sites. Find out how fast your schoolyard soil absorbs water. Survey small schoolyard soil samples for tiny plants and animals.

Materials and Equipment:

Pebbles
Shovels
Juice cans (remove both ends with a can opener)
Water measured into 1/4-liter portions (in jars or cans)
Wristwatch, stopwatch, or alarm clock with second hand
Jars about 3/4 full of water (with tops)
Hand lenses

How-To-Do-It: Divide your class into small groups and give each group a pebble. Have a member of each group close his/her eyes and throw the pebble on your schoolyard (or other) soil study site. Each group can then use the soil immediately beneath its pebble as the study sample. (This procedure allows for random sampling of the soil of your study site.)

The following activities can be done at each pebble-marked location:

1) Water absorption investigation. Have kids push a juice can (open on both ends) about one cm into the soil. Then they can time how long it takes for 1/4 liter of water, poured into the can, to sink into the soil. Comparison of water absorption times from all groups can be used for later class discussion of relative soil compaction and composition.

2) Soil profile study. Each group can use a small shovel to cut a triangular wedge of soil (about 30 cm wide and 50 cm deep) near where the pebble fell. Kids can examine the wedge and look for layers or regions of different colors and textures. If layers are present, their thickness can be measured, and comparisons of particle sizes, colors, and textures can be noted.

For further investigation of each soil layer discovered, kids can take a sample of each layer and place it in a jar of water. They can shake the jar and let the contents settle. This will separate the original layer into more layers formed from its components. Are some of the same components found in all the jars? Are colors or textures apparent in the jars that were not observable in the original soil samples?

3) Soil creature survey. Youngsters can use hand lenses to search each layer of soil in another sample for small plants and animals. Each group might make a chart showing a cross-section of their soil sample and the numbers and types of green plants, fungi, insects, worms, and spiders found at various depths in the soil. Where are most living things found in the soil? Which creatures are found deepest in the soil? What adaptations do some of these creatures have for living underground?

Further Challenges:

1) Hammer a wooden stake into the ground near each pebble-marked soil study location. Compare the effort needed to drive the stake with the compaction results of the water absorption study.

2) Cover one side of a large piece of cardboard with rubber cement. Place a soil sample wedge on the cardboard so one side of the sample makes firm contact with the cement. Dump the soil off the cardboard. A soil profile should then be recorded on the sticky surface.

STREAM STUDIES

by JoAnne Jones and William Sorenson

Focus: A creek or stream located nearby your school can be a fascinating place for long-term ecological studies. Both physical and biological characteristics of a stream change considerably during a year. Much can be learned by monitoring these changes.

Challenges: Monitor the flow, temperature, dissolved materials, bank erosion and deposition of a stream during an entire school year. Monitor the populations of living organisms found in a stream at different seasons during a school year.

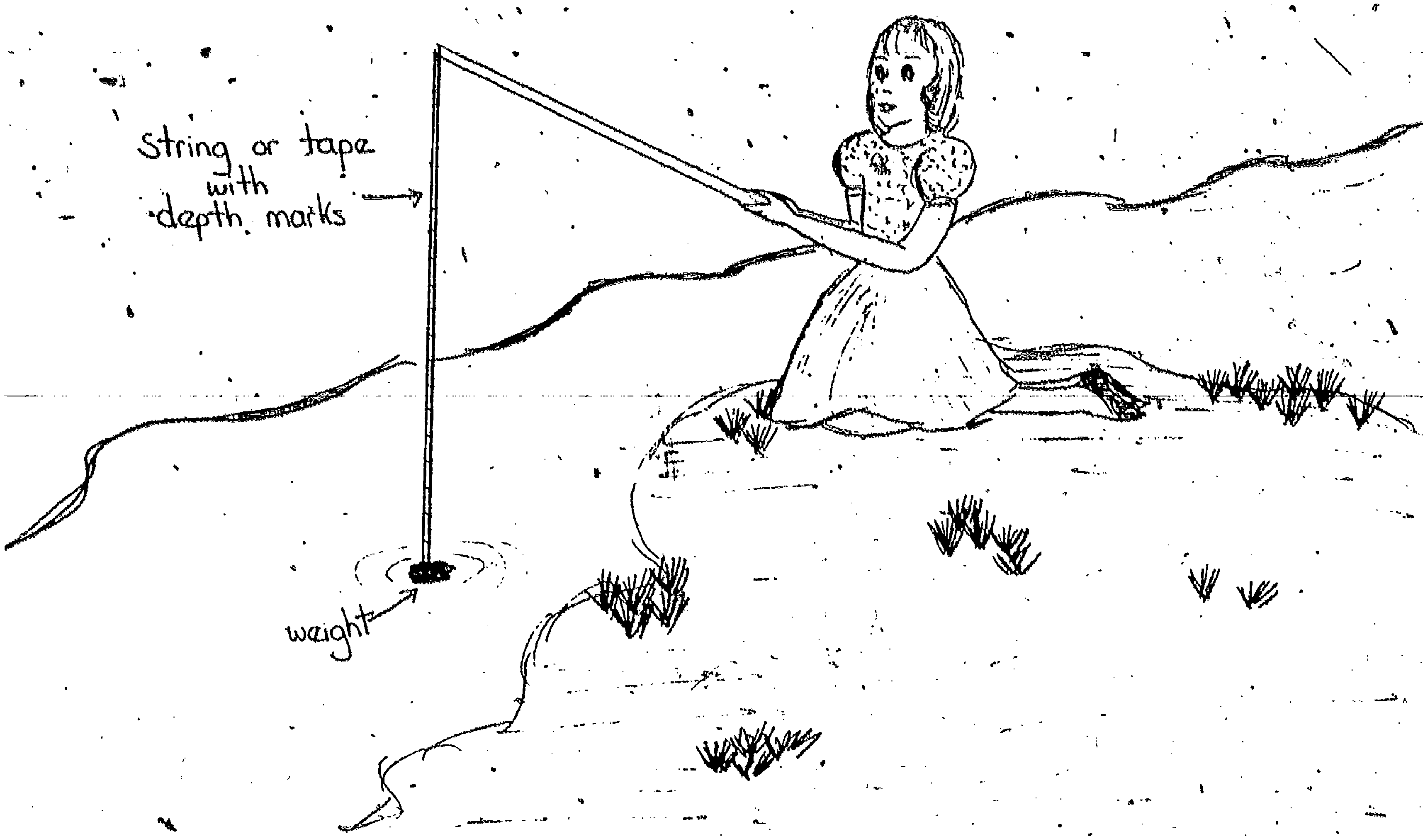
Materials and Equipment:

Large sheets of paper and felt-tip markers for maps
Meter sticks
Long wooden pole (optional)
Boots for youngsters
String
Thermometers
Ping-pong ball or cork
Stopwatch or wristwatch
Homemade aquatic collecting devices (see Appendix)
Large jars
White plastic basins (optional)
Cameras (optional)
White jar lids

How-To-Do-It: If you are fortunate enough to have a stream near your school, your class can be organized for year-long monitoring of changes taking place in the stream. At several times (perhaps three to eight) during the year, kids can conduct the following activities, keep and data, and make interesting comparisons.

Mapping and Photographing: Groups of kids can be assigned to different sections of the stream. They can make a detailed map of their stream section including shape and inclination of the banks, depth of the water, rocks, trees, rapids and still water areas, etc. If the stream is a shallow one, youngsters with boots can carry meter sticks right into the water to measure depths. If this is not feasible, perhaps long sticks can be obtained from which measuring lines and weights can be dipped into the water.

If possible, youngsters should accurately measure the width of the stream at several places and try to make a top-view map of the stream drawn to scale. If cameras are available, photos taken of identical sections of the stream at different times during the year can be quite intriguing.



Measuring Stream Velocity: Kids can measure a distance of 10 meters along the stream path. One youngster can drop a bright-colored cork or ping-pong ball at the upstream starting point of the 10-meter course. He should yell "start" as he drops the float and another youngster (the timer) starts a stopwatch or notes the position of the second hand on a wristwatch. A third youngster should be positioned at the downstream end of the 10-meter section and yell "stop" just as the float passes the finish line. The timer notes the time, in seconds, for the 10-meter journey of the float. The velocity of the stream can then be calculated as follows:

$$\text{Velocity} = \frac{\text{distance (10 meters)}}{\text{time of travel in seconds}} = \text{(?) meters per second}$$

To find meters per hour, do these calculations:

$$\text{Velocity (meters per hour)} = \text{(meters per second)} \times 60 \text{ sec.} \times 60 \text{ min.}$$

To determine kilometers per hour, divide the result of the above calculation by 1,000.

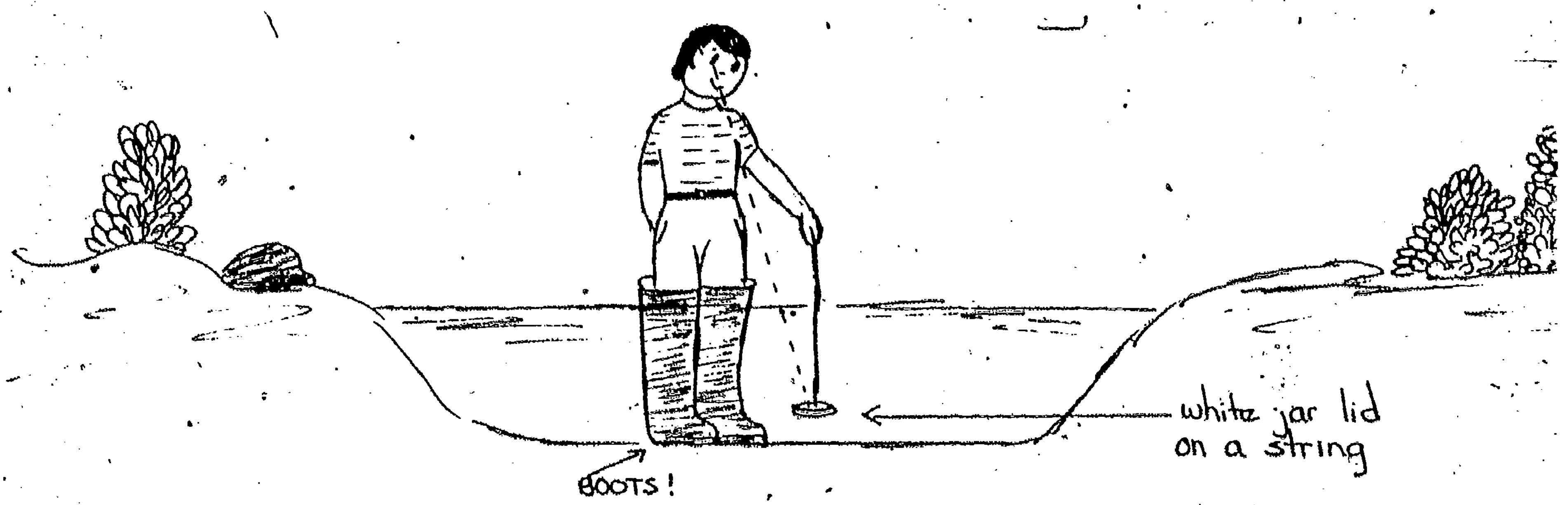
It is usually a good idea to measure the time of the 10-meter journey of the float several times and then use an average time for your other calculations.

Measuring Temperatures: Kids can measure water temperatures at different depths of water in their stream section, and also measure soil temperatures along the stream banks. They might measure air temperatures above the water and the stream banks and make comparisons. These measurements can be recorded on their maps.

Observing Dissolved Materials: Kids can compare the amount of materials dissolved in stream water in two ways:

1) Collect four to five liters of the water in a large jar and let the sediment settle to the bottom of the jar for a few days. Then measure the thickness of the sediment layer.

2) Suspend a white jar lid from a string. Then lower the jar lid into the water slowly until it cannot be seen. The distance the lid is lowered is the relative measure of the amount of dissolved material in the water.



Observing Living Organisms: Youngsters can use a variety of dip nets, bottom scrapers, and plankton nets to temporarily capture and observe creatures that inhabit the stream (plans for various aquatic collecting devices you can build are included in the Appendix). To encourage a "no damage to the environment" ethic, have kids collect organisms and observe them in jars or white plastic basins, and then return them unharmed to the stream. Small samples of mud and water may be taken back to your classroom for microscopic examination if microscopes are available. Kids may want to sketch or photograph some of the larger creatures found. Identification of some of the organisms can be accomplished by consulting appropriate fieldguides and sourcebooks. Or, kids can invent their own names and classification schemes for the creatures.

After a stream monitoring field trip, one or more classroom sessions can be devoted to analysis and comparison of the collected data. As the year progresses, youngsters are likely to observe dramatic changes in the physical characteristics and biological populations of the stream. Encourage them to make inferences to account for these changes, and perhaps try experiments to test their ideas.

Further Challenges:

1) Find out how to test the chemistry of the water in your stream. Monitor changes in chemicals present.

2) Make plaster casts of footprints of animals found on the banks of your stream.

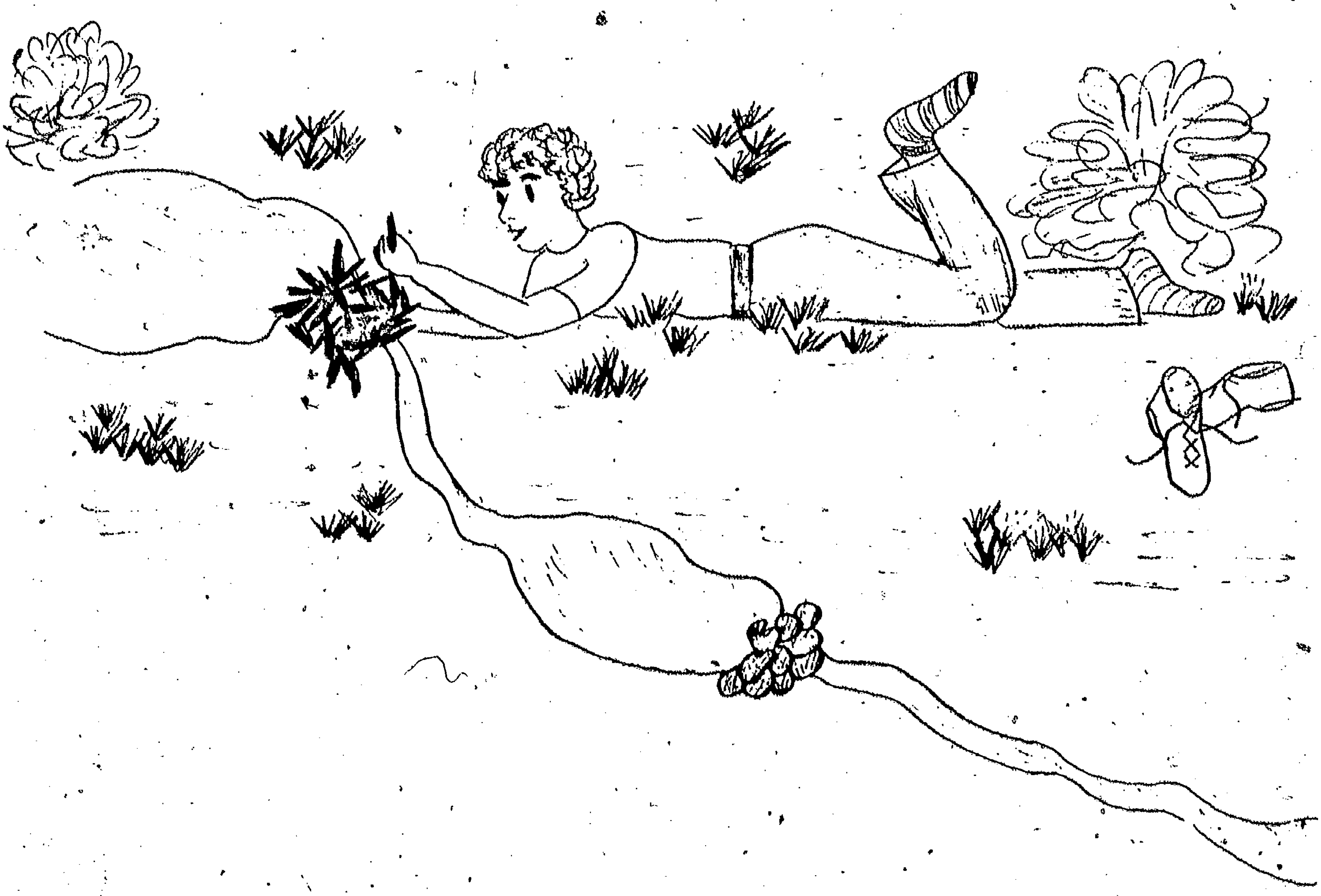
3) Try to estimate the volume of water flowing in your stream.

4) Try to estimate the amount of sediment carried by your stream.

5) Where does your stream begin? End? Is the water used for anything? Explore to find answers to these questions.

CHAPTER V

PHYSICAL SCIENCE ACTIVITIES



SCHOOLYARD STREAMS, LAKES AND DAMS

by Michael R. Cohen

Focus: Miniature examples of streams, lakes, and dams can be found in schoolyards during and after rains. These mini-examples exhibit most of the geologic characteristics of their larger counterparts, but they are much more accessible to observation and experimentation. They also go through geologic development and evolution much more quickly. Kids can witness stream erosion, meandering, and the life cycle of a lake in less than an hour. They can also have the fun of building mini-dams and witnessing the resulting effects on an environment.

Challenges: Observe and experiment with miniature streams, lakes, and dams in your schoolyard. Compare their characteristics to those of large-scale geological counterparts.

Materials and Equipment:

Notebooks or drawing paper, pencils
Sticks or spoons for mini-dam building
Small corks, bits of styrofoam, or other buoyant materials

How-To-Do-It: Start with this question: Where are the closest streams, lakes, and dams to this classroom? This can lead children to the unanticipated idea that small examples of these geological forms might be found right in the schoolyard.

Immediately after a rainfall, lead youngsters on a tour of your schoolyard in search of small streams, lakes and dams. When some of these have been located, children can work in groups and make more detailed observations. Each group can invent names for, make sketches of, and watch the evolution of a stream and/or lake. Current flow rates of different streams can be compared by observing small corks or styrofoam pieces float with the currents. Encourage kids to look for signs of erosion and soil being carried and deposited by the streams. If natural lakes are found, the following questions can be considered:

1) Where do lakes form? Why in one location rather than another?

2) What causes lakes to get larger? Smaller?

3) Where does the water for a lake come from?

4) What happens, in time, to lakes fed by sediment-bearing streams?

Children will enjoy using stones or mud to dam up some of the mini-streams. Have them predict, before building a dam, what effects the dam will have. Will a dam completely stop a stream? What shape will the body of water formed by a dam have?

It is also a worthwhile experience to have kids build dams along expected stream beds <u>before</u> a rainfall and then observe them during or after the rain shower. Kids can study the area behind their dams as the water dries up. What type of material is found there? What would happen to this area over a long period of time?

Lots of variations of these activities are conceivable. If water runs in a stream along a street or parking lot, it will often have a film of oil on top. The oil-films provide observable patterns kids can use to better understand stream flow. Straight lines in the surface oil-films indicate smooth flow, while swirling patterns signal turbulence. Look for relationships between stream turbulence, erosion, and meandering.

When lakes dry up, various sorts of materials are left behind in the dry lake beds. Try to find out where the lake bed materials came from. Have kids predict what happens to a lake as material continues to be deposited (eventually it becomes a marsh and then dry land).

As a result of activities like these, kids will better understand patterns of stream flow, lake formation, and lake life-cycle, and some of the environmental effects of dams. And, it can be a lot of fun!

<u>Further Challenges:</u>

1) How long does it take for schoolyard streams and lakes to dry up? Does this vary depending on the time of year? Conduct observations to find out.

2) Consult geology books to find out how many of the characteristics of schoolyard streams and lakes apply to large-scale bodies of water.

3) Which would carry more sediment--a fast-moving or a slow-moving stream? Do some experiments with schoolyard streams to find out.


P.S. #6
SMALL DIVIDE OR BUST!

ACROSS THE SMALL DIVIDE

by Michael R. Cohen

Focus: A divide is the line separating drainage systems. The top of every hill or rise in the landscape is, in effect, a divide. The Continental Divide does not separate a continent in half. It is the place where water flows in different directions. There are divides which separate water flow east and west and those that separate the flow north and south. The main idea is that a divide indicates the boundaries of a drainage system. The drainage could be as small as a part of a small valley, schoolyard or backyard or as large as half a continent. Drainage basins become important when considering water resources.

Challenge: Find answers to these questions: How many divides did you cross on your way to school? Where is the closest divide? Who can locate the closest divide?

Materials and Equipment:

Plastic gallon jugs
Dictionary
Meter stick or other straight stick
Commercial level or glass of water used as a home-made level

How-To-Do-It: Most children will have trouble with the word divide. It sounds like an arithmetic function. This is an opportunity to discuss the multiple meanings of words (a dictionary will help). The geologic divide is similar to the arithmetic division in that it separates two areas, like dividing a pie. But it is different in that the separation is caused by height and not by size.

The idea of geologic divide is novel to most children and helpful to those who have heard of the Continental Divide. They will quickly begin to find examples of divides around school. Hills are the easiest place to start. Have children suggest various places around the school or their homes they think are divides.

The next step is to draw a map of an area indicating the divides. This map may take two forms; a small detailed map of a specific area such as the school yard or backyard of a home, or a less detailed map of several blocks, a section of the city, county or larger area. The children should locate the divides on the map and then indicate the direction of the water flow from the crest of the divide. An example of a map of the divides around a child's home is shown in Figure 1.

It is possible that children will have trouble indicating the direction of water flow along some divides. There are several ways student opinions about the location of divides and water flow from the crest can be substantiated. The simplest is to have them pour water along the top of the divide and watch the way it runs down the sides. They can experiment with a thin spray of water, a deluge of water, water in a wind, etc. The reason for this type of experimenting is to check their original thoughts. In some cases the use of water still leaves doubt as to the direction of the water flow. If that happens, or if the children want to check their original measurements again, it is possible to use a commercial or home-made level. The children can lay the meter stick along the crest of the divide and use a level to indicate the direction and extent of the slope around the divide.

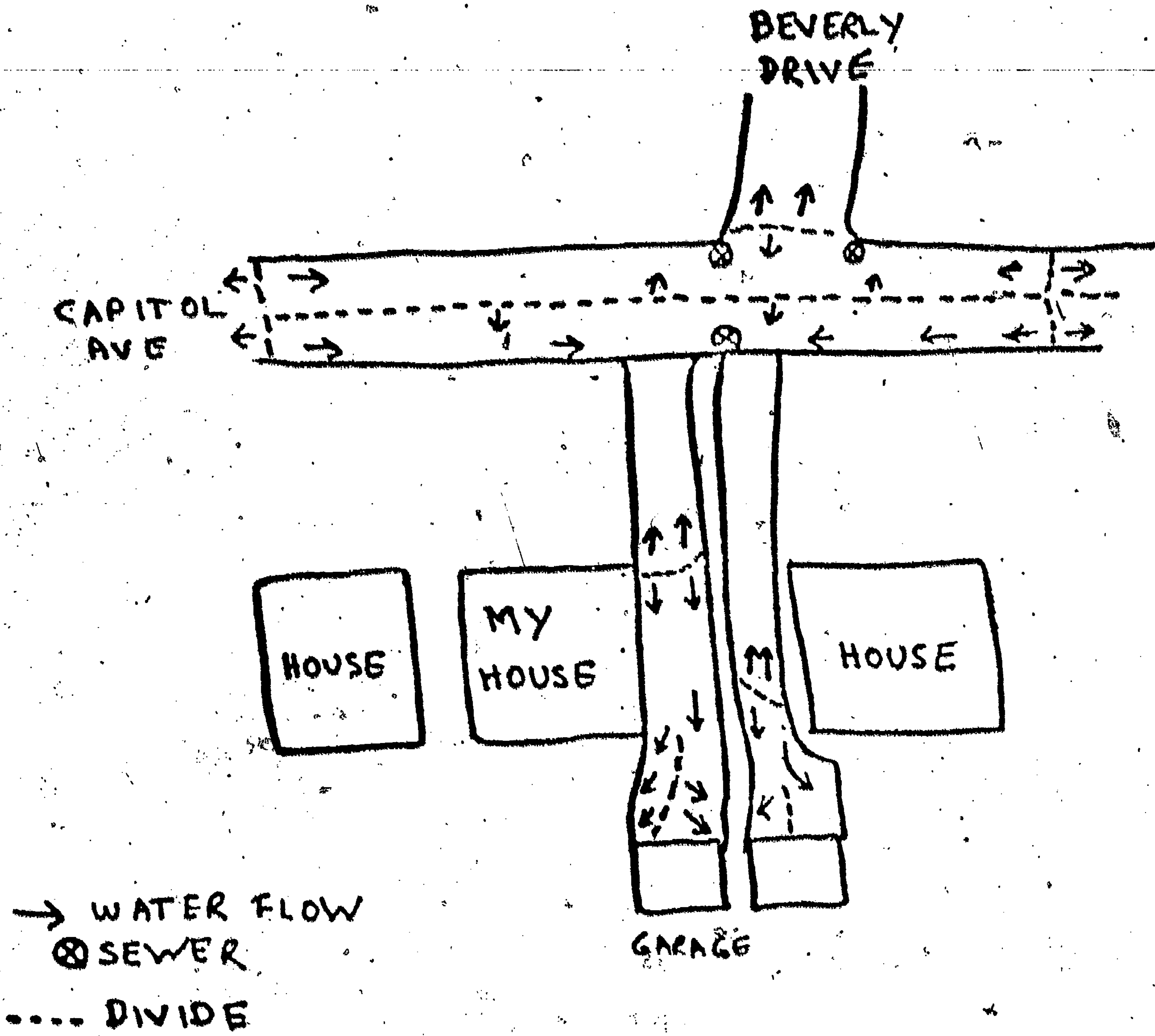
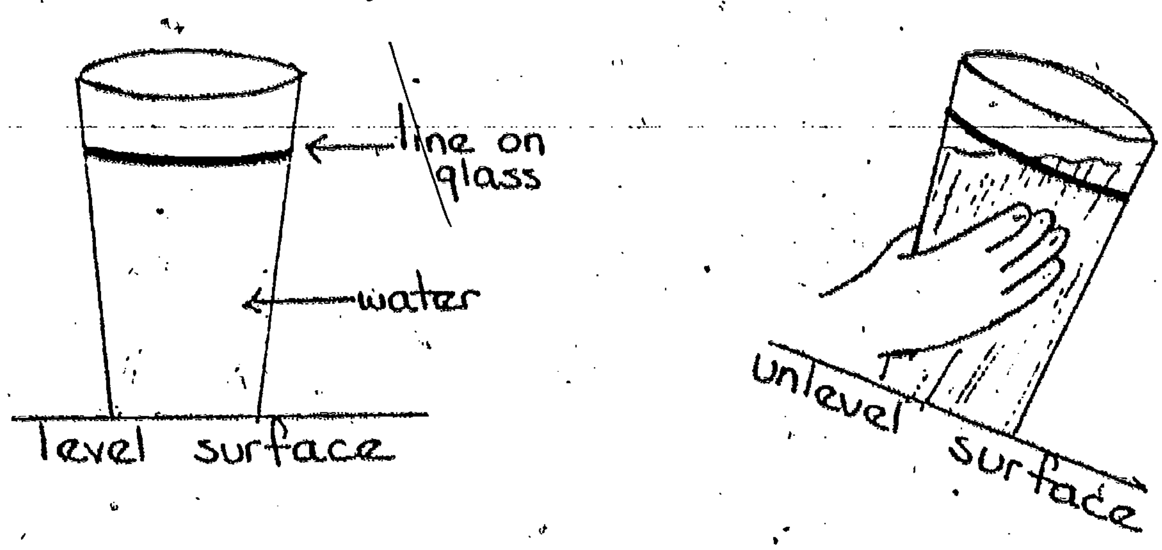


Figure 1. Map of area around a child's home with indication of divides (dotted lines) and water flow from the divides (arrows).

