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ABSTRACT

Designed to be a supplement to a short course for middle school children and their parents, this document provides learning experiences for studying ecology during the winter. The purposes of the course are to introduce families to the pleasures of outdoor field exploration and to give them a basic ecological framework as well as specific skills that they can use to explore the out-of-doors. Under the general topic of winter ecology there are sections devoted to: (1) snow field studies; (2) catching snowflakes; (3) determining wind chill; (4) building a snow shelter; (5) snowshoeing/skiing; (6) dogsledding; (7) ice ecology; (8) acid precipitation; (9) animal tracking; (10) bird feeder observations; and (11) bird banding. Each section includes an overview of the topic and descriptions of all of the activities that will be taught in that section. Included in some of the sections are descriptions of learning activities to be done at home. (TW)

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WINTER NATURE STUDY

FOR MIDDLE SCHOOL CHILDREN AND THEIR PARENTS

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This course is designed to introduce families to the pleasures of outdoor field explorations; to give them a basic ecological framework as well as specific skills that they can use to explore the out-of-doors. Many ecology classes have been designed for the individual, but few for the family unit.

A Family Orientation

This course is specifically aimed toward parents and their middleschool aged children.

Most of the following activities are designed so the family works together as a unit. People do however, appreciate, getting to know the other families in the class. Therefore, occasionally two or more families are teamed up to work together on one task. At other times, as in group discussions, the entire class may be working as a whole.

YOUR Course in Ecology

The science content of this course revolves around several broad concepts of ecology. The technique is to observe and investigate local phenomena including weather, plants, animals and the effects they have on each other, and then derive ecological principles from the observations.

Since the course is based so strongly on local field observations, it is difficult to write activities that are equally appropriate across the country and in all seasons. This is where the ingenuity and creativity of the naturalist/teacher is so vital. You know, for example, better than anyone else what animal in your area is the best one to illustrate territoriality. Is it the red-winged blackbird, as we used in a midwest marsh? Or would the fence swift, snowshoe hare, robin, or fathead minnow be better where you are? Take the ideas and run with them; these activities are only a jumping off point.

Ecology Concepts

Underlined here are the ecology concepts chosen to investigate, along with a paragraph briefly highlighting the main ideas and objectives of each. Following that is a chart that keys each concept to a list of objectives and the specific activities that can be done to satisfy them.

ecosystem: An ecosystem includes all the living organisms as well as the non-living environment and the interactions between them.

Ecosystems cannot be seen; only their parts can. Ecosystems can be as small as a rotting log or as large as the entire earth. Since ecosystems are made of interdependent units, changes in one part will affect the other parts. The study of ecosystems is called ecology.

physical environment: The physical environment is the non-living part of an ecosystem.

Factors such as light, heat, soils, landforms, air, and water can be investigated as part of the physical environment. Participants will be better able to collect data about the physical factors in the environment and to analyze the effects of these factors on plants, animals, and humans.

plant and animal communities: Plant and animal communities make up the living part of an ecosystem.

Communities are made up of interdependent populations of plants and animals. To be successful in a particular environment, a plant or animal must have special features that make its survival and reproduction possible. These are adaptations to its environment. Participants will be better able to identify organisms using field marks, collect organisms using various collecting techniques, classify them into groups using common designators, and observe their adaptations for survival.

relationships: Relationships tie together the various parts of an ecosystem.

How organisms affect each other in an ecosystem will be investigated. A hypothetical food web for an ecosystem will be constructed. Participants will be better able to discover inter- and intraspecies relationships and to predict what effect a change in one part of an ecosystem might have on the other parts.

succession and change: Succession is the orderly series of changes that occur in an ecosystem under normal conditions.

Ecosystems, because of their interdependencies, are never static. A change in one population affects the physical environment, which affects another population. Some changes take place in a short span of time, others, like geological changes, take place over millenia. Participants will be better able to investigate some of the dynamics of an ecosystem and the resulting changes that happen over time.

humans in the ecosystem: Humans in the ecosystem affect, for good or bad, all the other parts.