Youngsters can make their own levels using a glass of water (a clear plastic glass is best). Have them use thin tape or a marking pen to make a line about four centimeters from the top of the glass. This line must parallel the bottom of the glass. If this glass level is placed on even ground and filled with water to the line, the water will reach the marked line all around the glass. If the glass is placed on unlevel ground, the water will rise over one part of the marked line and fall below another section of the line.



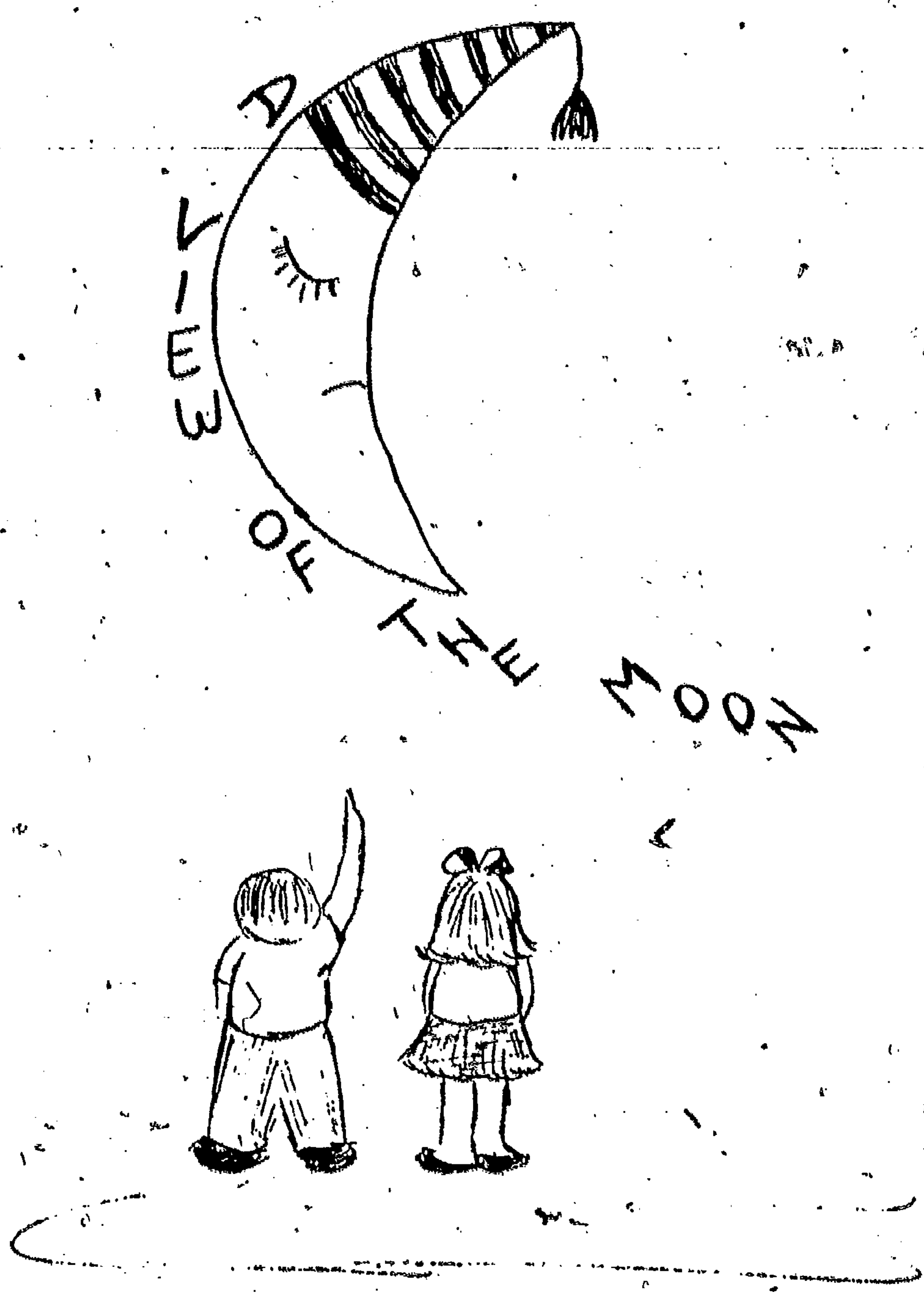
As a result of this activity the children may become aware that water falling on the ground does follow a particular path. They will more fully understand the conditions that determine the flow of water into streams and rivers. This information is basic to an understanding of the drainage patterns in various parts of the United States, and the effects of the drainage patterns on flooding, farming, irrigation, highway and building sites, and flood control.

Further Challenges:

1) Visit a construction site and observe various gullies cut into the soil. Predict which gullies will grow larger and where drainage basins will form.

2) Which would have more run-off water--a paved parking lot or a wooded area? Make some observations to support your answer to this question.

Note on Safety: In this activity the children are likely to find some of the divides on or near streets. They should be cautioned to stay on the sidewalks at all times and not to conduct measurements in the street. A number of containers for water, jugs and glasses may be used in this activity. These should be made out of plastic and never out of breakable material.


A VIEW OF THE MOON

Activity #36

A VIEW OF THE MOON

by Dorothy Alfke

Focus: This activity stresses the importance of direct, concrete experiences as basic to true understanding of complex interactions of bodies within our solar system. Children are involved in a natural outdoor laboratory--observing the sky--to witness patterns of change with time. After long-term observations and record keeping, the following ideas are developed:

a. the moon appears to rise in the east, move in an arc across the sky, and set in the west.

b. the moon goes through an orderly sequence of change in appearance from full moon, through stages of gradual disappearance of the right side portion until none of the moon is visible. Then it reappears as a right arcing crescent which gradually increases to a full moon.

c. this sequence of change repeats itself in cycles of approximately four weeks.

d. the time when the moon is visible also follows an orderly and predictable pattern of change--i.e.:

- A full moon rises at about sunset and sets at about sunrise.
- The moon rises and sets about 50 minutes later each day.
- A waxing quarter moon rises at about noon and sets at about midnight.
- A waning quarter moon rises at about midnight and sets at about noon.

Challenge: Discover the orderly patterns of movement of the moon through our sky.

Materials and Equipment:

Compasses
Hypsometer (see Appendix)

How-To-Do-It: Launch this activity at a time when the sky is fairly clear and the moon can be seen in the sky during at least half of the school day. The moon should be in a phase between first waning "quarter" and third waxing "quarter," preferably the waning quarter.

Take the class outdoors when you know the moon is visible. Caution the children not to look at the sun at any time. Tell them to search the sky and find the moon.

When all the children have found the moon, discuss its location.

1) Is it directly overhead? Is it just above the horizon? Is it about 1/3, 1/2, 3/4 (etc.) of the way between the horizon and directly overhead?

2) In what direction are they facing when they look at the moon? Draw on any background the children have to estimate direction (position of sun, orientation of school building, use of compass if available).

Repeat the observation experience about one and a half hours to two hours later. Include in the discussion the change in the moon's position from the earlier observation. Establish a need and interest for recording the information obtained through observation.

Take the children back to the classroom and establish a method of keeping records of their observations of the moon.

Make an ongoing class assignment to observe the moon and record date, time, shape of moon, direction and elevation above horizon. After they have been observing and recording to identify patterns of change with time, have them start listing questions that occur to them as they make their observations.

Whenever possible, take the class outdoors for moon observations which they can incorporate into their cumulative record. Encourage the children to include sequences during 24-hour periods and sequences of observations made at the same time for several days.

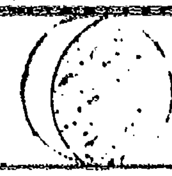
Incidentally, it is relevant to record time when the sky is clear and no moon is visible.

Occasional class discussions are important to sustain interest, to help the children become more skillful in keeping records and to help them identify the patterns of change with time.

As time goes on, the children should be able to make predictions of when and where the moon can be seen in the sky. This will help them evaluate their ideas of patterns of change as they gather further evidence. Through experience they will become more efficient in their viewing and record keeping. They may figure out ways to reorganize their data to show patterns which support their ideas. They also will grow in their concepts of the patterns of change with time in their view of the moon.

This activity should span at least two months so that the monthly cycle is seen to repeat itself. It may be necessary to extend this period if there are too many cloudy days and nights for the patterns to become apparent to the children.

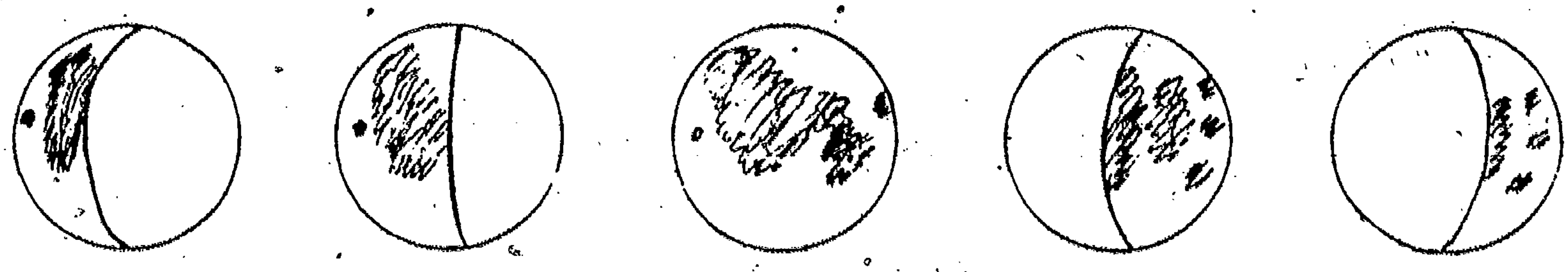
One Way for Children to Record Their Observations

date	(indicate a.m. or p.m.)	shape of moon	direction	elevation
				

*Note: We suggest using a coin for outline, have children draw in visible portion shading part not visible.

Further Challenges

1) Encourage the children to observe conspicuous features they can see on the visible surface of the moon. Have them include these in their drawings of the moon in their records. This will produce the important evidence that the moon always keeps the same side turned toward the earth. Their cumulative evidence can be further supported by examining photographs of the moon in various reference books.



2) Plan ahead for a time when the moon will rise during the school day. Arrange for the class to be outdoors at this time. Establish with the class the idea that just over the curve of the earth toward the eastern horizon, the moon is located in space. As they watch and wait, the turning earth will carry them around to a position where they will be able to see the moon. If the moon does not appear in a short time, have individual children take turns "standing watch" to alert the class to when it "rises." The rest of the class can be gainfully occupied with some other outdoor education activity or playground activity.

Reference:

Science and Children, published by the National Science Teachers Association, has a regular Sky Calendar feature. This will provide information you need for moon-viewing.

Note: The rising time for your location may vary from the times stated in sky calendars for any of several reasons. A hill or mountain on the eastern horizon will block the moon until it has risen higher than the sea level horizon for which the sky calendar data is given.

AND NOW FOR THE LOCAL WEATHER REPORT

by William Sorenson

Focus: When the weather forecaster announces that the temperature today is 20°C (68°F) and the wind is moving 22kph (15mph) from the southwest, does this mean these measurements apply everywhere in your vicinity? Probably not. The temperature, wind speed, light intensity, and humidity can vary a good deal, even within the immediate surroundings of a school building.

Challenges: Determine the temperature, wind speed and direction, humidity and light intensity of a number of locations around your school. Make comparisons of data collected at the various sites.

Materials and Equipment:

Wooden stake (about 30 cm. long)
Hammer
Thermometers
Human Hair Hygrometer
Wind vane
Anemometer
Photographic light meter
Magnetic compass

(Human Hair Hygrometer through Magnetic compass:) Students can build these (see Appendix).

How-To-Do-It: Divide the class into groups and assign each group to record weather data at a variety of different locations around your school grounds. Select areas that are likely to be different from each other: corners of the school, an area under a tree, a paved area, a grassy area, etc. Each group can be issued (or they can build) a set of measuring instruments, or this equipment can be shared among the groups. At each study site, the following measurements may be made:

1) temperature--push a wooden stake into the ground to make a hole about 15 cm (6 inches) deep. Place a thermometer in this hole. Locate a second thermometer on the surface of the ground, and a third 15 cm above the ground. Wait three to four minutes and then record temperatures.

2) humidity--use a human hair hygrometer to measure the amount of moisture in the air.

3) light intensity--this can be quite precisely measured with a photographic light meter.

4) wind speed and direction--use an anemometer to measure wind speed and a wind vane to determine the direction wind is coming from.

It will probably take kids about 15-20 minutes to gather the data. The entire class may then meet to compare results. It is quite likely they will find that readings will vary a fair amount from station to station. Compare the readings from each station, one variable at a time, and have youngsters suggest possible explanations for differences noted. Finally, the class might discuss the accuracy of weather forecasts made for broad geographical areas.

Further Challenges:

1) Compare local weather readings in diverse environments: paved lot, meadow, woodland, beach, and streamside.

2) Experiment with ways to change the weather conditions at your local schoolyard measurement stations.

SUNBEAM TARGET PRACTICE

by Alan McCormack

Focus: Almost everyone has had fun reflecting sunbeams from pocket mirrors. Why not use this casual pastime as the basis for some good outdoor investigations of the science of light? Principles of light reflection can be learned in the guise of an outdoor target game.

Challenges: Find out how the size of a mirror-reflected beam of sunlight relates to the size of the mirror and the distance to a target. Find out if paper shapes attached to mirrors are reflected as shadows. Try to determine how far a light beam can be reflected from a mirror. Reflect the same light beam between two or more mirrors and hit a target.

Materials and Equipment:

Small pocket mirrors
Tape measures
2 cardboard boxes
Plasticene clay
Construction paper
Masking tape

How-To-Do-It: Obtain a number of small pocket mirrors. On a sunny day, issue a mirror to each student or each pair of students. Go out to the schoolyard and find a place where a shady area is produced by a wall of your school building.

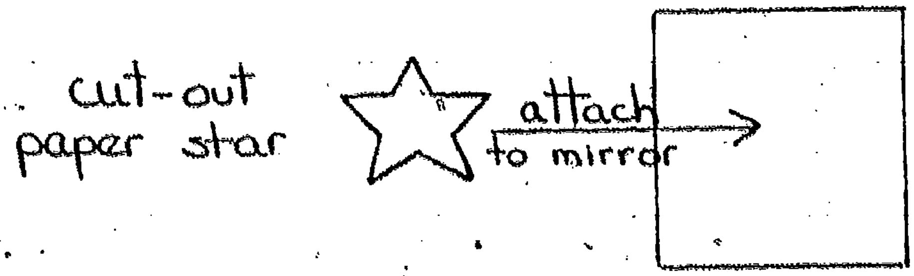
Measuring Sunbeams: Have kids reflect light from the sun on to the shady school wall. Then use tape measures to find the sizes of the mirrors (perimeter or area) and the sizes of the corresponding spots of light on the wall.

1) Are the reflected light spots shaped like the mirror or like the sun?

2) What happens to the size of a light spot as you change the distance of the mirror from the wall?

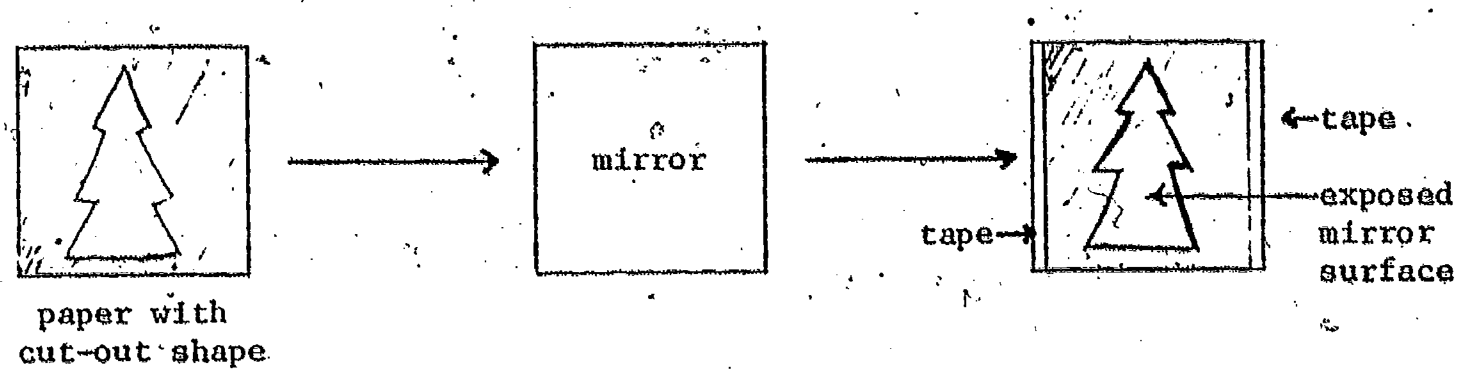
3) How far away from the wall can you get and still reflect a light-beam on to the wall?

Projecting Shapes from Mirrors: Suppose you cut out a star shape from paper and attach it to the center of a mirror with doubled-over masking tape.



Will the shape be projected as a shadow within the sunbeam? Try it and see.

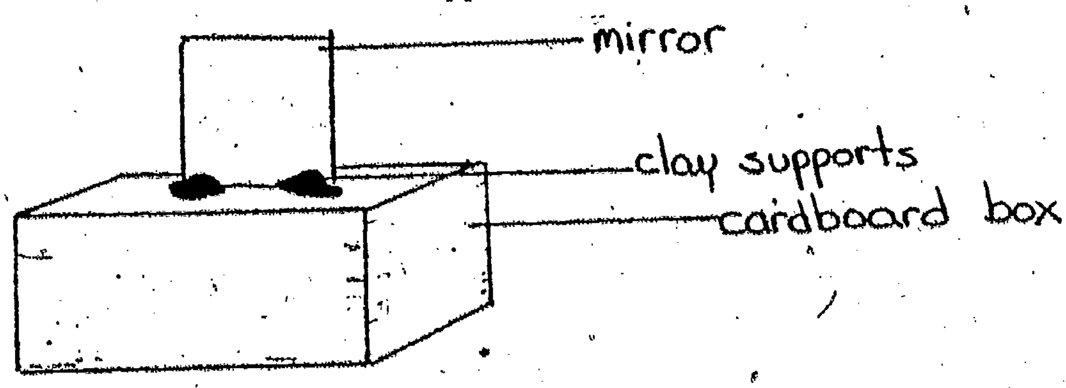
You can also make construction paper "frames" in different shapes for the mirrors and investigate how these are reflected.



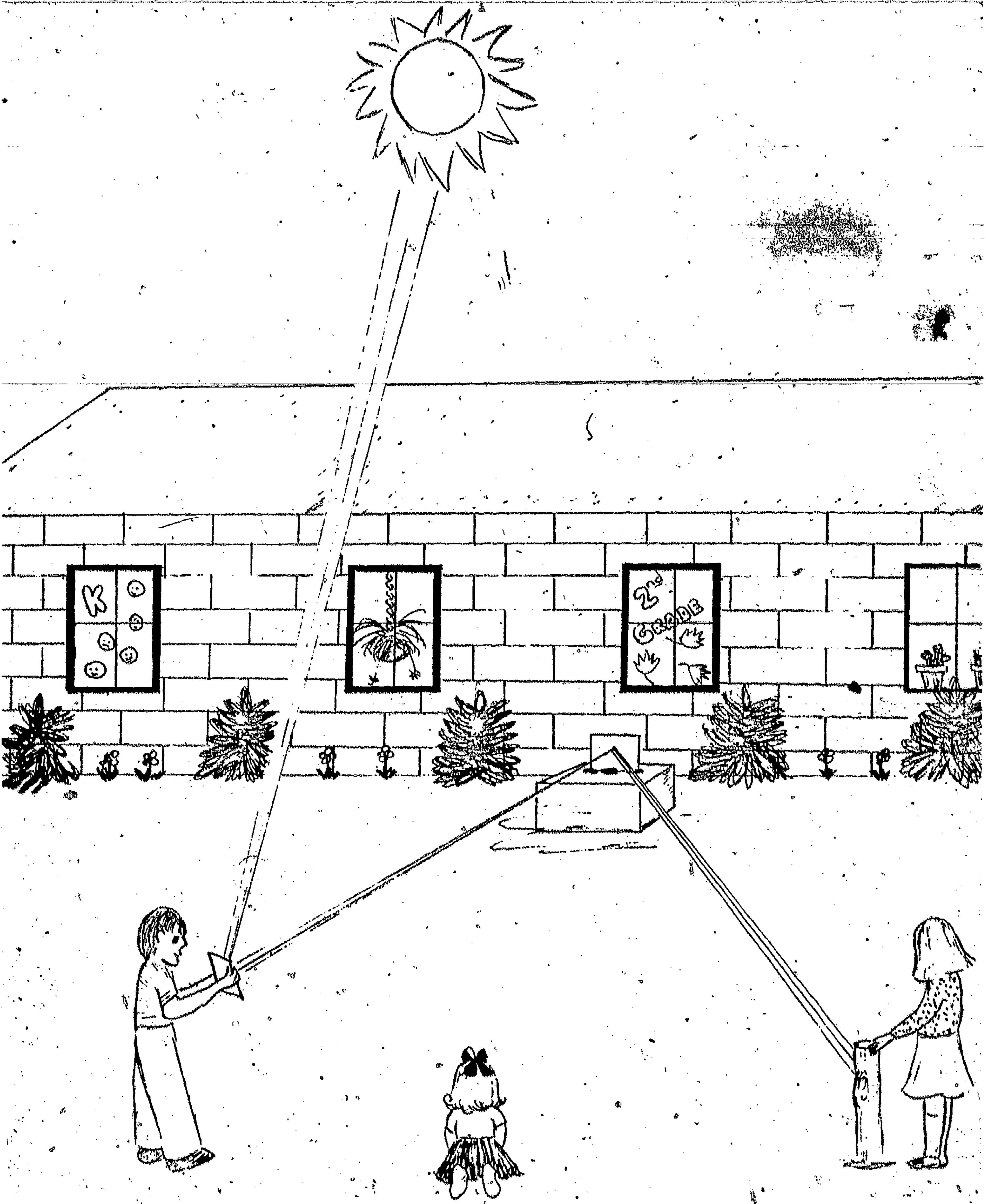
Combining Sunbeams: What happens if lights from two or more mirrors are shone on the same spot? Is combined light brighter or the same as light from a single mirror?

Target Activities: Place a cardboard box in the shady area. Have kids try try to "hit" the box with sunbeams from their mirrors. They will find this easy to do.

Now set up a mirror on top of the box so the shiny side of the mirror is perpendicular to the top of the box and is facing the youngsters. Plasticene clay works well as mirror support bases.



Now place another cardboard box or a wooden stake on the ground somewhere near where the class is standing. Challenge the kids to reflect sunbeams from their mirrors to the stationary mirror, and then hit the target! This isn't easy, but it can be done. If you are lost by my description, there is a sketch of the activity set-up on the next page.


K
2nd
GRADE

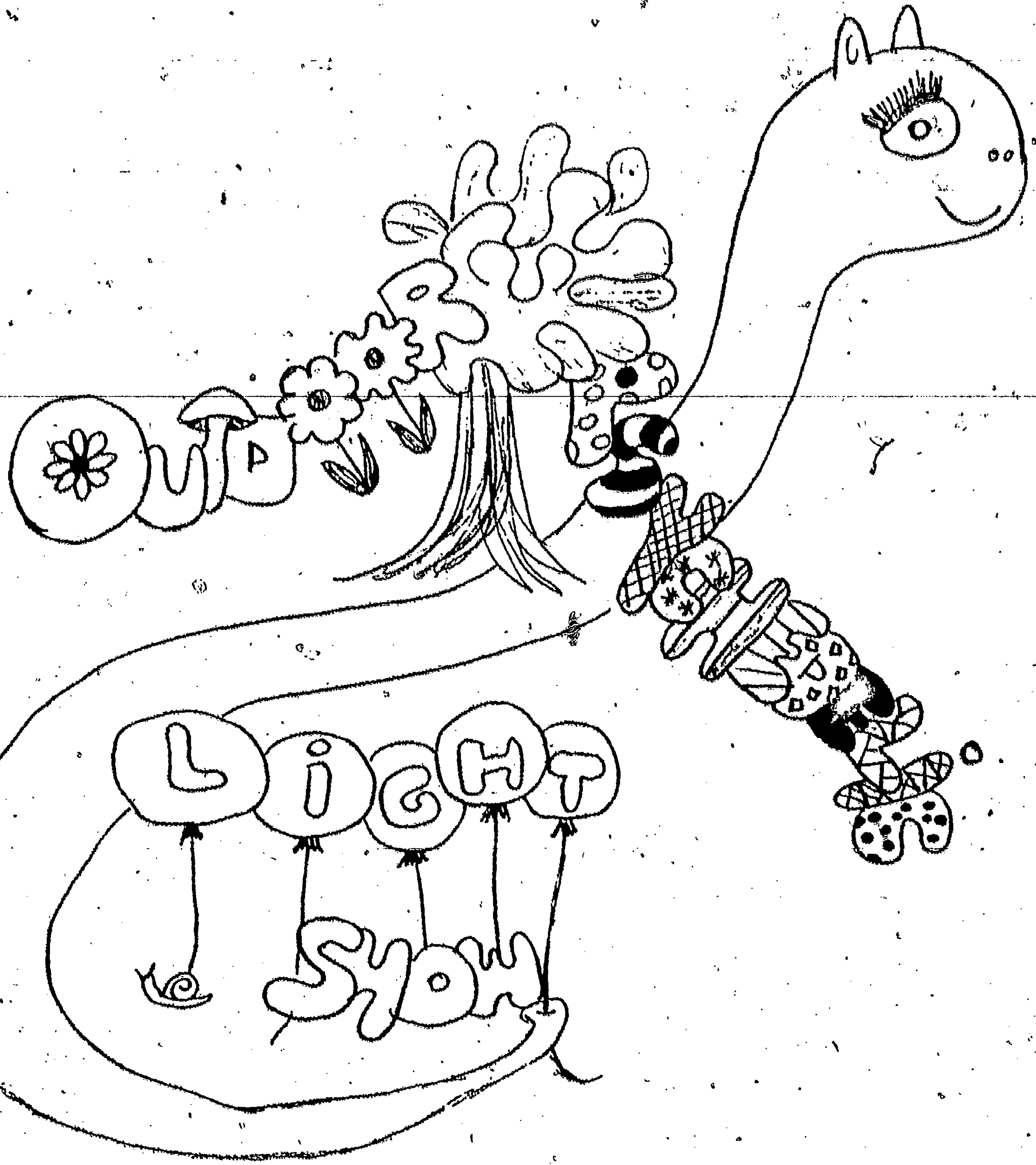
Try to get kids to figure out the relationship between the angle at which the light beam hits a mirror and the angle the beam reflects away from it (they are the same--as physicists say, "the angle of incidence is equal to the angle of reflection").

You can vary the angle of the stationary mirror and the placement of the target and have some enjoyable target practice.

Further Challenges:

1) Try to hit a target after reflecting a light beam among three mirrors.

2) Develop a signal code for mirrors and light beams.


LIGHT
SHOW

OUTDOOR PSYCHEDELIC LIGHT SHOW

by Alan McCormack

Focus: Though most kids have played with reflections of sunbeams from pocket mirrors, very few have explored mirror reflections of colored beams of light. With very simple materials it is possible to produce vibrant-colored light, mix and move the beams, and even orchestrate your class's own psychedelic light show!

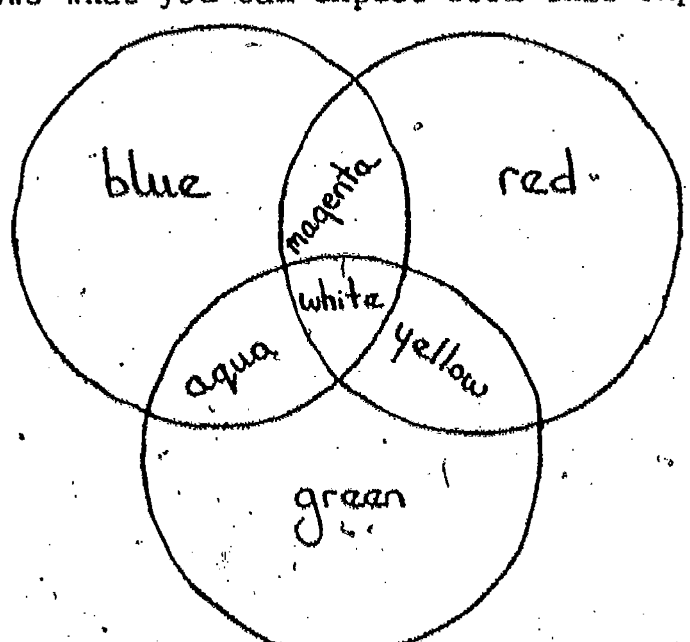
Challenges: Produce and reflect colored beams of light from simple pocket mirrors. Discover the colors resulting from mixing red, blue, and green light beams. Put on your own psychedelic light show.

Materials and Equipment:

Small mirrors
Red, blue, and green transparent cellophane or plastic
White paper
Masking tape
Battery-operated tape recorder or radio (optional)

How-To-Do-It: On a sunny day, take your class out to your schoolyard and go to a wall of the school that is casting a shadow. Provide small pocket mirrors and different colors of transparent cellophane or plastic to cover the shiny faces of the mirrors. When kids reflect sunlight from these covered mirrors, they will find the reflected beams to be the color of the material covering their mirrors.

Mixing Colored Beams: As a scientific experiment, have kids systematically mix the light beams. They can do this by reflecting two or more different colors on the same spot on a white piece of paper taped to the shaded school wall. Everyone will be in for a surprise--beams of colored light do not mix in the same way that colored pigments do! With paint pigments, red and green would blend into a brownish-gray. With light beams, they form yellow! The following diagram of overlapping colored beams shows what you can expect from this experiment:



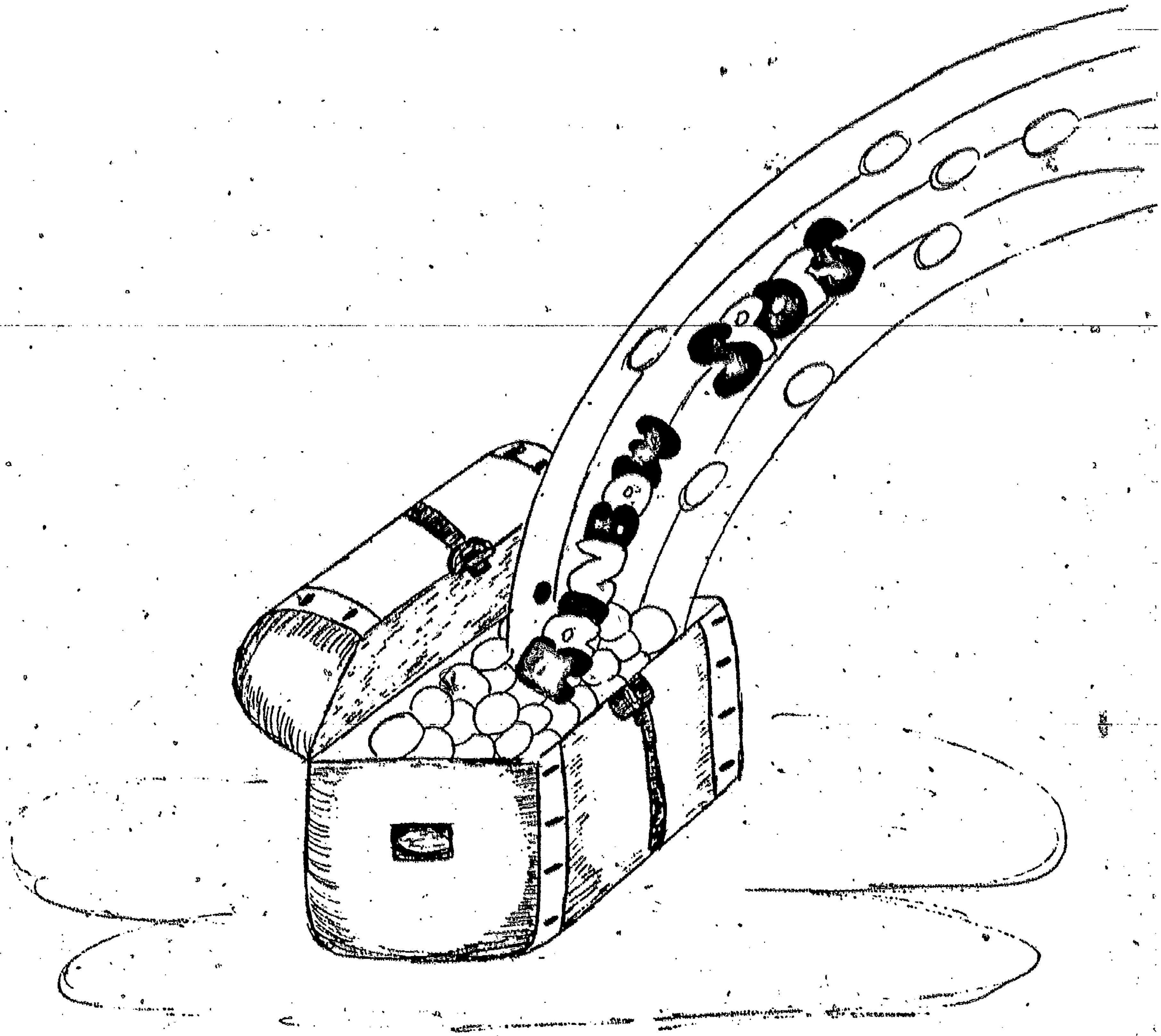
Producing a Light Show: Now for some real fun. If possible, play some music on a battery-operated tape player or radio. Have the kids line up in a position where they can reflect sunlight from their color-generating mirrors onto the shaded wall of your school. Kids can now move and blend their light beams to the cadence of the music, resulting in a huge moving kaleidoscope of colors--a psychedelic light show! If you wish, prepare a script for the show, having blues and greens take center stage during slower or more somber music, and reds and whites take over for livelier numbers. Have kids use their imaginations in developing the show, and then invite another class to be your audience. Try it, you'll like it!

Further Challenges:

1) Mix paint pigments and compare results with mixtures of light beams.

2) Try placing two or more layers of different colored transparent materials in front of the mirrors. Do they mix?

3) Try reflecting colored beams from one mirror to another. Can it be done? Do the colors change?



RAINBOW SPOTS

by Alan McCormack

Focus: White light is actually a composite of all colors: red, orange, yellow, green, blue, indigo, and violet. Most objects we observe do not generate their own light, but reflect light to our eyes which our brain interprets as a particular color. For instance, a green leaf appears green because it absorbs all other colors except green from white sunlight, and refletts green wavelengths of light to our eyes. The colored wavelengths that are absorbed by the leaf tend to be converted to heat energy, raising its temperature. All objects exposed to white sunlight are affected by this same principle--they absorb some wavelengths (colors) of light and become warm as a result; and they reflect some wavelengths, giving them their apparent color.

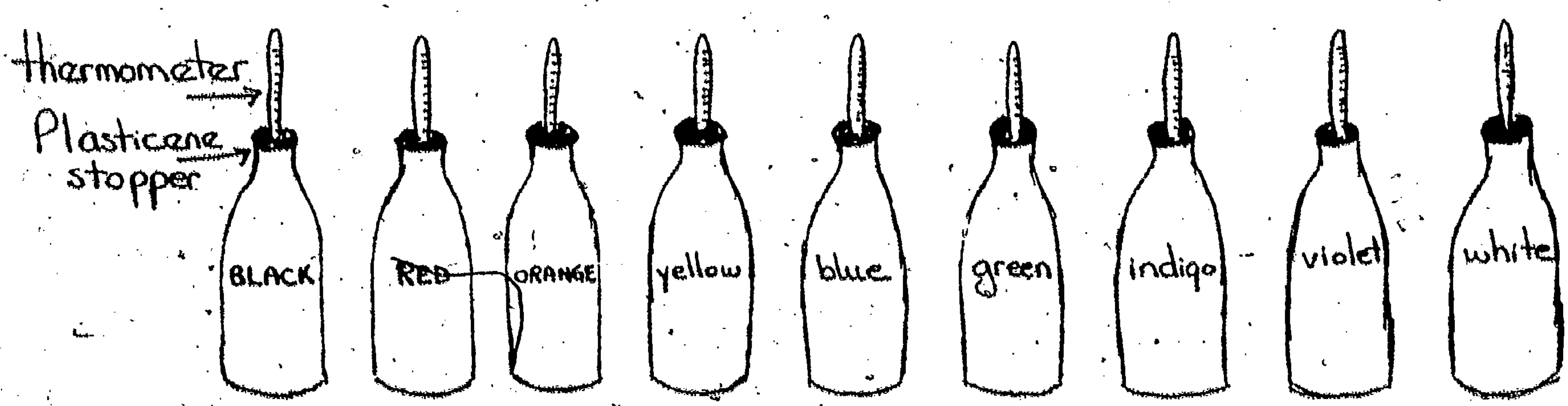
This activity is one approach to helping youngsters investigate relationships between color and heat absorption. It would be an excellent follow-up to Hot Spots and Cold Spots, Activity #46.

Challenge: Find out which colors absorb sunlight and become warmest. Also determine which colors stay coolest under the same conditions.

Materials and Equipment:

8 or 10 empty identical soda pop bottles
8 or 10 thermometers
Plasticene clay
Spray paint, tempera paint, or construction paper in as many of the following colors as you can obtain (red, orange, yellow, blue, green, indigo, violet, black, white).

How-To-Do-It: Paint, or attach construction paper to, your soda bottles so that you have a spectrum of different colored bottles. Place a thermometer in the mouth of each bottle, and secure it with a lump of Plasticene clay so that the bottle becomes air-tight.



Place all bottles in the same sunny place for one or two hours. Then have kids observe and record temperatures of each bottle. Have kids arrange the bottles in a series from hottest to coolest. Discuss: What would be the best colors to choose for clothing on hot days? Cold days? What colors would be best for exterior house paints in hot climates? Which color would be best for energy absorption in solar energy devices?

<u>Further Challenges:</u>

1) Try a similar experiment using colored water in transparent bottles. Are the results the same?

2) Do a survey of the colors of animals found in hot and cold climates. Are their colors consistent with what you might expect?

3) Gumdrops, M & M's, jelly beans and other candies come in a rainbow of different colors. Do different colored candies melt at different rates in warm sunlight? Do an experiment and find out.

PATTERNS OF MELTING SNOW

by Dorothy Alfke and Michael R. Cohen

Focus: Snow doesn't melt uniformly. Patterns are formed as snow melts on one side of trees, on dark surfaces; on pavement, and on various parts of buildings. Where does snow melt first in the neighborhood of your school? Do some rooftops melt snow more readily than others? What factors are involved in melting of snow? Questions like these can be springboards for good outdoor activities during winter months.

Challenges: Catalogue the spots where snow melts first on the ground in the neighborhood of your school. Make a school neighborhood map recording snow-melting rates on rooftops of homes and other buildings. Develop reasonable explanations to account for observed differences in snow-melting rates.

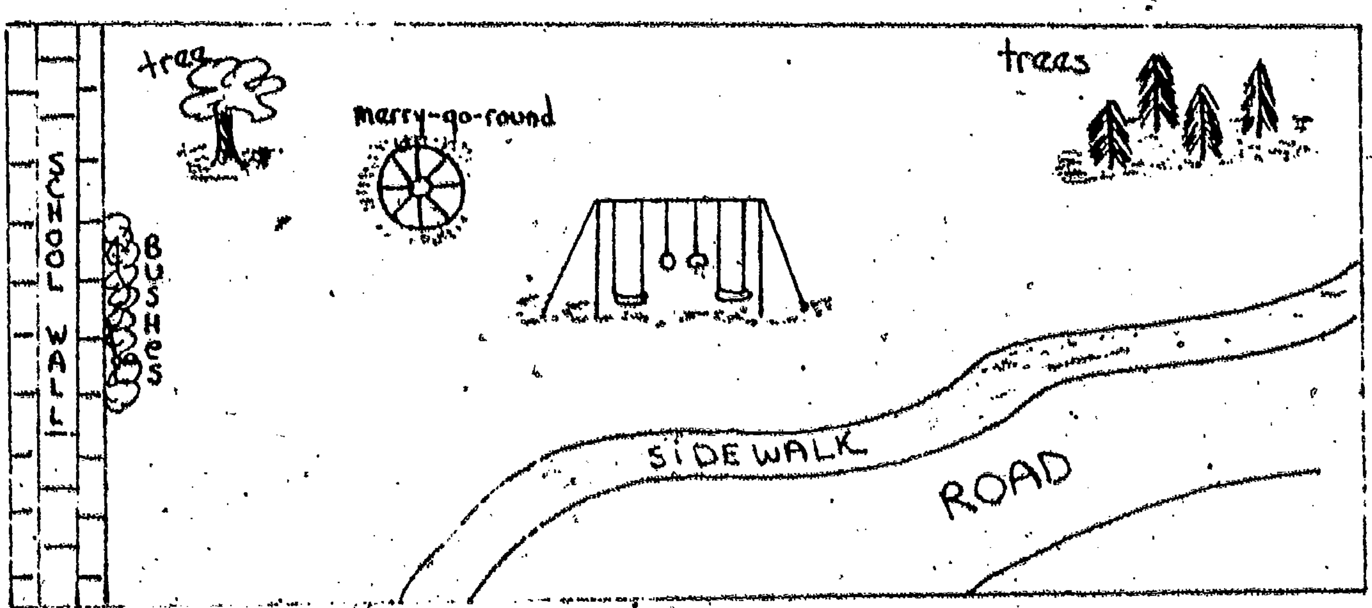
Materials and Equipment:

Paper and pencils for maps
Crayons or colored marking pens
Cameras (optional)

How-To-Do-It: One way to begin this activity is by observing your school neighborhood before snow falls and make rough maps recording youngsters' predictions of places where they think snow will melt first after a snowstorm. They can later compare their predictions with actual observations.

After snow has fallen, two main thrusts can be taken toward melting studies:

Ground Level Observations: Define some reasonable study areas for different groups of three to five children and identify boundaries of each area. Have each group of youngsters make a rough map of their study area, using sketches or symbols to identify prominent landmarks (buildings, trees, pavement, etc.). Using a crayon or felt-tip marker of a color contrasting with that used for drawing the basic map, kids can then shade in areas where snow appears to be melting fastest.



Each group can then try to develop hypotheses to account for the snow-melting patterns they have observed. Some possibilities are:

1) The snow was not uniformly distributed in the first place. Natural objects deflect wind-blown snow causing it to fall unevenly.

2) The amount of sunlight falling on the ground varies from place to place.

3) The color of the ground under the snow varies.

4) Melting snow patches result from nearby warm objects (walls of buildings, metal pipes, etc.).

5) Soot or dust collects on the snow in some places causing it to melt.

Elementary school children usually believe in one cause for an effect such as snow melting, and then build a case to support their idea. This activity should help kids realize that several factors may be involved in causing an event.

Rooftop Observations: Be alert for a time following a snowfall when rooftops show conspicuous differences in amount of snow melt. Watch for some roofs, or parts of roofs, to be bare when other roofs are still snow covered. These differences may be observed a day after a snowfall or several days later, depending upon several factors (i.e., depth of snowfall, amount of sunshine following the snowfall, air temperatures).

When conditions are right, take the class on a neighborhood field trip. Draw the children's attention to the rooftops of the various buildings. Have them identify differences in snow melt patterns on the rooftops. You may want to develop a map of neighborhood rooftops on which to record the observations.

As children describe observed differences, encourage them to infer cause and effect explanations for their observations. Some of the possible causes of variation in rooftop snow melting are:

1) Roof slopes oriented toward the south often show evidence of snow melt because they are exposed to the sun throughout the day.

2) Usually the more steeply sloping roofs will receive more nearly perpendicular rays than those with less slope. Also consider the effect of the steepness of slope on snow slipping off the roof due to gravity.

3) Often a difference in amount of snow can be observed between the roof over a house portion and the roof over an attached garage. If slopes are essentially the same, the difference may be due to heat loss from the heated house compared to the unheated garage.

4) Differences may be observed due to shading resulting from nearby trees or building structures.

5) In cases where the snow was light and dry and there were heavy winds, some differences might be explained by wind direction and wind currents.

6) Soot from chimneys and other sources may darken the snow surface, increasing heat absorption.

7) The amount of insulation varies in different buildings.

8) Temperatures maintained in buildings may vary.

9) Color and/or texture of roofing materials varies, affecting absorption and radiation of heat.

The inference aspect of this kind of learning experience is important. For many of the observations, two or more inferences may be equally appropriate (or correct). In most cases it is impossible to check such factors as amount of insulation in a building or temperature being maintained.

But often when several inferences are stated, one or more can be eliminated through critical thinking, further discussion and perhaps by gathering additional information.

Further Challenges:

1) Interview the occupants or owners of some buildings in your neighborhood to try to find information about snow melting on their rooftops. (Are ceilings insulated? What temperature is maintained in the house? etc.)

2) Make a class collection of rooftop snow melt photographs. Have children write an "inference" story for each picture.

3) Develop a series of proposals for saving heat energy in local homes.

Activity #42

COLORS AND SNOW MELTING

by Alan McCormack

Focus: One of the factors involved in melting snow is color. The color of objects touching snow and the color of surfaces underlying snow layers can absorb solar energy and radiate it as heat, thus melting nearby snow. Since different colored surfaces absorb and radiate different amounts of energy, they affect rates of snow-melting differently.

Which color on a surface would tend to melt snow most rapidly--red or blue? Yellow or black? Kids can try this experiment and find out for themselves.

Challenge: Find out which colors are most effective in absorbing solar energy and radiating heat to melt snow.

Materials and Equipment:

Colored felt or other cloth squares (about 10-12 inches square)
Paper punch or penknife
Large nails or small wooden pegs
Rulers
Materials for signs for study site (optional)

How-To-Do-It: Obtain some squares or rectangles of colored felt (or other cloth). Felt squares are available in a variety of colors in fabric or hobby shops and department stores. These are quite inexpensive. Try to get as many colors as you can, plus white and black. If enough felt is available, kids may work in groups of four or five. Or, the experiment may be set up for the entire class to observe.

Have the kids punch a hole with a paper punch or penknife in each corner of the felt square. Then insert a large nail, spike, or even a small wooden peg through these holes (these will be used to anchor the squares on the snow). After a new-fallen snow, have the class find an outdoor area where the snow is likely to remain undisturbed. They may want to post signs in the area indicating a science experiment is in progress to prevent curious people from interfering with the experimental materials.

Place one or more sets of colored felt on the surface of the snow. Each felt square should be in a position to receive the same amount of sunlight at all times during the day. Fasten the felt to the snow with corner spikes or small wooden pegs.

Return to observe the felts once a day for several days. At each observation kids should measure with a ruler the depth to which each square has sunken into the snow--this is a good indicator of heat absorption by the color of each felt. (The more heat is absorbed, the more the snow melts under a particular felt.) Data charts or simple bar graphs can be used to keep track of the observations.

A wrap-up discussion after completion of this activity should consider questions such as:

1) Which color absorbed the most sunlight?

2) Which reflected the most sunlight?

3) If a thermometer were placed on each square during daylight hours, on which one would the temperature be highest?

4) What colors would be best for winter coats?

Further Challenges:

1) Try a variety of common objects (aluminum foil, chalk, stones, paper, leaves) on the snow. Which objects absorb the most heat?

2) Freeze water colored with food colors in ice cube trays. Use a variety of colors. Do the different colored cubes melt at different rates when placed in sunlight on a windowsill? Try it and find out.

SOLAR ENERGY ACTIVITIES

by Vincent G. Sindt

Focus: In light of today's energy situation, elementary teachers should be continually searching for outdoor activities that deal with the tremendous potential of the sun as a source of energy. Several simple activities can be done with easily "scroungeable" materials which will help young people understand some of the basic concepts involved with solar heating.

Elementary teachers who involve students in solar activities soon gain the knack of recognizing valuable "junk" that they can use. Some everyday materials commonly used are cardboard boxes, aluminum foil (recycled if possible), black paper, old newspapers, clear plastic material, tape, cans, bottles, and discarded aluminum pie pans. A supply of thermometers of all shapes and sizes is helpful for most solar experiments because of the broad number of comparisons that are made in these experiments.

Challenges: Build pie pan solar energy collectors. Demonstrate the "Greenhouse Effect." Find out which materials are best for energy storage. Experiment to discover how angles to the sun and insulation can affect efficiency of solar energy collectors.

Materials and Equipment:

Aluminum pie pans
Spray paint (flat black)
Thermometers
Masking tape
Clear plastic food wrap
Cardboard boxes
Tin cans
A variety of heat storage materials (sand, salt, soil, water, etc.)
Insulation (newspapers or styrofoam)

How-To-Do-It: The following activities are each designed to develop one or more key concepts involved in operation of solar energy collectors. After completing these activities, youngsters will be ready to build and test their own solar collection devices.

Pie Pan Energy Collectors: Obtain two identical aluminum pie plates. Paint one black and leave the other shiny. Place a thermometer in each and cover with equal amounts of water. Then put the pie plates in the sun and record their temperatures every 10-15 minutes. Students will find that black surfaces absorb and radiate heat much more efficiently than do shiny, metallic surfaces.

The Greenhouse Effect: The "Greenhouse Effect" is the idea that light energy can pass through transparent materials (like glass of greenhouses) and be absorbed by dark-colored surfaces (like greenhouse potting soil) and be radiated as heat energy. If transparent materials completely enclose a space, the heat can be trapped in the space and used to help grow plants, to heat water, or in many other ways.

To observe the Greenhouse Effect, paint two identical aluminum pie plates black. Place a thermometer and identical amounts of water in each. Cover one pan with clear plastic food wrap and leave the other uncovered. Place both setups in direct sunlight and record temperatures every 10 minutes. Which pan heats up fastest? Which gets hottest?

Solar Energy Storage: Different materials can be used to store solar energy. This is normally done by converting sunlight to heat energy and storing the heat energy in solid or liquid materials. Which materials can store energy most rapidly? Which materials store energy for the longest time? Try this experiment and find out.

Paint several identical tin cans black. In each can place a different material--sand, salt, flour, water, soil, vegetable oil or any other safe material that is easily available. Be sure the level of the material in each can is the same. Place all cans in sunlight and observe the relative rates that temperatures increase in them. When cans have reached maximum temperatures, place them in a cool, shady place. Then observe rates of cooling.

Ask kids: Which material would be best to use for storing solar energy in a house? Would the material be practical?

Angles of Solar Collectors: The angle of a solar collecting device relative to the sun can affect the efficiency of the device. To demonstrate this, tape thermometers to the bottoms of two identical black-painted pie pans. Cover the pans with clear plastic food wrap. Use books, bricks, or boards to prop the pans up at different angles to the sun and observe the temperatures. See if you can find the ideal position of the solar collectors for your locality.

Insulation and Solar Collectors: Obtain two identical cardboard boxes and paint their interiors black. Use a knife to cut large windows on one side of each box. Tape clear plastic food wrap over each window, and tape a thermometer to the inside bottom of each box. Close the boxes and seal with tape. Cover one box (except for the window) with an insulating material such as newspaper or styrofoam. Then place both boxes in positions where equivalent amounts of sunlight enter their windows. Compare temperatures of the boxes at several times during the day.

Further Challenges:

1) Provide cardboard boxes, newspaper, black paper, clear plastic sheets, tape, thermometers, and other miscellaneous materials for students to use. Groups can work on this challenge: Using

the material available, see which group can get the inside of a box hottest when it is placed in the sun (burning the box is not allowed!).

You may be surprised to find that kids can produce temperatures high enough to boil water inside the boxes.

2) Make solar tea. Place tea bags in water in a clear container such as a gallon jug. Place in the sun. After an hour you will have excellent hot tea.

Activity #44

PURE WATER FROM A SOLAR STILL

by Lorraine B. Ide

Focus: Water that has evaporated and then condensed is very pure. It is identical to "distilled" water produced by using the same evaporation-condensation processes with expensive scientific apparatus. When water molecules evaporate from a body of water, they absorb sufficient heat energy to move away from other water molecules and any impurities present in the water. The impurities are left behind. If these evaporated water molecules touch a cool surface they can collect as pure water in the process we call condensation.

These principles can be applied to production of small amounts of pure water in a "solar still" you can build in, or near, your schoolyard. It's an inexpensive and interesting out-of-classroom way to experiment with water's properties and learn about harnessing solar energy.