At the same time, we are affected by our environment; human culture is our way of adapting to it. Humans as polluters, as members of a food web, and as ingenious users of natural resources will be considered. Participants will be better able to identify the effects of humans on ecosystems as well as our cultural adaptations to various environments.

Planning the Course

Consider the natural resources as well as the facilities of your area. This course could be based at one site, or could travel from place to place. Since this is a field work class, it is vital that the class size be limited. Groups of 15 people, or five or six families, are the maximum for working on a trail. If class sizes are larger than this, consider the use of an aide or two who are skilled in field work, in addition to the primary teacher. The aides can provide leadership for small groups in the field so the larger group can be split up when outside.

Pick and choose among the activities under each concept. Note the time estimates listed for each activity in its write-up, but realize that these are only estimates; outdoor activities can vary greatly in length of time necessary to complete them because of travel time differences, discussion variations and individual preferences for pace, etc. Some activities seem to be naturally allied. For example, "Plant Identification by Families" and "Wild Foods" can be easily taught in the same three and one half hour session. This is indicated by the phrase "Companion Activities".

Each session should also be accompanied by a home activity. These activities not only expand upon the class lesson, but give the families more ideas for worthwhile things to do on their own. The first few minutes of every class session should be spent in discussion of home activity discoveries and adventures.

Examples of Class Organization

In trial teaching, the following class organizations was used:

Sessions - Winter

1. Catching Snowflakes

   Snow Field Studies

   Determining Wind Chill

2. Bird Banding

   Bird Feeder Observations

3. Ice Ecology

   Acid Precipitation

4. Dogsledding

   Building a Snow Shelter

5. Animal Tracking

   Snow Field Studies (continuation)

   Snowshoeing

General Considerations of Cold-weather Outdoor Education

Winter is an exciting and enjoyable time to be outside. The beauty of lacy snow crystals, the magical appearance of animal tracks in the snow, and the wonders of a frozen lake are all phenomena that can only be studied in winter. But winter outdoor education has its unique problems also.

First of all, consider the comfort of your class. It certainly helps to have a building to take refuge in when necessary. People may need (and welcome suggestions about what to wear. It is wise to have extra scarves, hats, and mittens, even snowmobile boots tucked away somewhere for individuals to use when they get cold. If a person is miserable outside, all they learn is to hate winter. The instructor should also realize that class members may not be as well prepared as he or she is; we as instructors are often comfortable when the class is freezing.

On especially cold days, it may be better to split up the outdoor portion of your class into two periods with a warm-up break between; perhaps with cocoa and coffee. Snacks and hot drinks seem to be especially welcome in winter classes. Plan your routes on windy days to take advantage of sheltered wooded areas. If people are getting cold, you may have to postpone discussions until you get inside. In other seasons, it is easy to record data in the field, but in the winter, cold fingers make writing unpleasant. Members of a family should take turns being a recorder; and if even that becomes burdensome, individuals can be assigned to remember vital numbers until you get indoors.

Another consideration is class planning. Many winter activities require certain environmental conditions, such as fresh snow for animal tracking, a frozen lake for ice ecology, or wind for a lesson on wind chill. You may not be able to predict when these conditions will occur. For that reason you may want to prepare a tentative schedule of activities, but substitute freely so that activities are done when conditions are right.

A third consideration of winter outdoor education is the possibility of accidental damage to the site you are studying. Undisturbed snow cover is important to the survival of some plants, insects and small mammals. A well-meaning winter ecology class is capable of causing just as much snow compaction as a snowmobile. Check to see if there are policies in the area you are using. Are there established trails you should stay on? Or is the area so large and little used that the impact of your class is inconsequential? Share your concerns with your class.

SEASONAL CHANGE

(can be done in any season)

OVERVIEW:

Modern Americans are often unaware of subtle environmental changes. This activity encourages participants to look alertly for the small signs of seasonal passage.

Time est.: a few minutes each session

Companion activities: journal writing homework

OBJECTIVES:

Participants will be able to:

- point out evidence of seasonal change.