Challenge: Build a simple solar still that will actually produce pure water.

Materials and Equipment:

A large sheet of transparent plastic
A digging tool
A small stone
Several large stones
A clean container for collection of water

How-To-Do-It: Energy from the sun can be used to produce pure drinking water from a solar still constructed as follows:

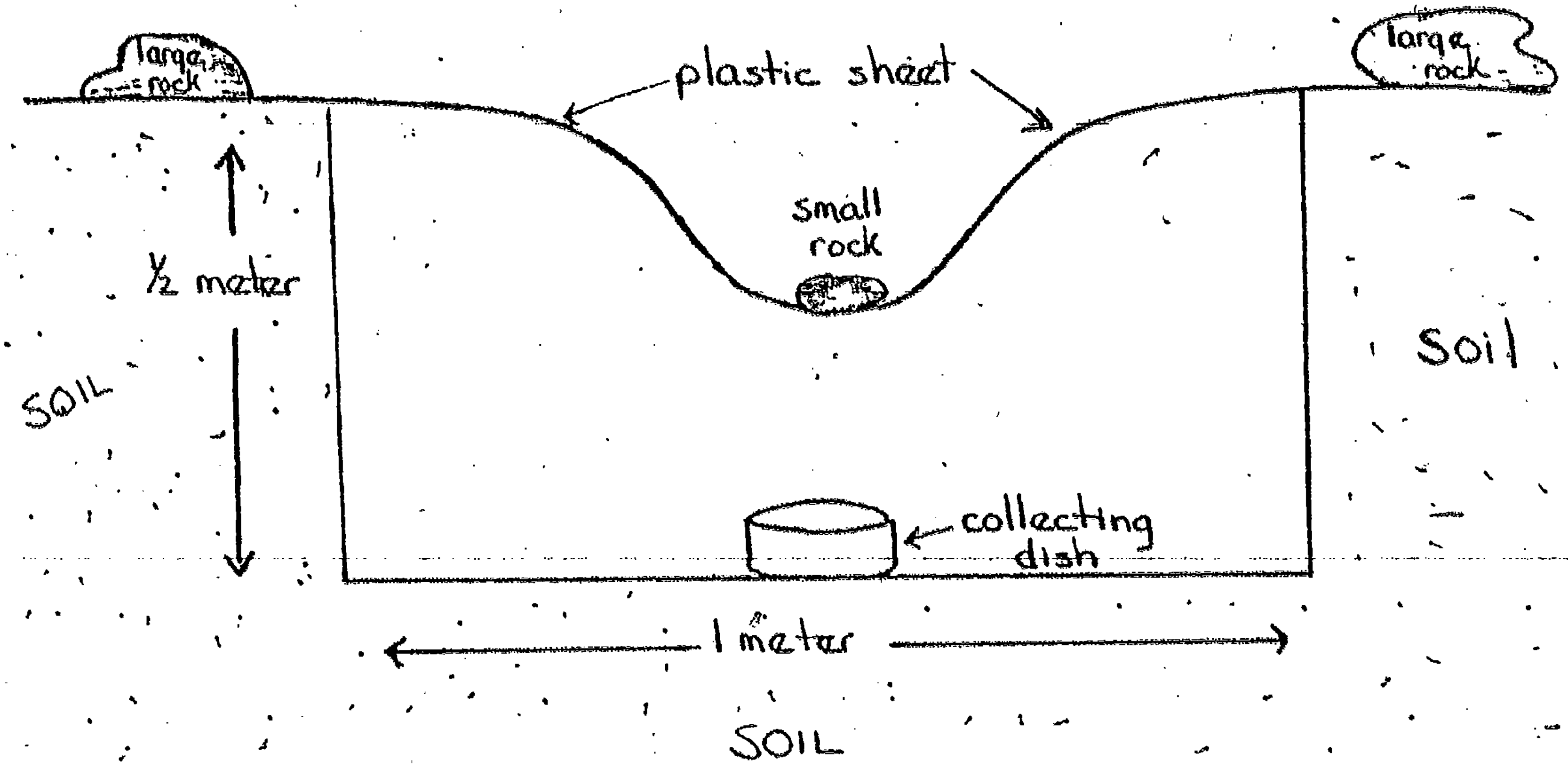
1) Find an unpaved spot away from traveled paths. The spot should be in sunlight all day and in a place where it can be roped off so it will not present a hazard to people walking in the area.

2) Dig a hole about 1 meter square and 1/2 meter deep.

3) Place a water collection container in the center of the hole.

4) Cover the hole with a large sheet of transparent plastic. Place some heavy stones around the edge of the plastic to keep it in place.

5) Poke the plastic down a little and place a small stone at the center so this weight pushes the plastic down into the hole. (Not far enough to touch the collection container below.) Your solar still will now look like this (side view).



6) You may want to fence off the area around your still with wooden stakes and rope and place a warning sign in a prominent place to avoid someone accidentally stepping into the hole.

When the sun shines, water will evaporate from the soil on the walls of your still and saturate the air inside the still. At night this water will condense on the underside of the plastic sheet, run down to the lowest point, and drip into the collecting dish. This still will produce at least one pint of drinkable water per day, and will work even in a desert!

Further Challenges:

1) Will a solar still work if it is built inside a cardboard box instead of in a hole in the ground? Try it and find out.

2) Would more water be produced by your solar still if leaves from weeds or trees were placed inside it? Try and see.

3) Place a dish of saltwater on the floor of your still, as far away as possible from the collection dish. Find out if the saltwater evaporates. See if any salt gets into the collection dish.

DRYING FOOD WITH THE SUN

by Vincent G. Sindt

Focus: As the conventional sources of energy become less abundant and more expensive, students should be made aware of the potential of sunlight to accomplish common tasks. Drying of food is an interesting activity many individuals enjoy and use to preserve meats, fruit and vegetables for later use.

Elementary teachers can work with students to build a simple solar dryer (see illustrations) and use the dryer to investigate several interesting concepts.

Challenges: Build a solar food dryer. Use the dryer to demonstrate which foods can be dried and how they are dried. Make as many observations as you can of the changes occurring in the food. Experiment with the dried foods to determine the best techniques to bring the foods back to their pre-dried condition.

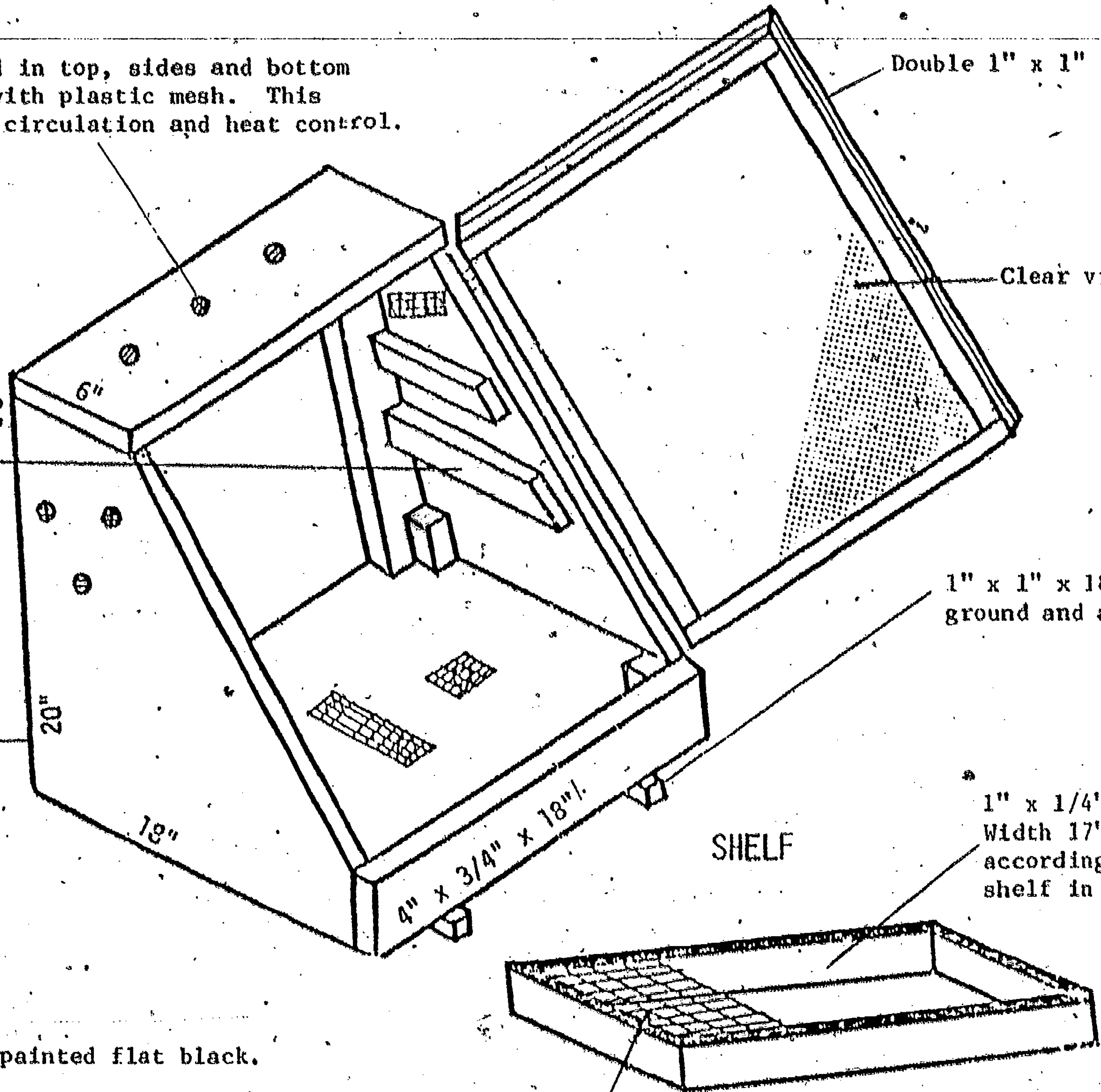
Materials and Equipment:

Plywood or Tri-wall cardboard
Spray paint (flat black)
Clear vinyl material
Wooden lathes
Plastic or coated screen material
Nails
Hinges and screws
A variety of foods to dry (turnips, carrots, tomatoes, mushrooms, bananas, etc.)

How-To-Do-It: The following activities use a solar food dryer for variety of experiments:

Build a Solar Dryer: A solar dryer can be constructed from the plan shown on the following page. Cardboard may be substituted for plywood in building this dryer if you wish.

FOOD DRYER



Entire dryer is painted flat black.

Prepare the Food: Obtain different kinds of foods to dry and have the youngsters try different thicknesses and shapes, and try cutting the food in different directions relative to the stems to see what differences occur in the times of drying.

Dry the Food: Make visual observations of the color changes and feel the differences of textures of the food as it dries. Weigh samples of vegetables before and after the drying to determine the amount of water present.

Enjoy the Results: Taste the different dried foods to see how the taste has changed. Try several different methods of cooking the dried foods such as starting with cool water and then heating, placing the food into hot water, slowly adding hot water, etc., to see what changes exist in the tastes using different approaches.

Further Challenges: Find out what you can about beef jerky, fruit leathers and dry soup mixtures from your county agricultural agent. Have the students try these.

Activity #46

HOT SPOTS AND COLD SPOTS

by Michael R. Cohen

Focus: When the TV weatherman announces that the temperature in your town at noon yesterday was 60°, does that mean it was the same temperature everywhere in town? Not a chance--temperatures vary by many degrees from place to place within a town and even within one backyard. In doing this activity, kids will discover that small areas within any larger study site have their own peculiar temperature characteristics. These small areas are sometimes called microclimates.

Challenges: Find the hottest and coldest spots in your schoolyard (or other study area). Plot temperature maps. Compare the temperature patterns of your study area at different times of the day and/or year.

Materials and Equipment:

Thermometers
Red and blue flags (made from popsicle sticks or twigs and colored construction paper)
Butcher paper, large pieces of cardboard, and tape for class maps of temperature readings

How-To-Do-It: A good way to launch this activity is to challenge youngsters to try to find the hottest and coldest spots of a staked-out outdoors study area--without using any instruments other than their own bodies. Provide small wooden stakes with red flags for hottest areas and blue for coldest. Issue groups of two to three children one of each type of flag and have them place the flags in what they decide to be the hottest and coldest places.

Disagreements about where the hot and cold spots are will certainly arise, developing a natural need for some kind of measuring instrument for temperature. At this point thermometers may be made available, and it would probably be worthwhile to review with youngsters how to use them.

Make a map showing the boundaries of your study area (a large piece of butcher paper taped to cardboard is good for this). Invite the groups to measure the temperatures of the spots they flagged and write these temperature readings at appropriate places on the map. Then have all groups do a hot spot-cold spot survey of the entire study area, again placing all findings on the map. Kids will find factors such as sunlight, wind, shadows, and moisture to have definite and interesting effects on temperatures of microclimates observed in the study site.

A good summary discussion could focus on the following questions: On a hot day, where would you stand to stay cool? On a cold day, where would you stand to stay as warm as possible? Also help kids think about relationships between solar energy and the hot and cold spots. Hot spots are small places that are higher in temperature for one or more of the following reasons:

1) Sunlight falls more directly on the spots or for a longer period of time;

2) The hot spots are able to absorb and hold energy better than cold spots (may be related to colors or textures of the spots);

3) Hot spots have less evaporation or fewer air currents than cold spots.

A worthwhile extension of this activity is to repeat it at different times of the same day or during different seasons of the year. Are the same spots relatively hottest and coldest all the time, or do changes occur? Make comparisons of your hot spot-cold spot maps to find out.

Further Challenges:

1) Make a temperature map of your own back yard.

2) Visit a weather bureau and find out how they measure temperature.

3) Do a hot spot-cold spot map of your own home. Use it to decide how energy could better be conserved.

Note on Safety: Certain areas of the home and school should be declared "off limits." These would be areas housing potentially dangerous appliances: furnaces, hot water heaters, stoves or microwave ovens.

Activity #47

WATER CLEANING MACHINES

by Lorraine B. Ide

Focus: Water found in small streams, puddles, or ponds in the vicinity of schools is often quite dirty. Dissolved soil, polluting chemicals, and overabundant algae and bacteria frequently make water cloudy, dirty, smelly, and quite likely dangerous to drink. The skills and equipment needed to make contaminated water completely clean and safe to drink are ordinarily beyond what is available to elementary school youngsters. But these kids can do a lot with ordinary scrounged and found materials to build simple filtering machines to at least remove some of the sediment and discoloration from local "natural" water supplies.

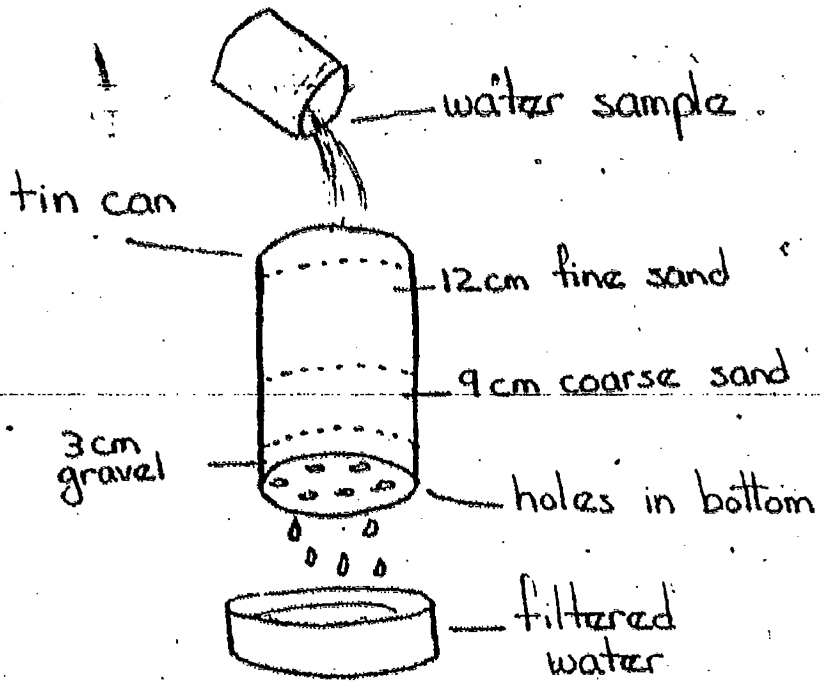
Challenge: Build and test a device that can improve the clarity of some local dirty water.

Materials and Equipment:

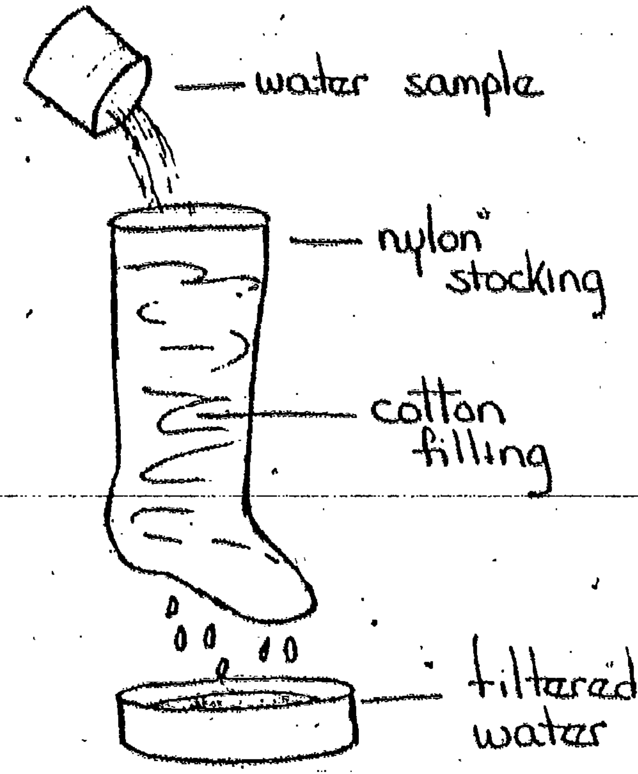
Large jars
Tin cans
Sand
Gravel
Cotton
Old cloth
Paper towels
Rubber or plastic tubing
Old plastic detergent bottles
Old nylon stockings
Any other discarded materials kids might use for their "machines"

How-To-Do-It: Form groups of children and have each group collect about four liters (or about one gallon) of water from a puddle, stream, or other source of dirty water near your school. Have the children examine the water with hand lenses. Ask them to speculate about what sorts of things make the water appear "dirty." Then ask each group to develop a device, using materials provided or others found at the study site, that could improve the "clearness" of the water. How could at least some of the "dirt" be removed?

Encourage different groups to experiment with various solutions to the problem. If a variety of materials are available, a number of different filtering systems are likely to be developed. Here are some examples of devices kids have used:



SAND FILTER DEVICE



COTTON FILTER DEVICE

Kids should keep some water from their original samples so they can compare water clarity before and after the water is treated by their water cleansing machines. Also, be sure youngsters understand they should never drink water that could be contaminated, even if it is filtered and appears clear. Bacteria, viruses, and dissolved chemicals are not removed by most filters, and these can cause human diseases.

When all groups have built and tested their "machines," compare the "cleaned" water samples and have the class decide which cleaning method seems most effective. Have the youngsters suggest ideas for improving each group's device. If you have microscopes available in your school, samples of "dirty" and "cleaned" water might be compared microscopically and any differences noted.

Further Challenges:

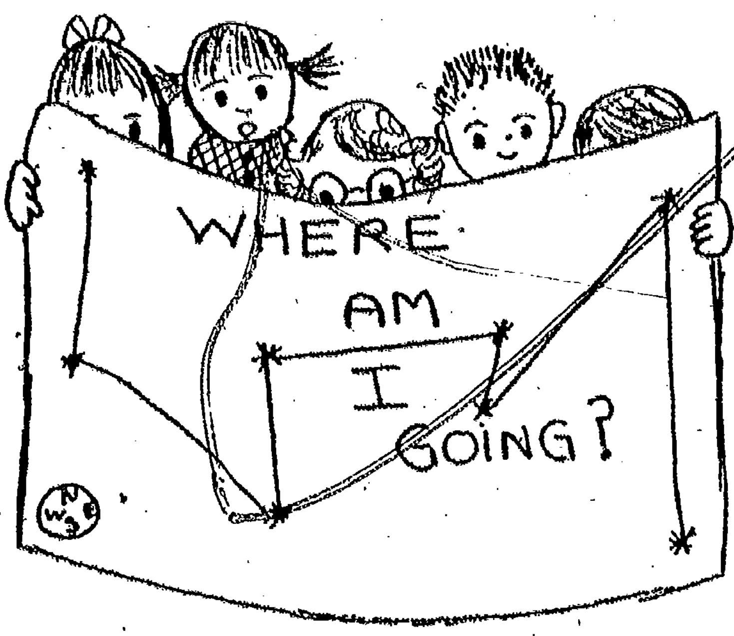
1) Find a way to remove salt from a sample of water with salt dissolved in it.

2) Find out how your school's water supply is purified.

3) Find out if any industrial chemicals pollute bodies of water in your area. Then find out what procedures are necessary to remove these pollutants before the water is drinkable.

CHAPTER VI

INTERDISCIPLINARY ACTIVITIES



Activity #48

WHERE AM I GOING?

by Mary K. Bowe

Focus: This is an exercise in learning how to use and trust a compass to get to and from one place to another in unknown country. It is an introduction to the fast-growing sport of orienteering.

Students will learn how to use a compass and measure distances so they can get from one place to another in wilderness areas without problems. They will also discover some factors that can cause errors in the use of a compass.

Challenge: Use a compass to correctly navigate an orienteering course.

Materials and Equipment:

Compasses with degree gradations (trail compasses, if possible)
Waterproof felt pen
Ditto copies of course directions
Tape measure
Pieces of iron, nickel, cobalt, aluminum or brass

How-To-Do-It: Students must first learn that distances can be measured quite accurately if they know the length of their pace over a measured distance. A pace is that distance covered when the heel of the same foot strikes the ground for the second time.

The teacher can lay out a measured distance of from 100 to 200 feet with beginning and ending markers. The students should then, using ordinary steps, count the number of their paces necessary to cover the measured distance. (It would be best to have the students do this two or three times to arrive at an average.)

The teacher then picks six youngsters at random. The kids are challenged to cover a measured distance in a specific compass direction. The teacher can then check to see if kids have read their compass correctly.

Each student is then given a piece of metal from the materials list and told to hold it close to the compass. It will quickly become obvious that iron, nickel and cobalt seriously affect the accuracy of a compass. This can then easily be related to problems with items of clothing, such as metal buttons, belt buckles, and pocket knives.

The teacher may now hand out dittoed instruction sheets on which are given compass headings and distances between stations of an orienteering course. The course should have been laid out so no two stations will be in sight of each other. A sample plan for a course is included with this write-up.

Now the students are invited to find each station, record its code and return to home base as quickly as possible. The person or group with the shortest time and with all the station symbols is the winner.

As each person or group leaves, note the time of departure. When each returns, the time is again noted and the elapsed time is computed. Their score sheets also need to be checked for the correct symbol of each station.

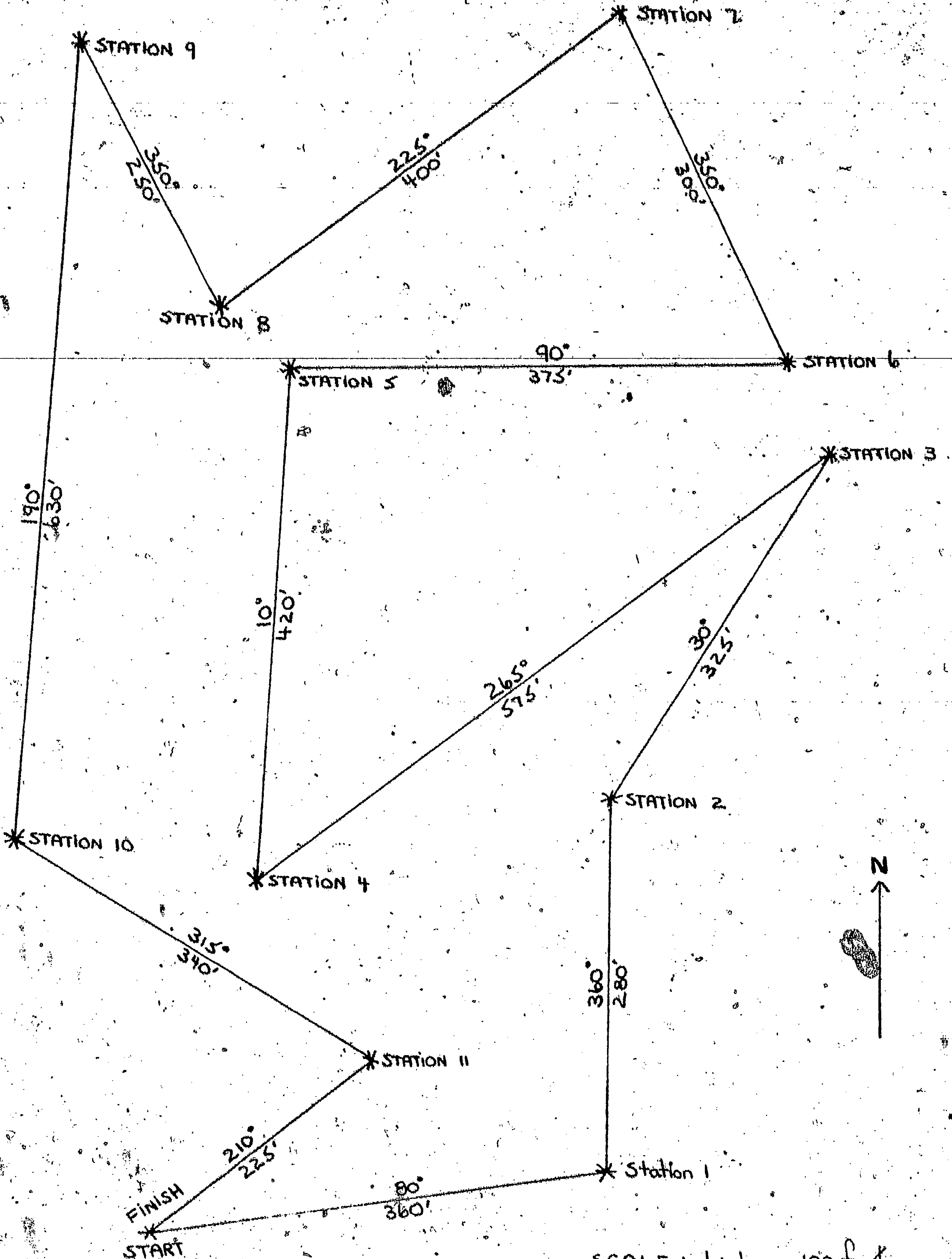
The students will have learned that a compass, used correctly, can be a valued tool for charting paths through unknown territory.

A good follow-up exercise could be to have students use a contour map of the area with an "X" marked on it as a reassembly point. Groups of students can be dropped off at different places and try to get to the reassembly point as quickly as possible.

Further Challenge:

Use simple materials to build a home-made compass.

SAMPLE ORIENTEERING COURSE



SCALE: 1 inch = 100 feet
(angles are approximate)

A NATURE TRAIL ON YOUR SCHOOLGROUNDS

by JoAnne Jones

Focus: If you are fortunate enough to have some wooded or non-landscaped land as part of your schoolgrounds, you and your students can develop a nature trail that can be used year-round as part of your school's science program. Stations can be set up along the trail at which youngsters can learn to identify trees or weeds, monitor the weather, watch bird or insect behavior, or see evidence of erosion or pollution. Possibilities are almost unlimited!

Challenge: Design a nature trail for your schoolgrounds. Develop a number of stations for student activities along the trail.

Materials and Equipment:

Ball of twine
Brush-clearing tools
Wooden signs for station markers
Miscellaneous equipment depending upon stations that are set up

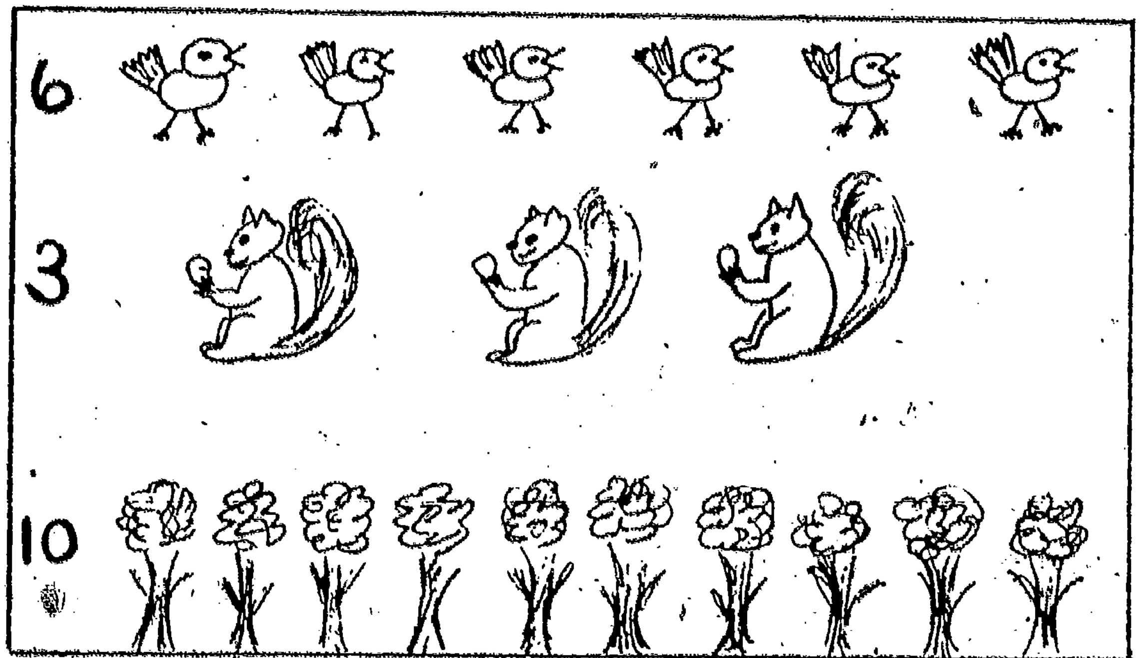
How-To-Do-It: If you have unused wooded or "raw" land as part of your school site, obtain permission to set up a permanent nature trail on the land. To lay out the trail, first look for natural or already-existing footpaths. Use these as part of your trail if possible. Otherwise, try to plan your trail so as to do as little damage to the environment as possible while still providing access to the most interesting or educationally useful places of your school's unlandscaped lands.

One way to mark the trail is to take a large ball of twine and mark the trail by tying the twine to trees along the trail. Youngsters and parents can help clear the trail of obstacles and perhaps put wooden "edges" made from fallen logs along the path.

Then, stations can be set up at appropriate places along the trail. A guide sheet or activity sheet can be developed for each station to provide direction for youngsters. Stations can vary tremendously in their topics or activities. For example, a station might invite kids to sit quietly and watch a pair of birds building a nest, use special homemade instruments to find evidence of air pollution, identify some trees or observe the positions of shadows. Stations can be permanent or very temporary. Cassette tapes can be made for each station so kids can listen to recorded commentary or instructions from a portable audio-tape player. Or, permanent information can be inscribed on a signboard at each station.

Many of the activities included in this Sourcebook would be suitable as activities for stations on a schoolyard nature trail. Or, you may be able to get some ideas for stations from local naturalists, scout leaders, or biologists.

One last thing! be sure to involve the youngsters of your school as much as possible in planning and construction of your nature trail. The more the kids are involved, the more they will appreciate the trail, and less vandalism will take place.



Using Math to Learn About Nature

USING MATH TO LEARN ABOUT NATURE

by Joseph Abruscato

Focus: When we teach science to children, we tend to place a heavy emphasis on the importance of careful observation and measurement. The outdoors presents many opportunities for children to lean and apply various skills that are stressed both in science and mathematics. By applying mathematics to education in the outdoors we give children an opportunity to directly experience the relevance and utility of mathematics.

Challenge: Practice counting skills out-of-doors. Draw bar graphs to represent observed objects and organisms. Practice linear measuring skills outdoors. Learn to estimate population size from a sample.

Materials and Equipment:

Package of blank paper
Crayons or pencils for each person
A meter stick for each group

How-To-Do-It:

1) Young children can practice their counting skills by making picture charts in which the number of various objects or organisms observed in a given area is recorded. For example, if a child observes 6 birds, 3 squirrels, and 10 trees with rough bark, he/she can make a chart in which 6 birds, 3 squirrels, etc. are pictorially represented.

2) Older children can draw bar graphs to represent the number of objects of organisms observed.

3) On repeat visits to an outdoor setting children can make linear measurements of such things as the growth of plants, the depth of shallow streams, and the length of branches blown down during storms.

4) Children can learn how to estimate the total number of objects and organisms from the number in a sample. For example, they can make an estimate of the number of wildflowers in a meadow from the number in a small area (assuming that the particular wildflowers are growing throughout the meadow).

5) Have some children bring hand-held battery-operated calculators on an outdoor excursion so that they can make rapid calculations of estimated population sizes for observed organisms.

6) Children can construct, using string and a straight twig, a simple field balance to determine the relative masses of a sampling of such things as stones, acorns, and pine cones.

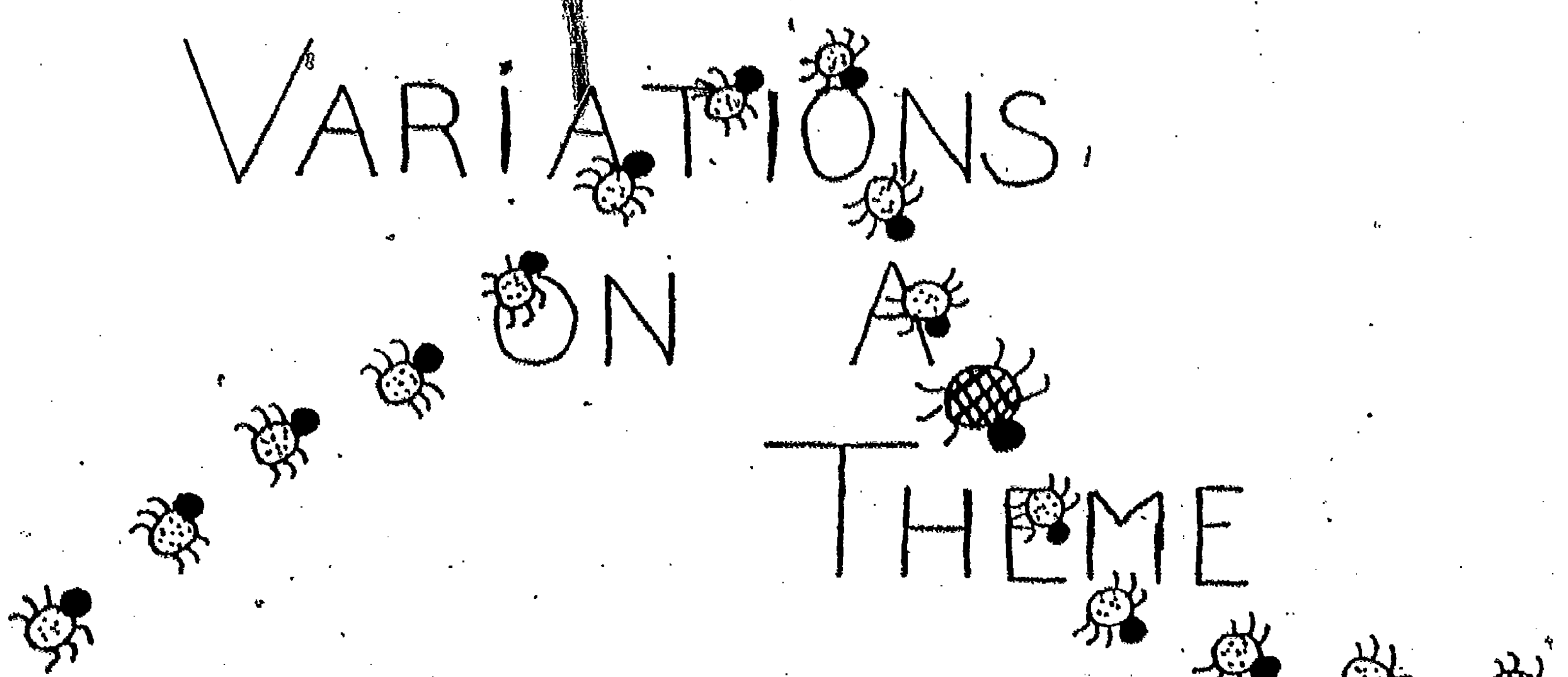
7) Bring graph paper to the outdoor site and have some children use it to determine which of a given pair of diversely shaped leaves has the largest area. (They can trace the leaves on graph paper and count the number of squares included in each tracing.)

Further Challenges:

1) Make a graph that shows the amount of litter in an outdoor area. Does the graph show more or less litter than you would expect to find in this outdoor area?

2) Find a way to estimate the heights of the tallest trees in this outdoor area.

3) Propose a way to measure the amount of harm people cause to an outdoor area in one year.


VARIATIONS
ON A
THEME

VARIATIONS ON A THEME

by G. Sue McCormack

Focus: "Variation"--something which deviates from the usual, the expected. Most people think of a variation in terms of man-made items: a slight change in lyrics in a song or poem; a word spelled sometimes with an "i," another time with a "y"; a wallpaper pattern shown in two different colors. But nature, too, has its variations, its unusual objects. The larger items, like a split tree that has grown around a rock, are eye-catching. The smaller ones are often passed by. Discovering the unusual things in nature is a test of observation, and can also utilize the descriptive powers and reasoning.

Challenge: Armed with your eyesight, curiosity, and imagination, what could you find that is unusual in nature?

Materials and Equipment:

Sketch pads
Pencils
Instant cameras (optional)
Various sized bags or boxes

How-To-Do-It: Divide the class into small groups of four or five kids. Each group should have a sketch pad and pencils, and bags or boxes for collecting oddities. If small instant-photo cameras are available, use those also.

Directions to the kids would be:

1) Keep your eyes peeled for strange sites.

2) If it's too large to bring back, or if its removal would damage the environment, sketch it (or photograph it).

3) If it is small and removal would be possible, bring it back to share with others.

4) If it is a concept and cannot be sketched or removed, write a description.

Upon return, have each group present their findings, perhaps eventually compiling the sketches as a believe-it-or-not type book.

Further Challenge:

Have the class brainstorm as to how the variation could have occurred. Remember to consider all ideas--even those that are oddball.

NATURE CREATURES

by G. Sue McCormack

Focus: Not all the creatures found in nature are alive and scurrying! There is a growing business afoot that markets wee creatures made from a variety of natural objects. There is, of course, the Pet Rock whose price depends upon its intelligence, good looks, and amiability. There are little nutshells and pebble creatures who sport googly-eyes and cute sayings. But why go to a gift shop and spend money for a pet you could invent yourself?

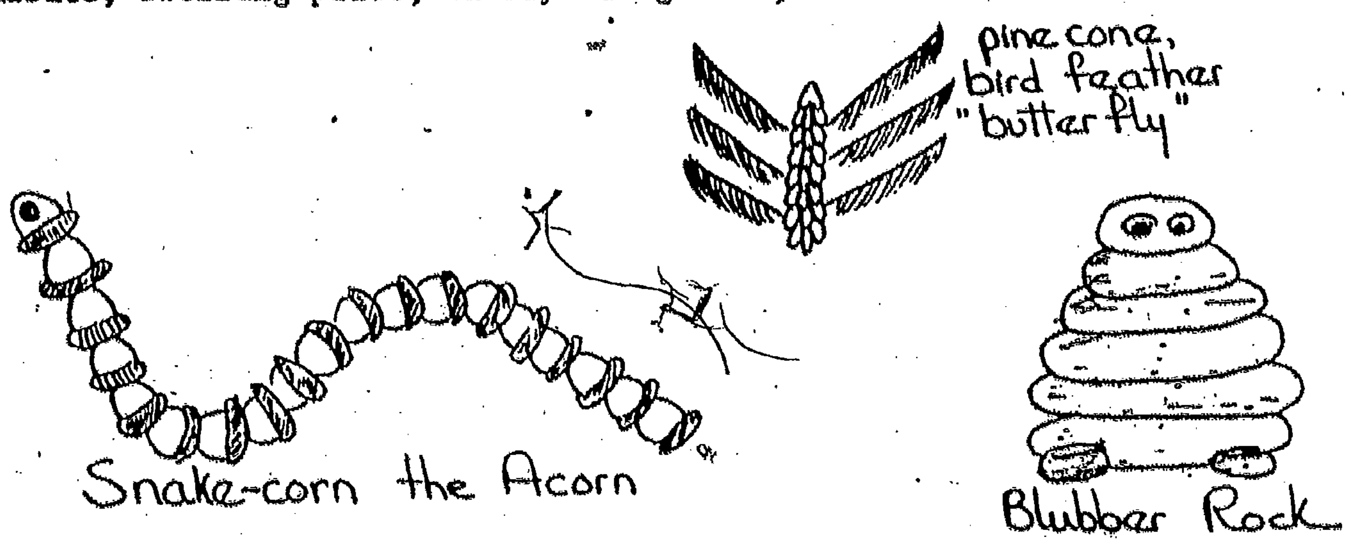
Challenge: Collect the parts of, and assemble, your own Nature Creature.

Materials and Equipment:

Bags or shoeboxes for collecting
Quick-drying glue
Tiny bottles of "model" paint and brushes
Googly-eyes--inexpensive and available in hobby shops

How-To-Do-It: If possible, display some of the commercially-made natural object pets. Have the children brainstorm and discuss what materials they might find in the area they will use (corn cobs, rocks, nuts, twigs, etc.).

Equip each child with a bag or box for collecting objects. Caution kids not to damage plants in the attempt to find parts for their pets. Make glue, paint, and googly-eyes available to the youngsters and stand back while they create their Nature Creatures--you could even try one yourself! Of course, they will need names, and each child could write a short whimsical story about his new friend's eating habits, dwelling place, family background, etc.



Further Challenge:

Make another Nature Creature using only natural items. Sap or clay can be used for glue, plant or berry stains for "paint," etc.

Activity #53

NATURE GAMES AND TOYS

by Hilma J. Smith

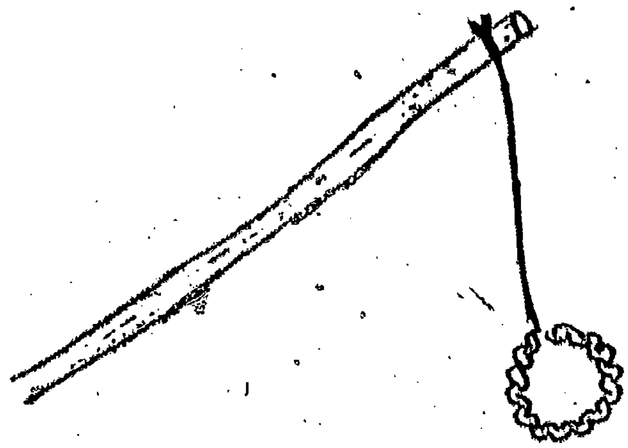
Focus: Children need toys and down through history they have always had them. That doesn't mean the early American Indian children had frisbees and skateboards, or that the pioneer youngsters played Monopoly by firelight. Many early toys were made by parents and even by the children themselves.

Challenge: Find the natural materials for, and make, toys and games.

Materials and Equipment:

Listed separately for each toy

How-To-Do-It:



Ring-a-stick

Long grass or weeds
String
Straight, sturdy stick

Weave the long grass or weeds into a circle. Attach one end of the string to the stick and the other to the grass ring. Object of the game is to flip it up and catch the ring on the stick.

Woodland horseshoes—

Sturdy sticks for stakes
Sturdy forked sticks for "shoes"

Arrange two sticks in the ground a suitable distance apart. (This will probably have to be worked out by trial and error.) The sticks used as "shoes" should be fairly sturdy so they have enough weight to carry when thrown. Proceed as in horseshoes.

Nature scramble

A supply of distinctive items from nature, such as shells, galls, twigs, acorns, etc. (collect items that will not easily disintegrate, or could be readily replaced if they do).

Divide the group into teams of equal numbers. Have them face each other across at least eight feet of space. Each child on one team gets a number; then the other team gets the same numbers. (There would be two number sixes—one on team A, one on team B.)

Place all the nature objects in the center area between the two teams. The teacher then calls out a number and the name of an object. The two children with that number run to the center and scramble to get the item. The first one to bring the object to the teacher gets a point for his/her team.

The game can be made more complicated by naming the object indirectly-- i.e., the seed of an oak tree (acorn).

Goldenrod friends

Goldenrod galls
Sticks, leaves, etc.

Goldenrod galls are interesting objects. Before using them to make toys, a discussion-learning session could be held. How are they formed? What is a parasite? Why are the galls found at the same height on a plant? You could dissect a gall to see what the inside is like.

Now for the fun. The round shape of goldenrod galls lends itself well to heads for dolls, stick puppets, or make-believe animal pets. Use twigs for arms and legs or tails, leaves for "clothes" and anything else your imagination might come up with!

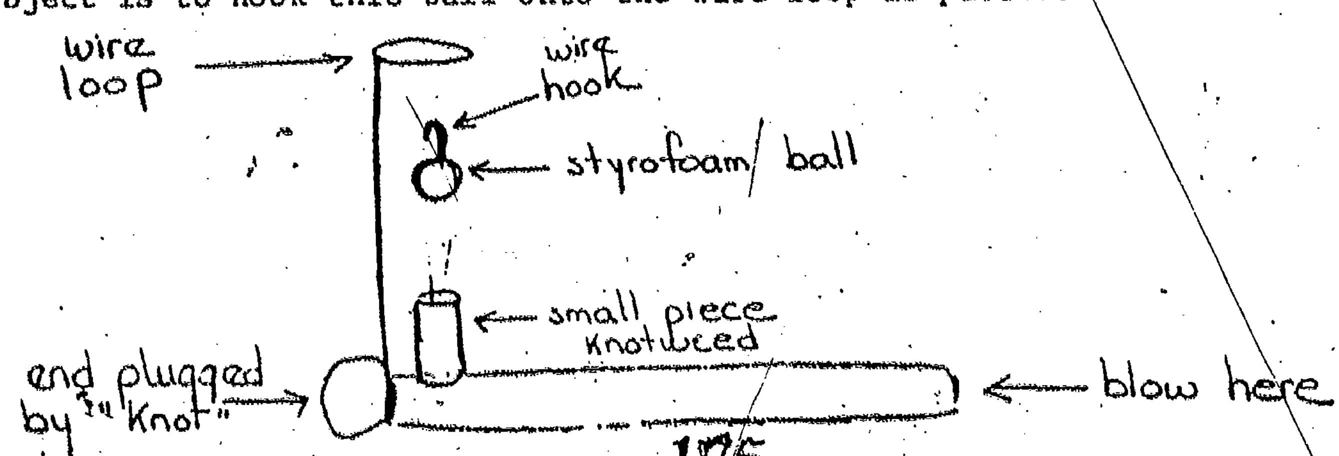
Japanese knotweed toys

Sections of knotweed
Knives or sharp instruments
Small styrofoam balls
Wire
Tiny nails

Japanese knotweed (Polygonum) is a useful plant to fashion certain types of toys because of its hollow spaces. Each knot or joint on the plant has a small membrane. Between one knot and the next is a sealed-in hollow space.

Cut a piece of stem with two knots or joints on it. When you toss this in your fireplace, it will "pop" due to the air sealed between the membranes. You have a firecracker!

A "flipperdinger" is an old American folk toy originally made from elder branches or sumac. You can make one from Japanese knotweed. The idea is to form a blowpipe with a plugged end. Air is diverted through another opening. A lightweight tiny ball with a hook is then blown into the air. The ball tends to hover on the blown stream of air. The object is to hook this ball onto the wire loop as pictured below.

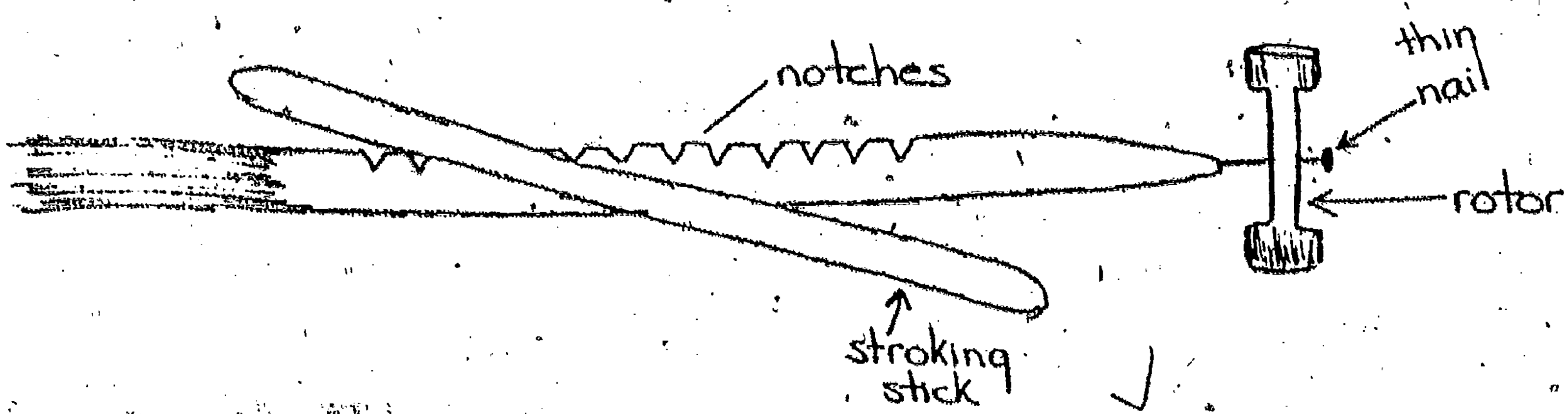


Whimmydiddle

8-10 inch section of hardwood branch, diameter of a pencil.
4-6 inch section of same diameter
2 inch section of same diameter
Tiny nail

Often called a gee-haw or a hooey stick, this is another early American folk toy. You must be sure to use small branches from a hardwood tree; and you will discover some woods work better than others.

On the biggest branch, carve the bark away from, and smooth down, a 5 1/2 inch section. Make 12 small, evenly spaced notches (see diagram). Carve and smooth down the entire middle-sized branch. Carve the small branch as shown in the diagram (this is the "rotor"). Attach it to the end of the longest stick with a small nail.

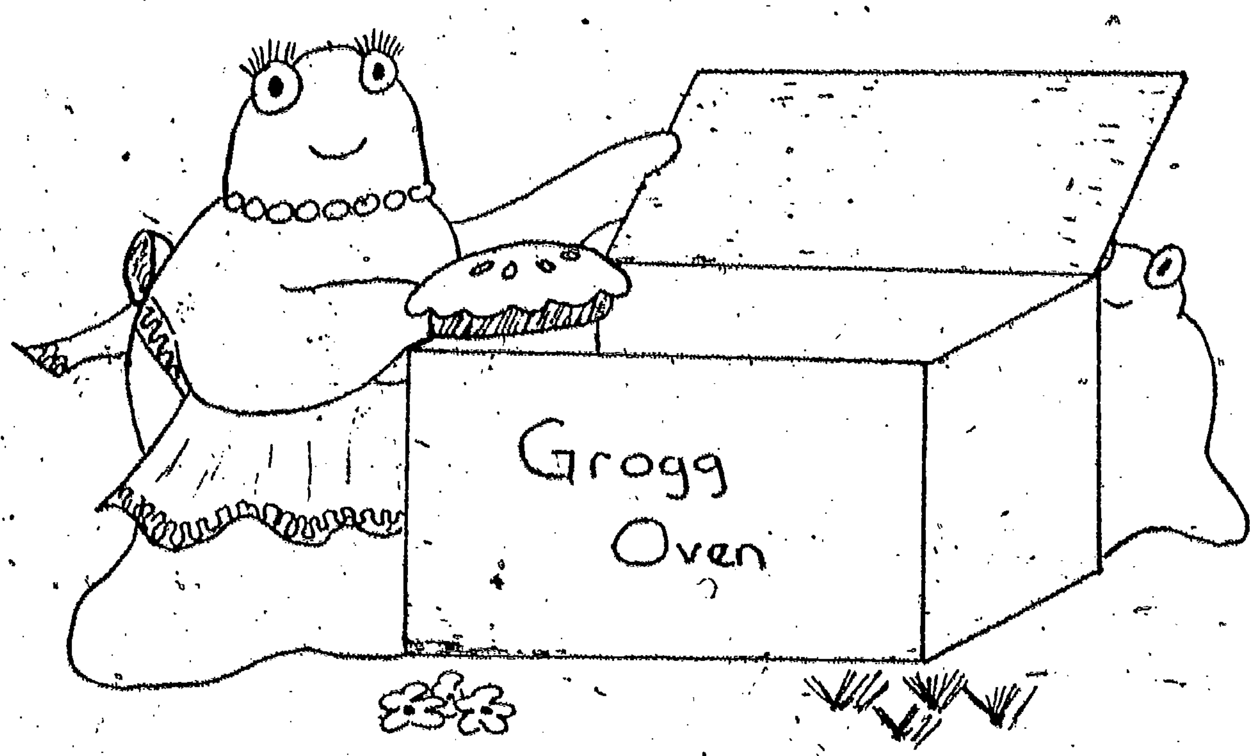


To work the whimmydiddle, hold the stroking stick across the notched stick. Put your index finger across so it rests lightly on the left side of the notched stick. Rub quickly and lightly, and watch the rotor spin. To change the direction of the rotor's spin, let your thumb rub lightly on the right side (instead of your finger on the left).