MATERIALS:

None are required, but these are optional:

- thermometers
- meter sticks
- phenology chart, if available

TEACHING SUGGESTIONS:

This is a simple observational exercise. Each week, ask participants to look for changes from the previous week. Measuring equipment can be used, but is not necessary. Look for changes in:

- day length, height of sun at a given time
- temperature
- other weather factors
- vegetation condition or changes in state, like flowering or seeding
- animals: behavior, like courting, nesting, storing food, hiding
  populations/stages, like before and after a migration wave, or hatching of birds or insects

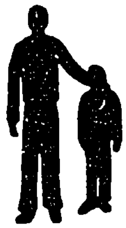
If you keep phenological information in a chart form, the participants can help you mark down information. These charts can show at a glance that natural history events, such as the spring arrival of a particular bird, or blooming of a particular flower, tend to occur at almost the same date each year. The variations are usually caused by weather differences. Sometimes a whole season seems to occur earlier or later than usual. The charts show, however, that the order of events usually stays the same. For example, in autumn, blue winged teal always migrate earlier than redhead ducks.

Keeping track of seasonal passage can become a life-long hobby. Data collection does not have to be time consuming, just accurate. Dates of events like the arrival of the first robin can be kept in notebook form, although a card system makes it easier to go back over your entries.

Homework Assignment

Keeping a Journal

The assignment is to keep a natural history journal for the remaining weeks of class. The purpose of the assignment is to keep careful observations. Participants have many options as to what, how, and when to write. Also, the journal can be private or public, individual or family, as they decide.



HOME ACTIVITY

KEEPING A JOURNAL

Your assignment is to keep a natural history journal for the remaining weeks of class. The purpose of the assignment is for you to keep careful observations. You have many options as to what, how, and when you write. Also, your journal can be private or public, individual or family, as you decide.

One thing you should decide early on is whether you want to keep individual journals, or one as a family. A family journal is a wonderful project. It can simply be a spiral bound notebook kept in the kitchen or other central location. Anyone can write in it. Over the years, this could become a clear voice of family growth as well as a natural history record.

For this class, the subject should be natural history, although it can certainly grow to include your thoughts on anything. A good way to start journal writing is to describe something every day. Describe the yard as it looks today, the quality of the air, the clouds, or whatever catches your eye.

A journal entry does not have to be profound or take a lot of time. But you will probably find that, without working at it, the quality of your entries will improve. What you write will probably amaze you when you look back at it!

You may decide to start a journal with a specific purpose in mind. For example, you would like to be more sensitive to the weather so you keep track of weather change. Or, you may want to record phenological information; that is, how you would record such things as the date of the first snow, of the first bloom of roses. Perhaps you may want to concentrate on clear writing which might lead to poetry. Journal writing is one of those exercises that helps the artist or poet as well as the scientist.

If you want to, you can share any part of your journal with others in the class.

WINTER ECOLOGY

SNOW FIELD STUDIES

OVERVIEW

In northern areas, snow is so abundant and ordinary that it is rarely investigated. Yet without understanding snow, it is impossible to understand the winter environment. Snow is a physical factor that changes the very structure of the habitat. It is the surface animals walk on and material through which they tunnel. It is an obstacle to food gathering for some (a robin is prevented from gathering worms, and so must migrate) and a protective surround for others (meadow voles abandon their earthen tunnels in favor of snow burrows in the winter). It is a source of drinking water, and, at the same time, an insulating blanket that prevents temperature fluctuations beneath it.

Time estimate: 60 minutes outdoors with 20 minute discussion

OBJECTIVES

Participants will be able to:

-study metamorphosis of fallen snow by observing crystals in different stages and by building a snow shelter.
-find different types of snow in the field and speculate as to the conditions that caused the different types as well as the ecological effects they might have.
-take temperatures above and below snow and make an inference about the role of snow as an insulator.