Further Challenges:

1) Indian children had some clever and interesting handmade toys. Do some research on this topic and then make some of their toys.

2) Take a piece of Japanese knotweed with two joints or knots and experiment to make a whistle.


Grogg
Oven

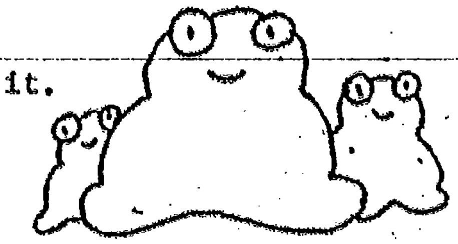
Activity #54

GROGG COOKERY #1--The Grogg Oven

by Hilma J. Smith

Focus: The Grogg is a wonderful creature who lives in the great outdoors. He is a little bit of everything: frog, glob, human, and magical mystery. Much of a Grogg's time is spent in and around water. Since they like to stay moist, they don't like spending time around hot, open fires cooking their meals. Groggs are smart little creatures and they have invented new ways to cook outdoors.

Challenge: Make a Grogg oven and cook something in it.



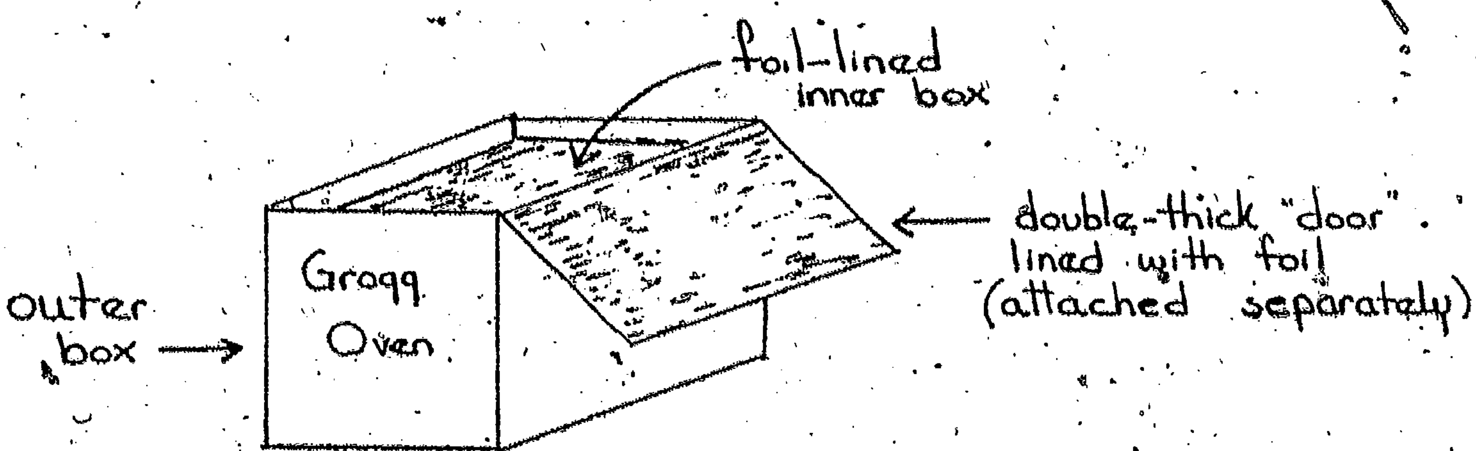
Materials and Equipment:

A TV dinner aluminum plate or similar item
2 cardboard boxes--1 must hold the aluminum plate with 2 inches to spare all around it; the other should be a bit larger
Heavy duty aluminum foil
4 metal cans, soup or fruit juice size
2 pieces of cardboard to make a double-thick oven door
5-7 pieces of charcoal, matches
A charcoal starter (optional)--see "How-To-Do-It"
Ingredients and utensils necessary to the recipe you choose

How-To-Do-It:

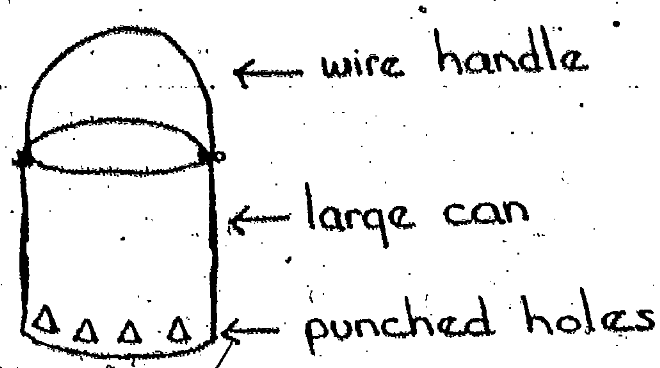
1) Line smaller box with foil and nest it inside the larger box

2) Make a "door" out of two thicknesses of cardboard; cover the inside section with foil and attach to box as shown:



3) Place TV dinner plate on bottom and arrange cans to support your baking pan.

4) Starting the charcoal—a fire bucket:



Put a small amount of tinder in the can, plus fire starter, and charcoal (5-7 pieces depending on size of Grogg oven, outside temperature, and oven temperature desired). Light through one of bottom holes. Swing to help it along, if necessary. BE CAREFUL!

5) When the coals are well-started, dump them carefully onto the TV plate, and pre-heat your oven five minutes.

6) Put one of the following recipes in the oven; prop the door open a tiny bit so the air will allow the charcoal to burn.

General Notes: Allow one-half hour for starting charcoal and pre-heating oven. Have water handy for fire safety. Clean up the area when you are through.

Grogg Recipes:

Papooses - 10

1 lb. hot dogs
2 pkgs. refrigerated biscuits
1/4 lb. cheese

Slit hot dogs, but not all the way through, to each end. Put a strip of cheese in the slit. Wrap each hot dog in two biscuits, leaving one bare spot at one end on side where slit was made (so you can keep the cheese side up). Place on shallow pan and bake in a hot oven about 15 minutes or until biscuits are browned.

Rise and Shines

2 Tbsp margarine
1/3 cup brown sugar
1/3 cup raisins
2 Tbsp wheat germ
1/2 tsp cinnamon
3 tsp fruit juice or water
1 pkg refrigerated biscuits

Mix sugar and cinnamon in cake pan. Add margarine and put it in the Grogg oven until it melts. (Be careful—it burns quickly!) Remove from oven, stir and sprinkle with wheat germ and raisins. Place biscuits on top and bake about 15-20 minutes in hot oven.

Baked Apples - 8 apples

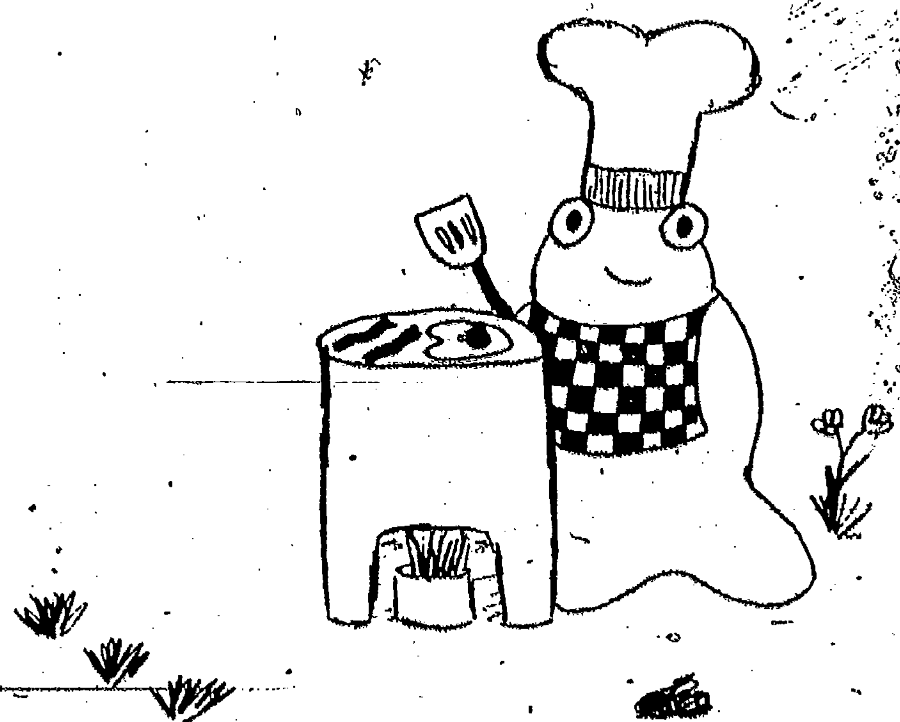
8 apples
1/4 cup brown sugar
1/2 tsp cinnamon
1/2 cup raisins

Wash and core apples. Place in a baking pan. Put raisins and sugar-cinnamon mix in center of each apple. Add enough water to cover bottom of pan. Baste occasionally while baking. Bake about 30 minutes or until apples are tender. (Moderate heat.)

Further Challenges:

1) Invent your own recipes to use with the Grogg Oven.

2) Make posters on outdoor cooking safety.



181

Activity #55

GROGG COOKERY #2 - Tin Can Stove and Buddy Burners

by Hilma J. Smith

Focus: The Grogg Oven (Grogg Cookery #1) is a neat thing to cook in, but the Groggs, being very versatile, also invented something to fry on. It's a tin can stove that fits over a "Buddy Burner." It has sharp edges, and becomes hot immediately, so to use it you must be as careful as a Grogg!

Challenge: Make some Buddy Burners and a tin can stove and cook something on it.

Materials and Equipment:

A No. 10 can--a three-pound coffee can or shortening can may be substituted but they are not quite as satisfactory
Punch-type can opener
Pair of tin shears
Pair of sturdy work gloves
A hard rock
Tuna or cat food cans
Corrugated cardboard strips
Wax--the kind used for homemade jellies or candles
A piece of string or small stub of birthday candle for wick

How-To-Do-It:

Building a Buddy Burner

1) The length of the cardboard strips used in a Buddy Burner depends upon the amount of heat you will need. Some examples: 4" for breads and pancakes; 6" for eggs; 8-10" for hamburgers, hot dogs, etc.; 10" for baking, 24" or more needed for boiling. Cold or windy days may require more heat. Experiment with the lengths and keep notes on what you use.

2) Melt wax in a pan over hot water (double-boiler).

3) Put the cardboard in the shallow can so that the holes in the corrugated strip will be vertical. Pour the melted wax over the cardboard. Be sure it is thoroughly soaked. (Pour any excess wax back.) A depth of about 1/4 inch in the bottom of a can is enough to cook with.

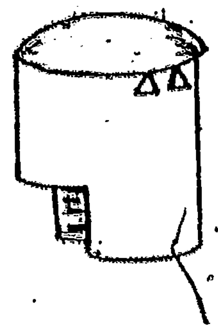
4) Add a piece of string or candle stub to use as a wick for easy lighting.

Building a Tin Can Stove

1) Have someone hold the can with the open end toward you while you cut a door with tin shears. Wear gloves! Make the cuts about two inches long and three inches apart. Fold this cut portion to the inside of the can. Be careful because the edges are very sharp.

2) Dull the cut edges of the can with a hard rock.

3) On the closed end of the can, opposite the door side, and just below the rim, punch three or four holes. See picture:

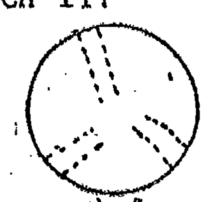


Using the Tin Can Stove and Buddy Burner

1) Pick as level a spot as possible. It may be necessary to even the ground out a little. If the can is tilted at all, your food will slide off! If your spot has grass or weeds, use of piece of foil or an aluminum pie tin under your stove and burner.

2) Light the burner and place the stove over it. DON'T TOUCH IT! It gets hot immediately.

3) If you wish to bake on your stove instead of frying, make a trivet from an old can lid. Cut on dotted lines as shown, but do not remove strips; bend them back to form feet under the trivet. (Wear those gloves!) Set the trivet on top of the tin can stove and set another can to bake in on top of the trivet.



<u>What to Cook:</u> Anything you can fry or cook on a griddle. Some old favorites: eggs, hot dogs, hamburgers, pancakes, grilled cheese, etc.

For baking, try anything simple that doesn't require too much top-browning. Gingerbread, corn muffins and packaged cake mixes work well.

The following recipes are special favorites of the Greggs:

Egg-in-a-Bag

1 egg
1 strip of bacon, cut in half
1 tsp margarine or bacon grease
1 small paper bag with flat bottom

Open paper bag and roll down the top until the bag is about 3 inches high. Put butter in bag. Start cooking bacon on Tin Can Stove top. Put bag directly on top of stove beside the bacon. When butter melts, break egg into bag and stir until cooked. Eat from bag--no plate to wash!

Johnnie Groggers

1/4 cup gingerbread mix
2 Tbsp Bisquick
1 Tbsp raisins
1 Tbsp water

In a cup, mix gingerbread mix and Bisquick. Stir in raisins and water. Dough will be thick. Have stove hot. Grease both hands well. Take the glob of dough and flatten as much as possible. Brown on both sides. Remove from stove. Cool slightly. (May frost with canned frosting.)

Grogg Bread

Take a commercial refrigerated baking powder biscuit and flatten as much as possible. Put some cooking oil on the tin can stove. Brown the biscuit on both sides. Remove from stove, butter and sprinkle with a cinnamon-sugar mix. For baking on a trivet:

Grogg Cobbler

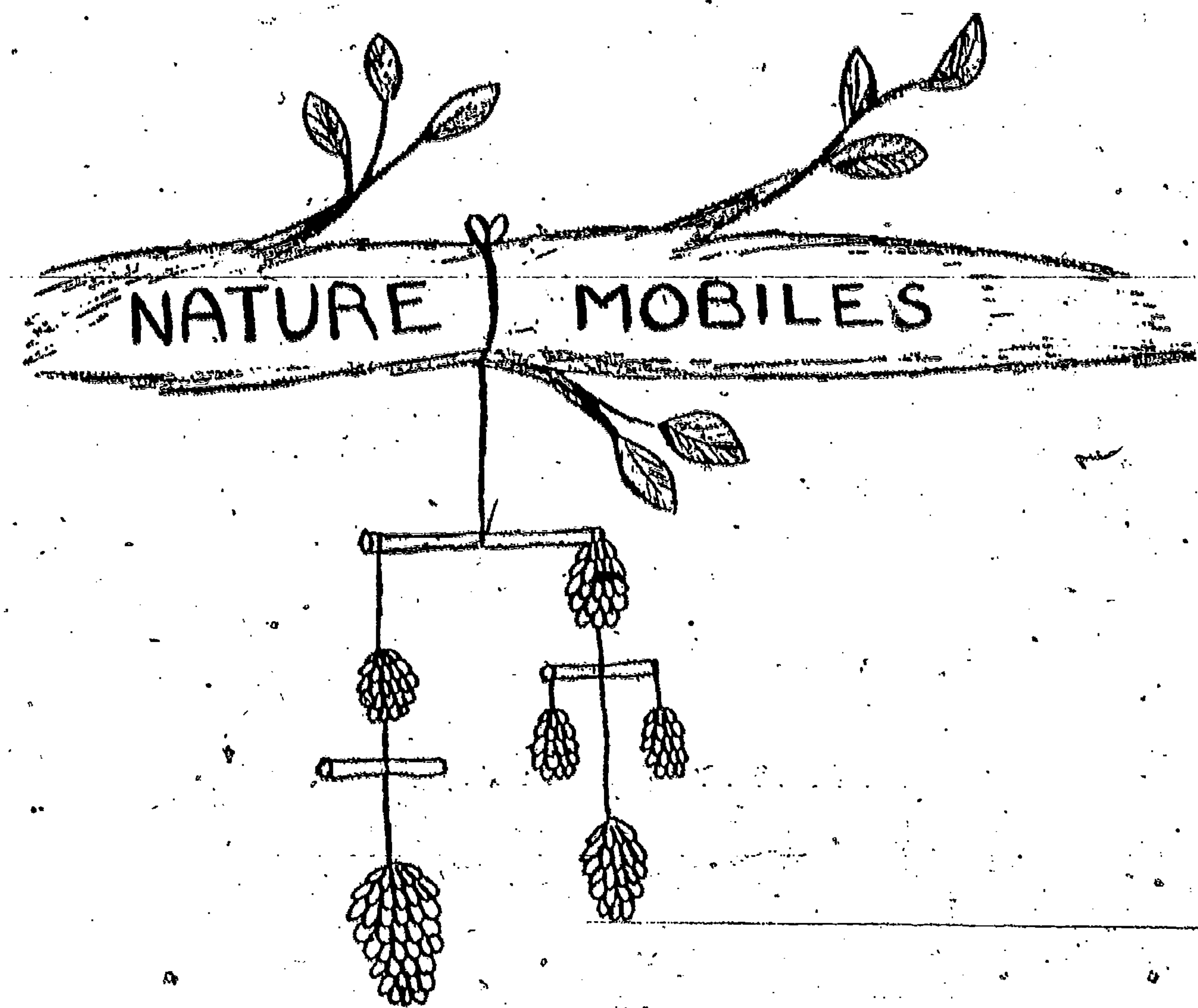
1/2 cup Bisquick
3 Tbsp milk
1 tsp cooking oil
berries or cut-up fruit
sugar and spices as desired

Grease a clean tuna fish can. Put in a layer of berries or cut-up fruit. Sprinkle with sugar and spices, if desired. Mix the Bisquick, milk, and oil and put the batter on top of the fruit. Bake 15-20 minutes.

Further Challenges:

1) Invent more Grogg recipes for the Tin Can Stove.

2) Think up some more uses for the Buddy Burners (starting fires in the fireplace, for charcoal grills, etc.).


NATURE MOBILES

NATURE MOBILES

by Joseph Abruscato

Focus: An outdoor science experience for children provides many opportunities for the gathering, observing, and grouping of natural objects on the basis of similar characteristics. One reason for teaching a child to express himself or herself through artistic endeavors is to foster an appreciation for the commonalities that transcend particular objects and tie them together in a more meaningful whole. The creation of mobiles by children can assist children in achieving this end.

Challenge: Collect and display natural objects as a mobile.

Materials and Equipment:

Found objects such as pine cones, twigs, bark, stones, etc.
String
Dead twigs or branches (1/2 meter to a meter long) to use as cross members
Tape

How-To-Do-It:

1) Upon arriving at an outdoor site, discuss with the children the types of natural objects and artifacts that they may appropriately gather during their stay. For example, an active bird's nest would certainly be inappropriate, whereas interesting stones or twigs might be acceptable objects to collect and retain. Ask the children to begin making collections of objects that are appropriate to gather.

2) At some time in the outdoor experience have the children use string, tape, and strong dead twigs to construct mobiles that display the things they have collected. You may wish to create a model mobile yourself to use as a reference during the activity. Young children may have some difficulty in getting their mobiles to balance and will require some assistance. Older children should be encouraged to create mobiles-within-mobiles.

3) When the children are done have them temporarily suspend their mobiles on tree branches and share with the rest of the class their reasons for collecting the various objects displayed.

The following are some ideas for extending this activity:

1) Encourage children to create mobiles in which stability is achieved by counterbalancing less massive objects with massive objects by placing the less massive objects at longer distances from the fulcrum (the place where a cross-member is suspended).

2) Encourage groups of children to assemble giant mobiles by interconnecting their smaller individual mobiles.

3) Have younger children tell a story that includes a reference to each object on their mobile.

Further Challenges:

1) Invent a mobile that would display living things in a way that would not harm them, and make a sketch to show what it would look like.

2) Build a mobile that would produce sounds as a breeze turned its parts.

3) Plan a mobile you could make that would remind people not to pollute the out-of-doors with litter.

Activity #57

PATTERNS FOUND IN NATURE

by Alan McCormack

Focus: Nature's architectural plan is generally based on repetition of lines, shapes, and textures: patterns. Dictionaries define "patterns" as "arrangements or repetitions of forms or elements" and most any environment is full of good naturally-occurring examples. Look at any tree leaf and you can find patterns formed by veins. And, a closeup view of any snowflake will provide a beautiful example of repeated geometric shapes. A natural pattern hunt can provide kids with a good experience in close observation and more of an appreciation of the intricacies of apparently common and uninteresting local environments.

Challenge: Seek and collect impressions of as many different natural patterns as you can find in a local environment.

Materials and Equipment:

Plasticene clay
Discarded jar lids
Writing, or art, paper
Crayons or soft pencils
Cameras (optional)

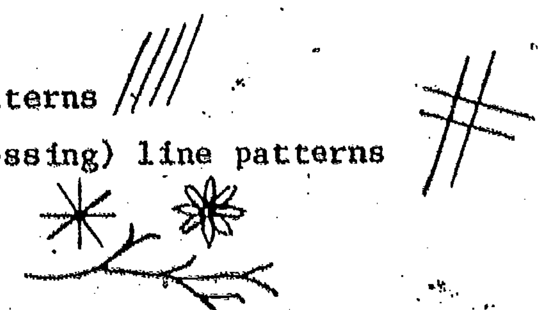
How-To-Do-It: Kids can work either in groups or as individuals on this activity. You can develop some interest by showing them samples or pictures of some naturally-occurring patterns (honeycombs, bubble clusters, snowflakes, reptile skins, etc.).

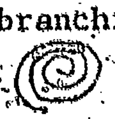
Challenge the kids to seek out and make impressions or sketches of as many items on the Patterns Challenge List as they can.

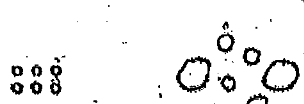
Patterns Challenge List

Try to find natural examples of some of these patterns:

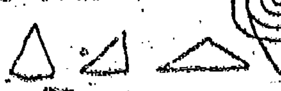
Repeating Lines
-- parallel line patterns
-- intersecting (crossing) line patterns
-- radiating lines
-- branching lines

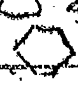


Spirals 

Repeating circles 

Concentric Circles 

Triangles 

Hexagons 

Spheres (round or ball-shaped)

Others

It is a good idea to instruct youngsters to avoid any destruction to the study site and to discourage collection of natural objects. Instead, they can make records of their "finds" in several ways:

1) Crayon rubbings--This works best with patterns having a raised texture. Place a piece of paper on the surface of an object, and rub the paper with the side of a crayon. A good impression of the object may result without any damage to the object.

2) Plasticene impressions--Plasticene (or other soft, oil-based modeling clay) can be used to make nifty "impression plates." To do this, fill old jar lids with Plasticene and smooth the clay to make a level, even surface. Objects firmly pressed on to the clay surface will leave a detailed three-dimensional impression.

3) Pencil sketches--Some patterns which lack texture may best be recorded by sketches.

4) Photography--The new breed of "instant" cameras are ideal for this but standard cameras requiring dark-room film development can provide beautiful images of nature's patterns.

After kids have collected as many patterns as they can, have them present their results to the class. Consider questions like: Which patterns are most common? Rarest? Are some patterns most common in animals and others in plants? What patterns occur in non-living natural objects? Which natural patterns have people copied or adapted?

Further Challenges:

1) Make a collection of impressions of people-made patterns and compare with the natural ones.

2) Select one of your natural patterns and use it as the basis for a work of art (mosaic, painting, sculpture, etc.).

ROCK SKETCHING

by Dorothy Alfke

Focus: Small pebbles and stones are found almost everywhere. Children pick them up and toss them, or scuff at them with their feet. But pebbles as art? Certainly! Many stones leave colored marks when rubbed across sandpaper. Children will discover that although the mark most rocks leave is the same as its outside color, some rocks leave different colored marks. Some rocks leave no marks at all. Some are soft enough to wear down from being scratched on sandpaper. These properties in various rocks will be discovered by students through trial and error.

Challenge: Find a good variety of "sketching rocks" to create drawings on sandpaper using rocks as pigments.

Materials and Equipment:

Sheets of sandpaper, preferably fine grain
Paper bags, shoe boxes, or something to collect rocks in
Egg cartons

How-To-Do-It: Before starting on a walk to collect "sketching rocks," hold a discussion on where are some good places to find small rocks (around bases of buildings, stream beds, gardens, etc.).

Give each child or small group a bag or box to collect the rocks, and a 3 x 5 piece of sandpaper to test the rocks for "scratchability." Show them how to firmly stroke the rock across the sandpaper to produce color. (Also, caution that mud or dirt on a rock will leave color traces.) Encourage the children to find as many rocks as possible that produce different colors.

When all the pebbles have been collected, they can be sorted according to the color marks they make and placed in egg cartons. Each child should have a sheet of sandpaper (full or half) and a small piece for test marks. (The art teacher may be interested in directing this activity.) The soft colors of rock marks determine the kinds of drawings best suited to rock sketching: winter scenes, Indian or pioneer life, mushrooms, wild animals, etc. Some completed rock sketches could be exhibited as motivation.

Further Challenges:

1) Children may be challenged to expand the range and assortment of colors obtained in the initial collecting trip. For example, rocks which produce green marks are extremely hard to find in most areas. Children quickly recognize the problems of drawing pictures with no green pigment.

2) Indians used finely ground rocks to make paints. Children can use their ingenuity to develop effective ways to produce fine powders from their rocks. Then, experiments can be made to see which liquids produce the best "paints" when mixed with powdered rocks. (An alternative would be to use library references to find methods for making paints from rocks and to find ways of powdering their rocks.)

Activity #59

CEMETERIES - SITES FOR MULTI-DISCIPLINARY OUTDOOR EDUCATION

by William Sorensen

Focus: Learning activities conducted in cemeteries can strengthen students' skills in observing, graphing, computation, hypothesizing, and problem solving.

Cemetery activities can also be useful in values education when questions like these are considered: What is the purpose of a cemetery? Why is it located where it is? How do burial rites and procedures vary among different cultures and religions? How can tombstone inscriptions and symbols be interpreted?

Challenges: Make inferences about language patterns, architectural styles, and customs of past generations of people by observing a cemetery. Make inferences about diseases and/or epidemics prevalent in past generations of people. Interpret symbols found on tombstones.

Materials and Equipment:

Crayons or charcoal sticks
Large newsprint paper
Masking tape
Hand lenses
Compass
Graph paper
Cameras (optional)

How-To-Do-It: These activities might be done as part of either social studies or geology units. They are also good in the mathematical areas of graphing, estimating, counting, and statistics.

A set of rules should be established before taking youngsters to a cemetery. (No unnecessary shouting, play, wrestling or horseplay allowed. Monuments and landscaping should not be disturbed or defaced in any way.) It is also wise to obtain permission for your visit from the organization that operates the cemetery.

When your class arrives at the cemetery, set up boundaries for study areas of approximately equal size. (Natural objects like roads, trees, and large monuments can be used as boundary markers.) Assign groups of four or five youngsters to each study area. Have each group then study as many monuments as they can and record information on Monument Datasheets like this one:

MONUMENT DATASHEET

Student's Name: ____________________

Name(s) on monument: ____________________

Date and place of birth: ____________________

Date and place of death: ____________________

Age (years and months): ____________________

Family relationships given: ____________________

Cause of death: ____________________

Type of monument (identify the shape on the "Types of Monuments" handout): ____________________

Size of monument (height, width, depth): ____________________

Monument material: ____________________

Inscriptions: ____________________

Symbols (make a sketch): ____________________

Direction monument faces: ____________________

Signs of aging and/or deterioration: ____________________

Other observations: ____________________

After groups have collected data on a reasonably large sample of the monuments of their study area, they can consolidate the data. One simple way to do this is sort the information into age categories by making tallies on a worksheet like this one:

Age Groups as Shown by Monuments

Age (Years)	Male	Female	Cause of death (if known)
0 - 5			
6 - 10			
11 - 15			
16 - 20			
21 - 29			
30 - 39			
40 - 49			
50 - 59			
60 - 69			
70 - 79			
80 - 89			
90 or more			

Then have youngsters consider questions like the following:

1) Which age groups have the greatest numbers of deaths?

2) Did males or females live longer?

3) Is there an age group that had a far greater death rate for females than for males? If so, why?

4) Is there any evidence of epidemics of disease or other calamity?

5) Can you make intelligent guesses about the wealth of people buried in your study site? How?

6) Are there differences in spelling or language styles from what you are accustomed to?

7) Are there ethnic groupings in the cemetery?

8) Is there a relationship shown between time period and family size?

9) Where is the oldest section of the cemetery? Who were some famous contemporaries of people buried there?

10) Do most stones face in the same direction? If so, is there a reason?

Tombstone Rubbings: An enjoyable method for recording data from monuments is by rubbings. These can be done as follows:

1) Pick a monument with an interesting description of art work.

2) Carefully pick any moss or lichens off the area to be rubbed.

3) Tape a piece of newsprint or light paper over the area to be rubbed.

4) With a back and forth motion, rub the side of a crayon or charcoal stick over the paper on the stone.

5) Do this until the letters or art start to appear. If the paper rips, ease up on the rubbing.

6) Be careful not to go over the edges of the paper onto the stone.

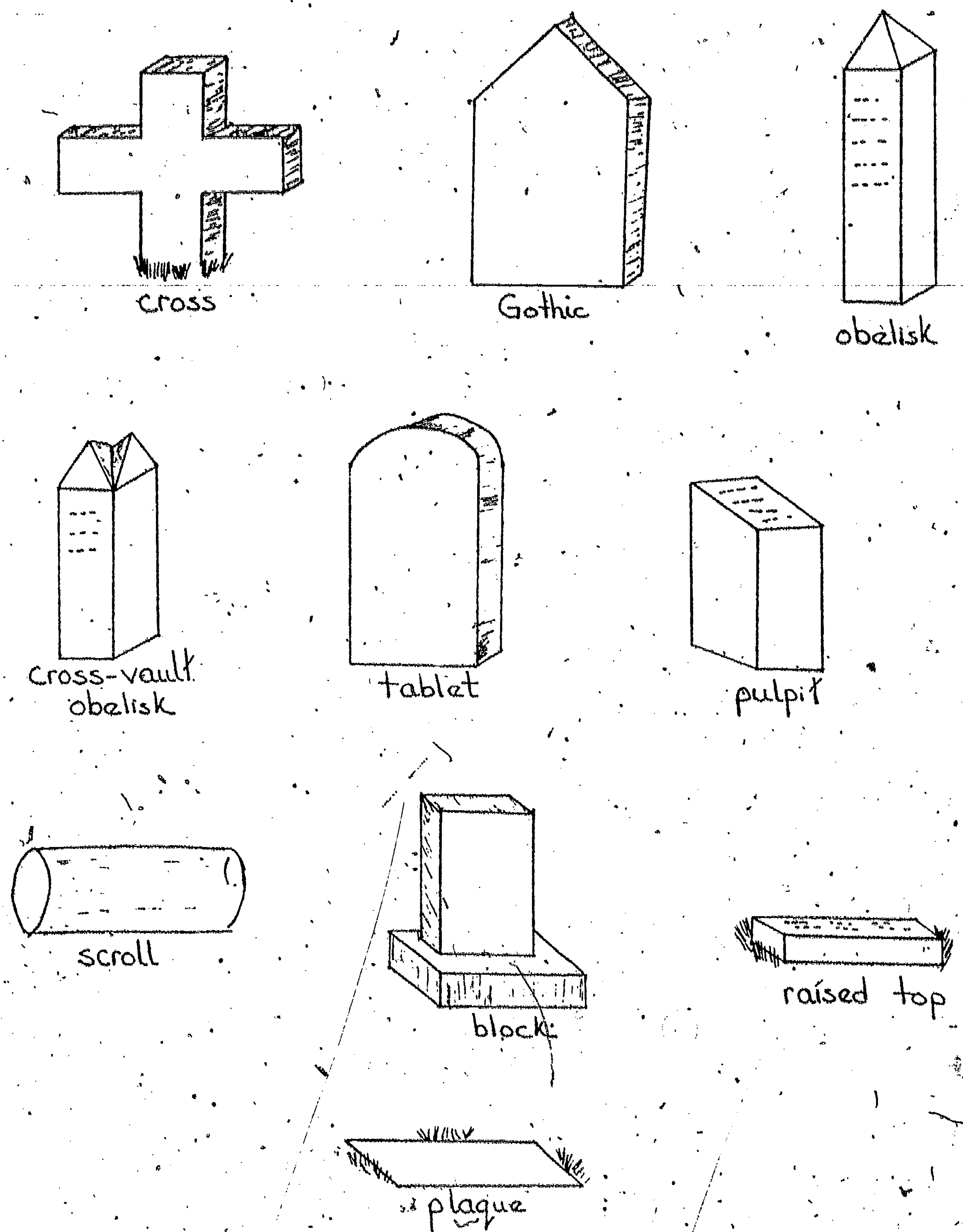
7) Practice first on a penny, tree trunk, brick or tile wall.

Reference Information: The following information about types of monuments and the meanings of symbols used might be helpful to your students. Ditto copies of the data could be supplied to each group.

Types of Monuments

A.	Crosses	Any height or size and any type of material
B.	Gothic	Usually marble. They had a pointed arch and were quite popular into the late 1800s. The average height was around 90 cm.
C.	Obelisk	Normally marble and copied from ancient Egypt. A vertical shaft up to 150 cm. Sometimes topped with an orb or other symbol. About 1890-1920.
D.	Cross-Vault Obelisk	As above but had a vault roof, and no point.
E.	Tablet	Vertical, no point, to 70 cm. horizontal to 90 cm. Marble or granite with a round arch top. Sometimes found in pairs as the ten commandments.
F.	Pulpit	Vertical to 75 cm, average. There was a slated top containing the inscription. They were marble or granite and sometimes the top was an open book.
G.	Scroll	Granite, sometimes opened out but always horizontal. Average 30 cm.
H.	Block	A granite piece sometimes with a rounded top. First started to be used around 120. Height average 60 cm.
I.	Raised Top Inscription	Height 15 cm. Top is horizontal not flat as a pulpit.
J.	Lawn Type Plaque	Granite or metal. Flush to the ground. Since 1940.

Types of Monuments



Monument Symbols

Skull - with bones or wings "Death's Head" - death

Coffin - Open or closed - death

Hour glass - Life passes

Sickle or Ax - Death, Grim Reaper

Lamp of Life - Extinguished - death/darkness

Weaping Willow - For those left behind to mourn

Urn - Receives all that is mortal

Urn with Flame - Soul rising

Wreath - Mourning

Harp with Broken Strings - No longer working

Flower Bud - To bloom in heaven, death of a child

Lamb - Innocence, death of a child

Cornucopia - Full of life, death of a child

Broken Flower - Life cut in full bloom, death of a child

Cross
Bird
Dove
Cherubs } Symbols of Christianity

Vine - Christ is vine, Christians are branches

Hand pointing up - Gone to heaven

Laurel - Victory

Further Challenge: Interview some senior citizens regarding their lives and any information they can provide on past disasters of the town. Ask "How has the town, county, country, world changed since you were my age?"

Activity #60

CREATIVE OUTDOOR EXPERIENCES FOR PRIMARY CHILDREN

by Mildred Moseman

Focus: Enjoyable outdoor activities for primary youngsters can cut across disciplinary lines. In any one activity kids may be learning science, developing language skills, and learning how to work while cooperating with others. They can also learn to use imagination to make the outdoor world more fascinating.

Challenges: Invent stories based on cloud formations. Carefully listen to all the sounds of an outdoor environment. Find solutions to "Treasures of Nature" challenge cards. Experience an outdoor color hunt. Find out what it is like to experience the world while blindfolded. Write an environmental riddle.

Materials and Equipment:

Notepaper and pencils
Felt or construction paper squares in a variety of colors
Blindfolds

How-To-Do-It: Here are some activities I have found successful at the K-2 level:

Cloud Mythology--Divide children into groups and have them establish a leader for each group. Have each group move to a different area of your school lawn. The youngsters can then lie on their backs and observe the clouds above. Each group should try to visualize people, animals, or objects in the clouds they observe. Then they can invent a story about what they see, and present this later to the entire class.

Sounds of Silence--While lying on their backs in a pleasant outdoor environment, have children close their eyes for five minutes. During this period they should try to listen to all the sounds they can hear. While doing this, they can think about these questions:

1) What produces loud sounds? Soft sounds?
2) Which sounds are happy? Which ones are sad?
3) Which sounds are man-made?
4) Which sounds do you like? Dislike?
5) Do you hear sounds you have never heard before?

An enjoyable class discussion may follow as children share their listening experiences.

Treasures of Nature--Write the names of different natural objects and organisms on cards. Give groups of children one or more cards and challenge them to find examples of what's written on their cards. Here are some samples of challenges for the cards:

Find a blue feather.
Find something that crawls.
Find something that is wrinkled.
Find something red that is not manmade.
Find something that is both hard and soft.
Find something that is changing.

Color Hunt--Place pieces of felt or construction paper in a variety of colors on the ground. Send children off to find both natural and man-made objects that match the colors. When they find a colored object, they place it on the matching felt or paper.

This is an especially good activity during fall in areas having broad-leaf trees with leaves that change color.

You're My Eyes--Obtain enough blindfolds so you have one for each pair of children. Have children work together in pairs and take blindfold walks. One child is blindfolded and is led by the other to touch plants, pebbles, seeds, pavement or any other non-harmful objects available in the local environment. After a short time the kids reverse roles.

Afterwards have children share their feelings about the experience. Did objects seem different, frightening, or more interesting when experienced while blindfolded? Did you trust the boy or girl who led you around? Were you more aware of sounds or smells than usual?

Environmental Riddles--Divide your class into groups and have each group survey a study site to find a living organism or some non-living object that they feel is interesting. Each group keeps secret its choice and makes up a riddle about it. When all groups have accomplished this, the entire class walks to the various areas where groups found their selected natural objects or organisms. At each site a group presents its riddle, and kids try to guess the answer. Here is an example of this sort of riddle:

I live in the ground.
I have short brown fur.
I am about as long as your hand.
I run in tunnels under the ground.
What am I?

(Answer: a mole.)

How Do We Feel? At the end of an outdoor activities session, I have youngsters join hands and form a large circle. Then I instruct them to close their eyes for one minute and think a "happy thought" about the best thing they feel has happened in our outdoor session. After opening their eyes, boys and girls share their thoughts with the rest of the class. This helps us finish on a pleasant and positive note.

SENSORY AWARENESS CIRCLES

by Alan McCormack

Focus: Most people, kids included, spend most of their time in a state of vague awareness of the world around. Many rarely take time to really explore even a small portion of the world with full attention and application of all the senses. So, an experience in total-immersion observation of some common object can be worthwhile for almost any person of any age level.

Challenge: Totally observe an object so that you can identify it even while you are blindfolded.

Materials and Equipment:

Blindfolds (a torn-up old sheet makes many)
Rocks, pine cones, or other common objects found in your outdoor study area
Paper or cloth bags (for optional challenge)

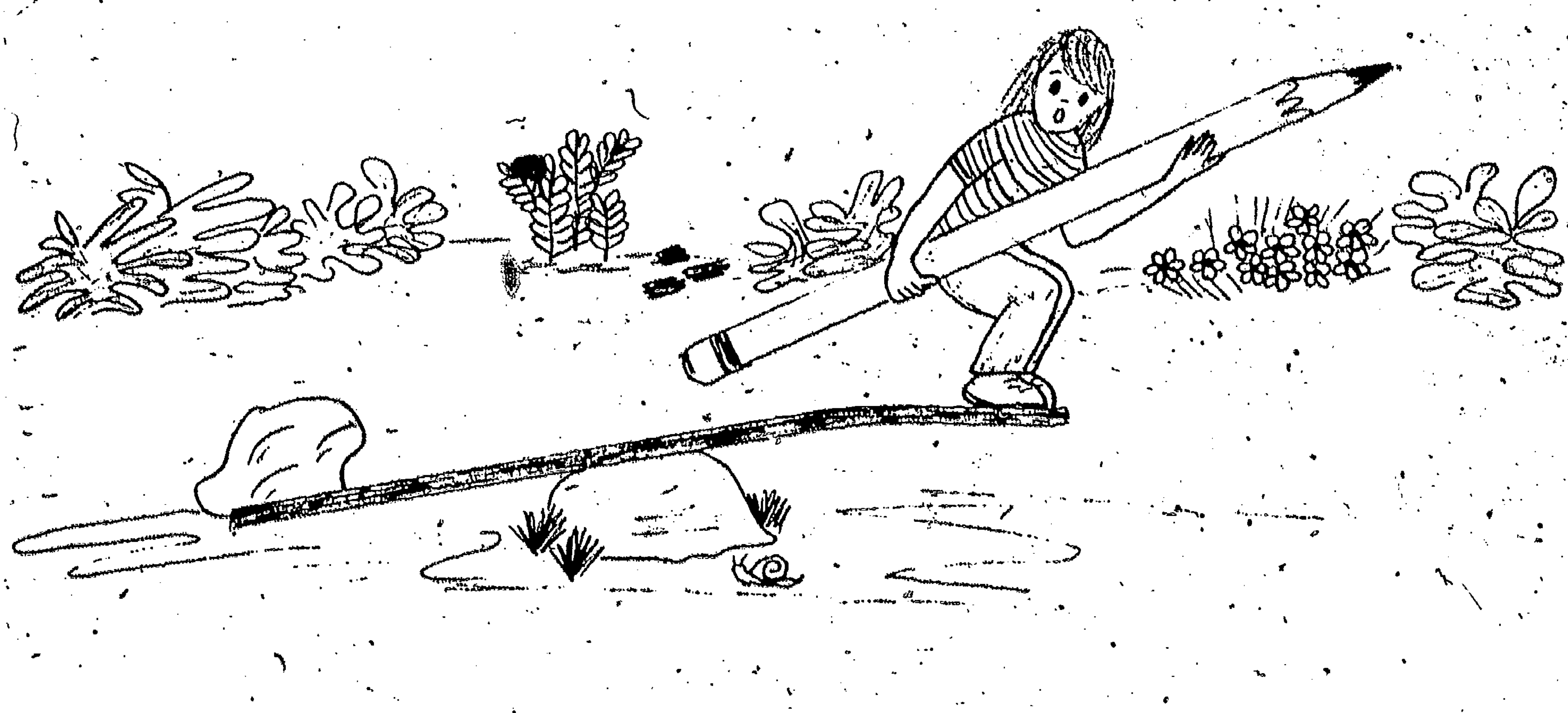
How-To-Do-It: Visit an outdoor study site with your class (any place will do). Decide upon some group of similar objects found at the site to use for this activity (rocks, pine cones, corncobs, tree leaves--almost anything will do as long as the objects show some variation and the supply is adequate for each youngster to have one).

Divide the class into groups of six to eight students. Each group then forms a circle, and the kids sit on the ground. Each youngster is given one object to totally observe during a five-minute allotment of time. Then, all objects are placed in the center of the circle and mixed together randomly. Kids in each circle put on blindfolds, pick objects from the pile, and pass them around the circle until they think they have found their "own" object. (It may be wise to have kids write their initials on their object before putting on blindfolds--thus avoiding arguments later.) When everyone feels certain he/she has found the correct object, remove blindfolds. You and the kids may be amazed at how well they can observe and find the objects when a true effort is made at careful observation.

Further Challenges:

1) Put single objects in paper and cloth bags. Have each student observe one of these through sense of touch only. Then put all objects in the center of the sensory awareness circle and see if they can identify their object through vision alone.

2) "Most people see but do not observe." Discuss this statement with kids after participation in sensory awareness circles.



THE OUTDOORS AS A SPRINGBOARD FOR WRITING

by Joseph Abruscato

Focus: The improvement of writing skills is an important component of elementary school language arts experiences. Outdoor science activities can provide many opportunities for children to become interested in expressing themselves through writing. And, they can make the writing more fun and relevant to actual, rather than vicarious, experiences.

Challenges: After outdoor activities children can:

-- Write and draw posters that describe their outdoor experiences.

-- Write letters to others about some facet of their outdoor experiences.

-- Communicate observations made in the outdoors.

-- Keep a written log of their experiences.

-- Write a skit describing portions of their outdoor experiences.

Materials and Equipment:

Paper and pencil
Optional art supplies

How-To-Do-It:

1) After children visit an outdoor education site they can write letters to newspapers, community officials, and potential visitors concerning such matters as observed pollution or the encouragement of greater utilization of the site by the public.

2) Children can create a series of posters for placement on school bulletin boards that share the experiences that occurred during their outdoor work.

3) Young children can be encouraged to dictate to older children, to you, or to their parents, a story about an interesting observation or incident that occurred during their outdoor work. They can use the written transcription of their experiences as a source of new vocabulary words.

4) Children who participate in an outdoor field experience can be encouraged to keep an ongoing written log of their work. Young children can be encouraged to accomplish the same end by making tape recordings of their experiences.

5) Children can write skits or plays that depict various observations and incidents that took place during their outdoor experience.

6) Some children may wish to refine their written work to the point at which it becomes appropriate for submission to a school or community newspaper.

7) Some children may enjoy adding art work to the written products that result from their outdoor experiences. Such illustrated written materials can then be used for bulletin boards, school displays and even as "gift" books for parents.

Further Challenges:

1) Write a rhymed and unrhymed poem about something you observed during your outdoor work. Which poem do you like best? Why?

2) Write a short story about a living thing in the outdoors that receives the magical power to observe and talk to humans who come to visit an outdoor area. What would the plant or animal say? What questions might it ask of the person who is writing?

ROCKS-IN-A-BOX

by Hilma J. Smith

Focus: An activity to open a young child's eyes to the fact that there are many kinds of rocks. Any place where small rocks can be found is suitable. Knowledge of geology is not necessary for either the child or the adult in charge.

Challenge: Fill each compartment of an egg carton with a specific type of rock you have found.

Materials and Equipment:

An egg carton for each participant or group
Small labels that can be glued to the box
Pencils or pens

How-To-Do-It: If desired, have a brief discussion on rocks. What are they? Why are they here? How were they formed? Can we tell what they are made of?

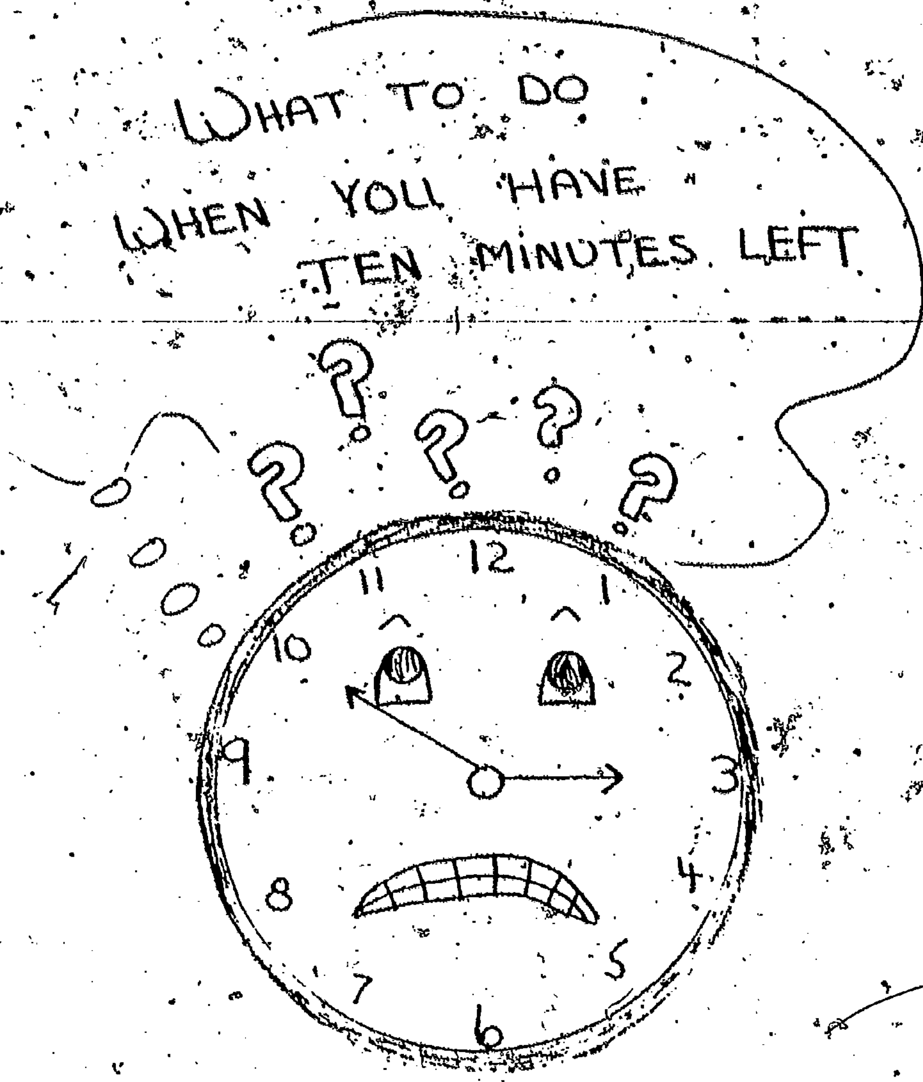
Encourage the children to come up with "types" of rocks, such as flat rocks, glittery rocks, round rocks, speckled rocks, rocks shaped like animals, lucky stones (banded all the way around), etc. Write each type on a label and glue it to the lid above a compartment.

Now you are ready to search for rocks to fill the carton. A time limit can be set on this, or it can be an ongoing project. At the completion of the activity, have the groups or individuals share what they found with others. Have reference books available for those who wish to know more.

Further Challenges:

1) Use the "pretty" rocks in some art form--rock mobiles, rock collages, etc.

2) Select a rock shaped like an animal, give it a name and make up a story about it.


WHAT TO DO
WHEN YOU HAVE
TEN MINUTES LEFT

Activity #63

WHAT TO DO WHEN YOU HAVE TEN MINUTES LEFT

by Patricia Chilton

Focus: Have you ever taken your class outside for a 40-minute lesson, but everyone was finished in 30 minutes? "What do we do now, teacher?" is an all-too-familiar question.

What you need to have is a repertoire of very short, worthwhile outdoor games or activities requiring very little preparation. Here are some I have found useful for that unexpected but long-lasting ten minutes.

Challenge: Participate in an interesting game or activity during the last ten minutes of a class trip outdoors.

Materials and Equipment:

None required

How-To-Do-It: Get right to one of these quick-but-fun activities if kids have finished with their major outdoor activity of the day. "Dead time" with restless kids can only lead to problems.

The Perfect Observer Game: Have kids sit in a large circle. Pass a twig, leaf, rock or other object around the circle. As each student receives the object, he/she states one observation of the object (using any of the senses).

Rules:

1) Listen well. If you repeat an observation made by someone else you are "out."

2) Only observations, not inferences, are acceptable. Statements about an object's purpose, uses, or inside non-observable structure are not observations.

Pass the object around several times. Everyone will be amazed at the number of observations possible.

Super Soil: Challenge students to name or find something that cannot be traced, in some way, back to soil. When an object is suggested, have the class help you trace the material making up the item back to soil. Examples:

glass
↓
sand = soil

leather shoes
↓
cow
↓
grass
↓
soil

206

Texture Descriptions: Have students sit at least one arm's length away from each other. They then close their eyes and use their hands or bare feet to feel the area around them. After one or two minutes, ask youngsters to write descriptions of the textures they felt. (Instead of writing the names of objects such as soil, pebble, stick, grass, they should describe the texture. This isn't so easy, but it's a good experience in using adjectives.)

Instant Scavenger Hunt: Whenever going on a field trip or outdoors for a lesson, have a set of file cards with you. Each card should have one of the following challenges written on it:

Find something a bird uses for nesting material
Find a seed
Find five pieces of litter
Find something that shows signs of erosion
Find an oak leaf
Find something that makes its own food
Find something red
Find something that is not living now and never was
Find a bird's feather
Find something a squirrel would eat
Find something showing that nature recycles materials
Find something that shows change
Find an insect home

Caution kids to collect only very small quantities of materials, and not to collect at all when doing so would damage an environment. (They can write descriptions in this situation.)

Pass out one card to each student and challenge them to meet the challenge within 10 minutes. Results can be discussed later back in the classroom.

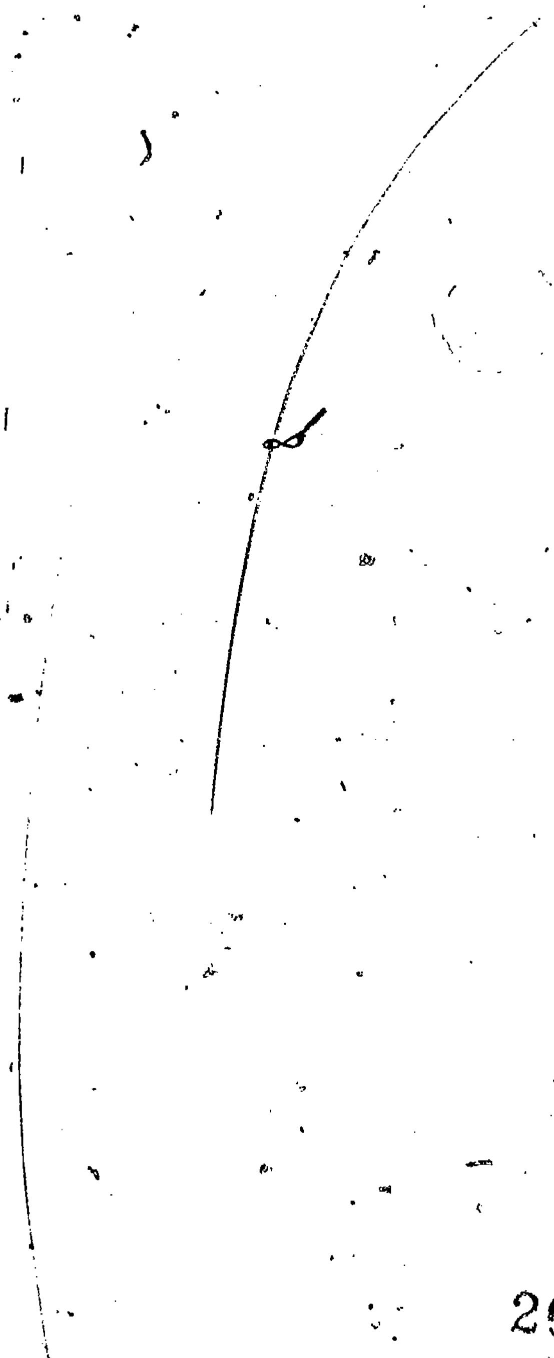
APPENDIX

Plans for instruments your students can build to use in outdoor studies.