MATERIALS

One per family:

-meter stick

-thermometer, preferably armored

-clipboard, paper, pencil

-hand lens

-snow pressure feet

-sharp, straight-bladed snow shovel

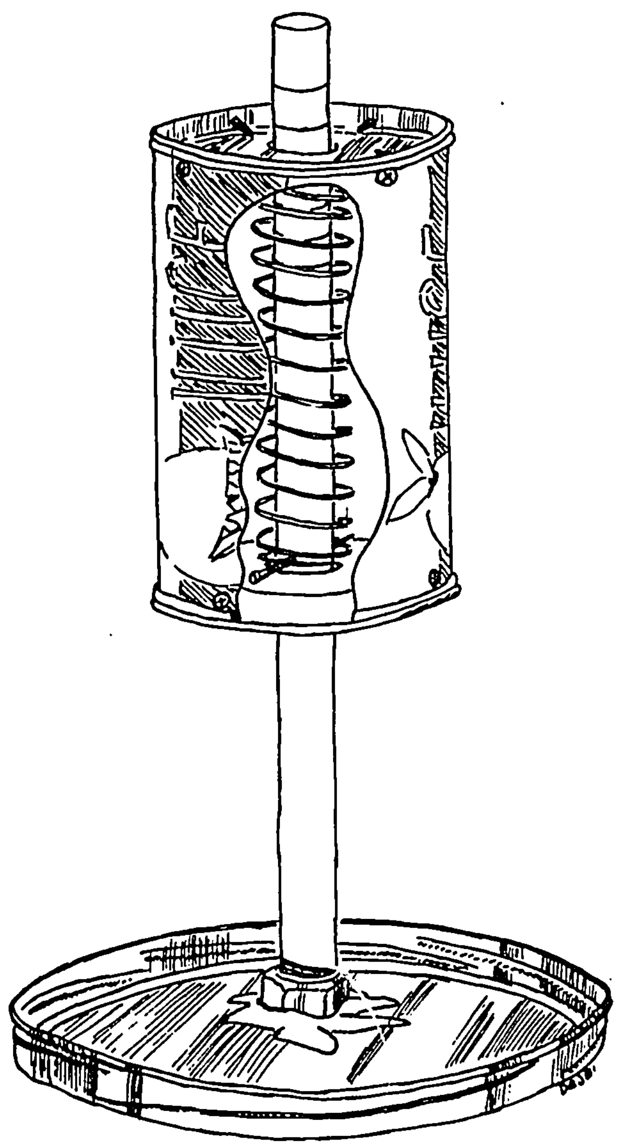
Optional:

-snow pressure foot

-chart of snow names

ADVANCE PREPARATION

Select a route that will lead to three stations that are significantly different in snow type. For example, a route might lead from the woods to the grassy margin of a lake to the frozen lake itself. If you want to use the snow pressure feet, make one or more ahead of time (see diagram) and practice using them.



TEACHING SUGGESTIONS

At each station have the participants work in family groups to investigate the following:

Cross section: Use the sharp snow shovel to cut a smooth slice from the top of the snowpack to the bottom. Clear out the snow on one side of the slice so participants can see the snow profile. With the hand lens, examine crystals from the top, middle and bottom. Sketch at least the surface and bottom crystals. How are they similar? How are they different?

Temperature: At the cross-section, take temperature readings at ground level, half-way up the snowpack, and at the surface, as well as the air temperature. For snow temperatures, push the thermometer in so the bulb is well into the snow and not measuring air temperature. Sketch the snow profile and record the temperatures that were found.

Snow Depth: Use the meter sticks to measure the snow depth at the cross-section as well as in two other sites within the same area. Record the depths.

Snow firmness: Use the pressure foot to get an estimate of the firmness of the snow. Hold it by the can, set it gently on the snow surface, and press down gently and evenly until it breaks through the surface. Record the number of lines showing at the point of breakthrough. The firmer the snow, the more lines will show before the foot breaks through.

Do all of these investigations at the three stations.

Upon returning, discuss the findings, taking one characteristics at a time. For example, consider snow depth at the three sites. What could account for the differences? Then look at temperatures. Is there a relationship between snow depth and temperature at ground level? How might that affect small animals that burrow through the snow? Were the snow crystals the same at the top and bottom of the snow pack? What could account for differences?