HYPSOMETER

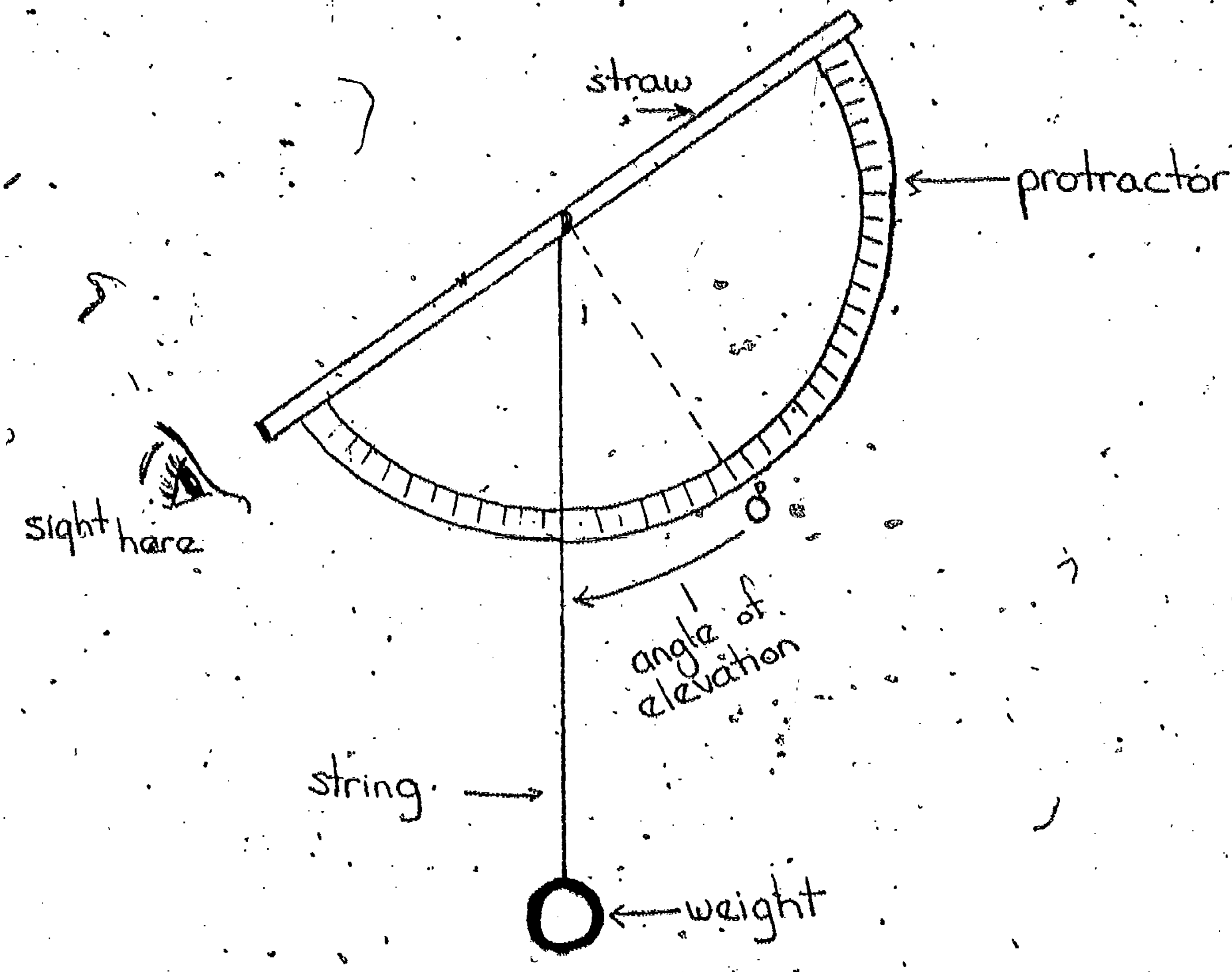
A hypsometer is used for measuring heights of inaccessible objects (tree tops, clouds, model rockets in flight, etc.). A simple one can be built from a drinking straw, protractor, string and a metal washer or other weight.

To use a hypsometer, measure a baseline (20-50 meters) from the base of a tree or other tall object you wish to measure. Site through the straw to the treetop and record the angle of elevation as shown on the protractor. The angle on the protractor is identical to the angle of elevation of the large right triangle shown in the "Using A Hypsometer" sketch. To find the height of the tree, plot the large triangle to scale on graph paper. Then you can determine the height by simply counting the graph paper scale units covered by the tree.

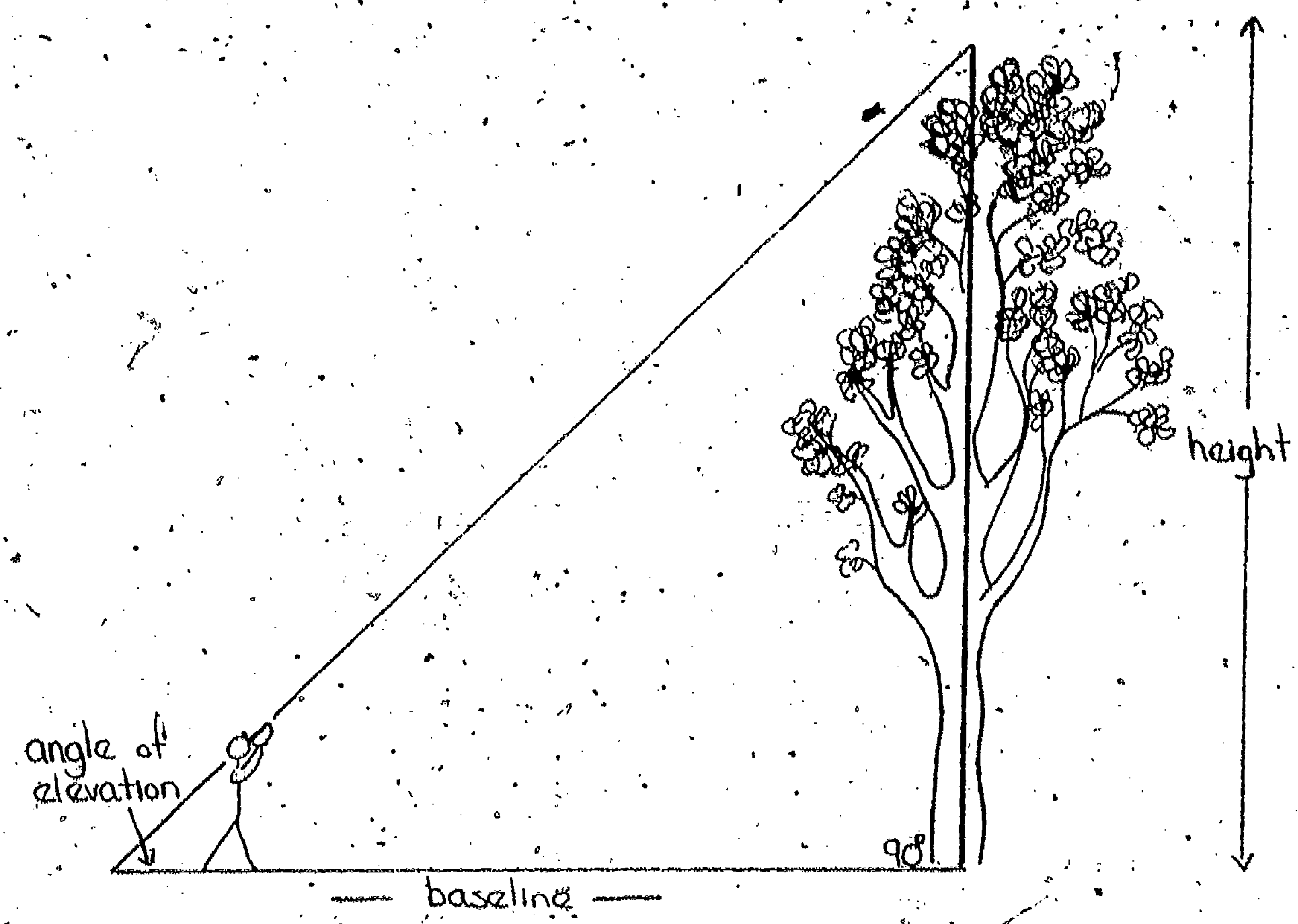


209

Hypsometer


straw
protractor
sight here
angle of elevation
string
weight

Using A Hypsometer



211

CESI BUG CATCHERS

It is often difficult to pick up small insects without injuring them. Here are two devices kids can use to alleviate the problem.

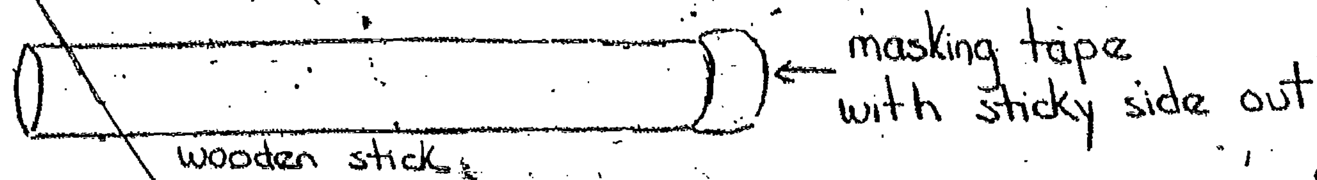
Type 1. Sticky-side out masking tape on the end of a stick can make a nifty bug catcher. Gently touch the sticky tape to a small insect, and you've got him! The insect can be removed from the tape by gently prying him loose with a toothpick.

Type 2. Make two holes in the top of a baby food jar. Place the ends of two pieces of rubber or plastic tubing through the holes, and attach them securely with silicone cement. Screw the lid firmly onto the jar.

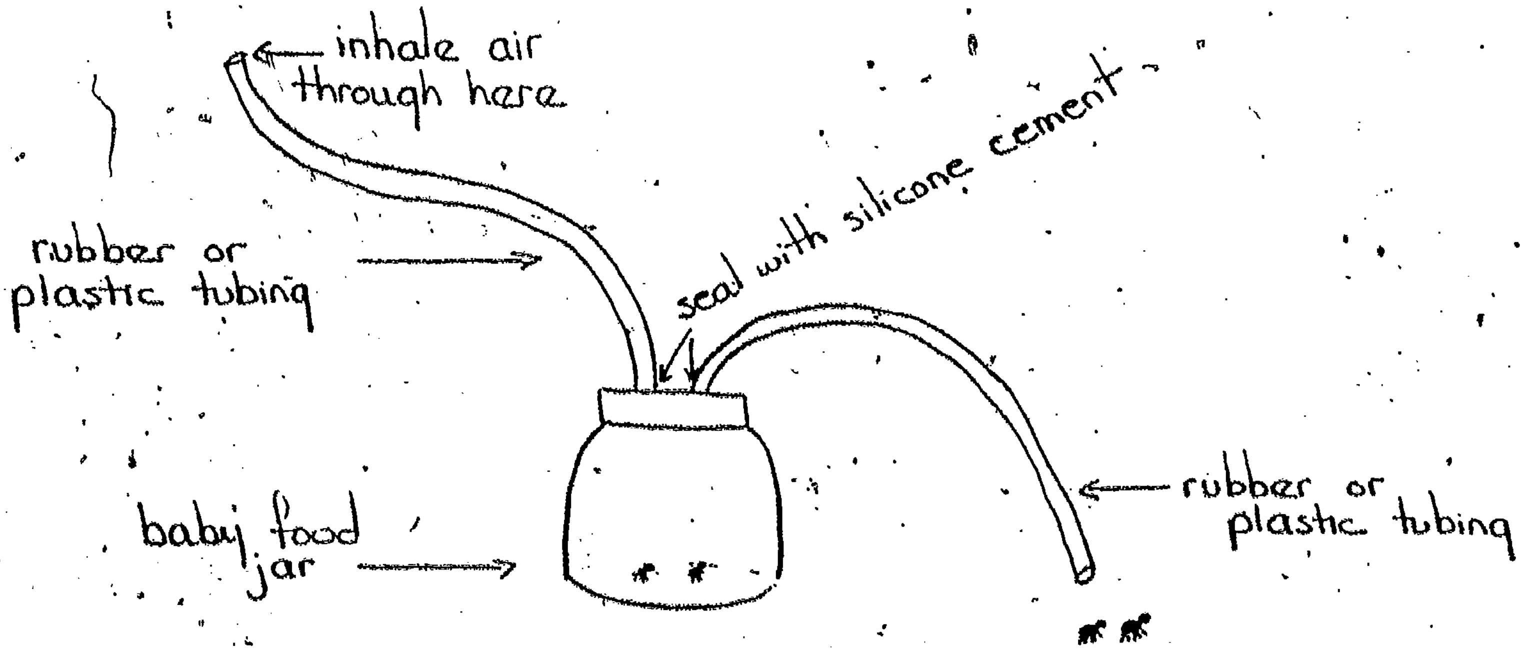
When you inhale air through one tube, you will find the other tube acts like a vacuum cleaner. The air stream moving into the tube picks up small insects and deposits them in the baby food jar. (Don't worry! It would be pretty hard to suck one up the tube into your mouth.)

CESI Bug Catchers

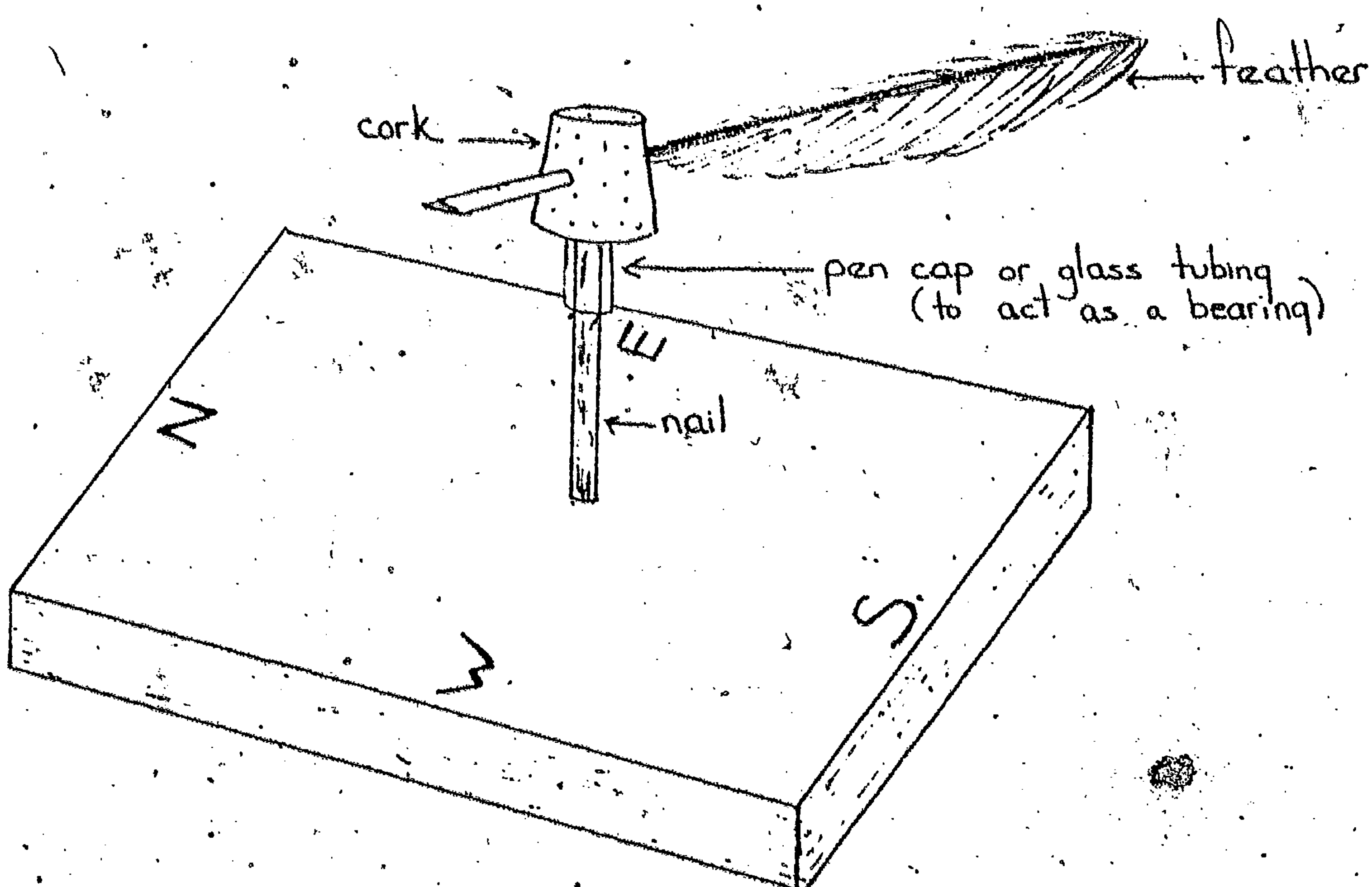
Type 1



Type 2



WIND VANE



214

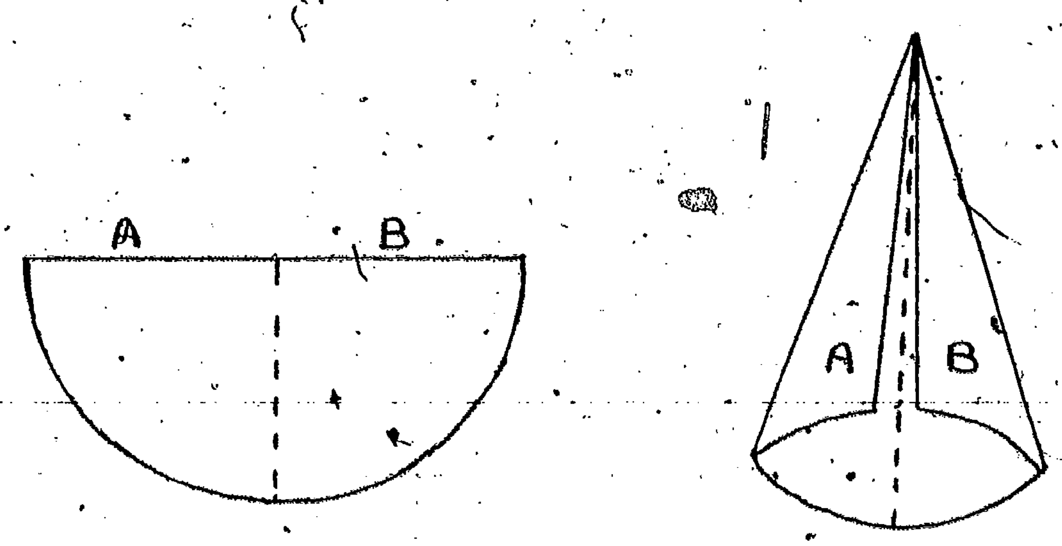
ANEMOMETER

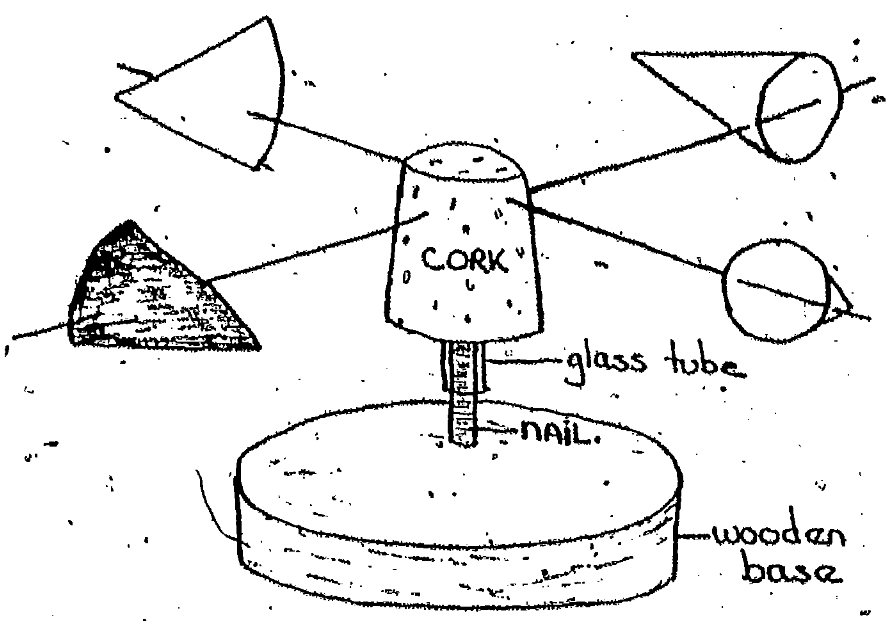
An anemometer, or wind speed indicator, can be built from oak tag, wire, a cork, a short piece of glass tubing, a nail, and a wooden base.

Begin construction by making cone-shaped windcups from oak tag or other heavy paper. Cut semicircles from the paper, fold and join with tape as shown in the diagram. Use heavy wire to attach four windcups to a cork, as shown. Use a strong glue to secure the cups to the wire. Obtain a short piece of glass tubing which has one closed end (the end can be closed by melting in a flame). Insert the closed end of the tubing into the cork--this will form a low friction bearing when placed on a nail fastened to a base.

To calibrate your anemometer, paint one windcup a bright color. Hold the anemometer out of the window of a car while traveling at 10 mph. Count the number of turns of the colored cup. This will give you the number of turns to expect from your anemometer in a 10 mph wind. If the anemometer turns twice as many turns in a certain wind, then you know the wind is 20 mph, and so on.

ANEMOMETER





HUMAN HAIR HYGROMETER

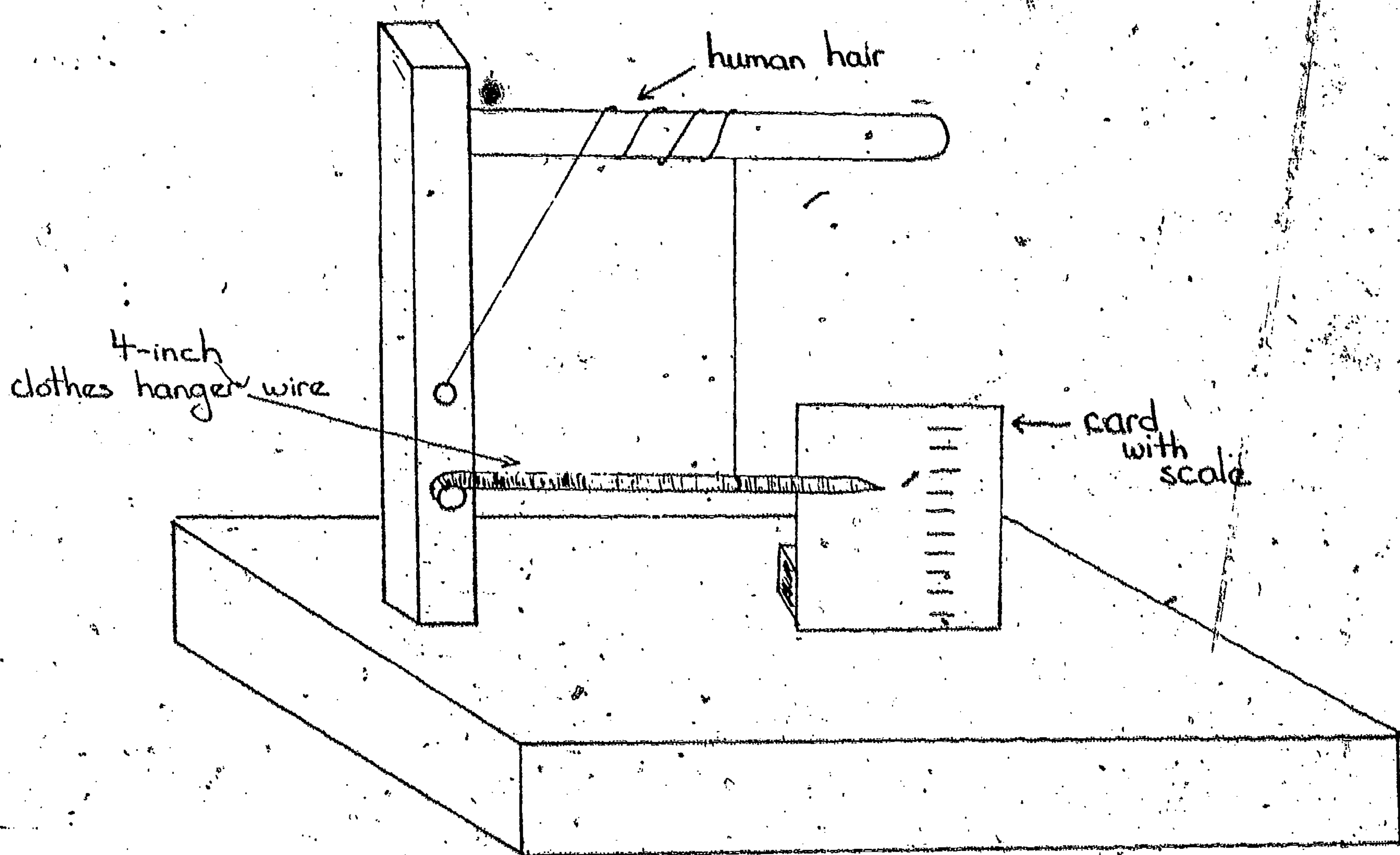
This device will measure relative amounts of moisture in the atmosphere (often called humidity).

To build one, use scrap wood and assemble as shown to form a base. Obtain a long clean hair and tie it to a piece of sharpened clothes hanger wire. Wrap it over the dowel and attach it to the wooden upright with a thumbtack. When the air is dry, the hair shortens and raises the pointer. When the air is moist, the hair absorbs moisture and stretches.

Suggestion: blond hair works better than dark hair.

217

Human Hair Hygrometer



AQUATIC SAMPLING TOOLS