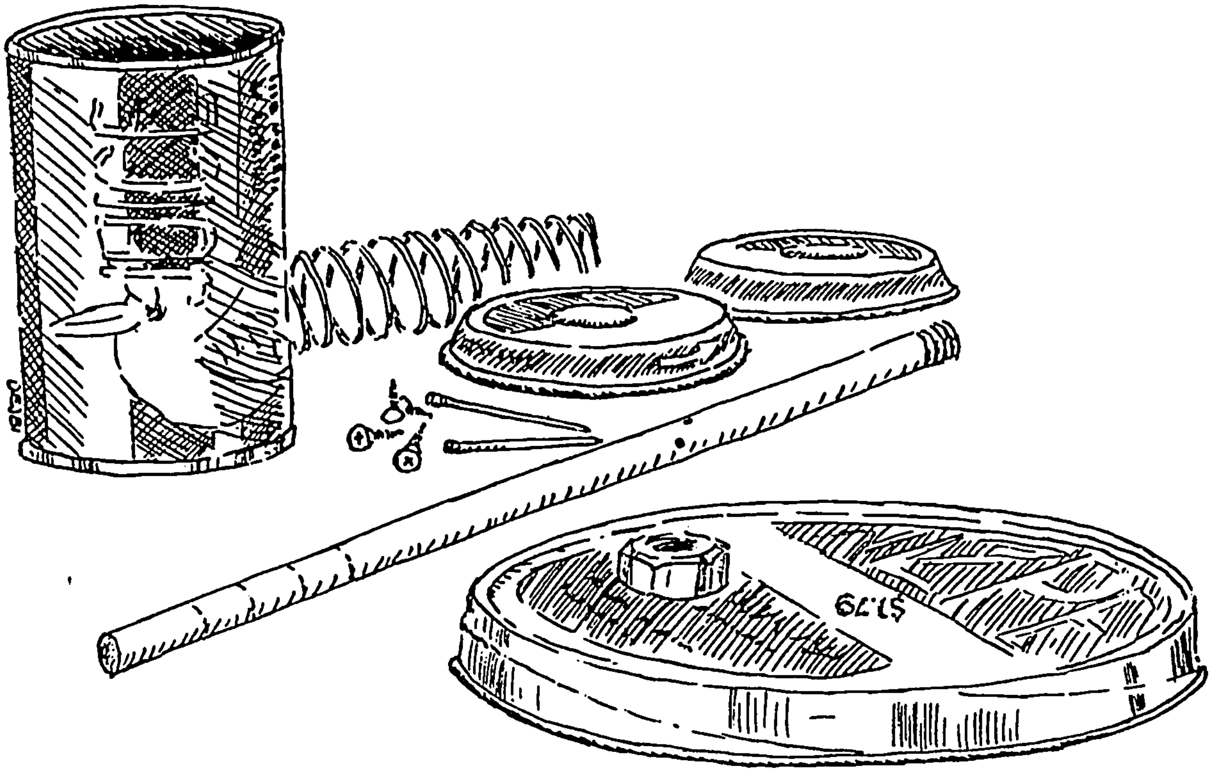
This is a good time to discuss snow metamorphosis. How does snow metamorphosis affect burrowing animals? Did the snow vary in firmness from place to place? Is this related to depth? How might this affect animals that walk on top of the snow as well as those that burrow? What kind of adaptations might an animal have in order to cope with deep snow?

The point of this discussion is not to nail down every aspect of snow ecology, but to help the participants become aware that 1) all snow is not the same, and 2) snow affects animal and plant life.

Participants may also enjoy looking at a chart of names of snow types from different languages. It will quickly become evident that English does not have much snow terminology. On the other hand, Eskimo, Russian and various northern American Indian languages are very rich in terms that precisely describe snow conditions. The class can speculate on why this is so. It is also fun to adopt a few terms to use in class.

DIAGRAM 1

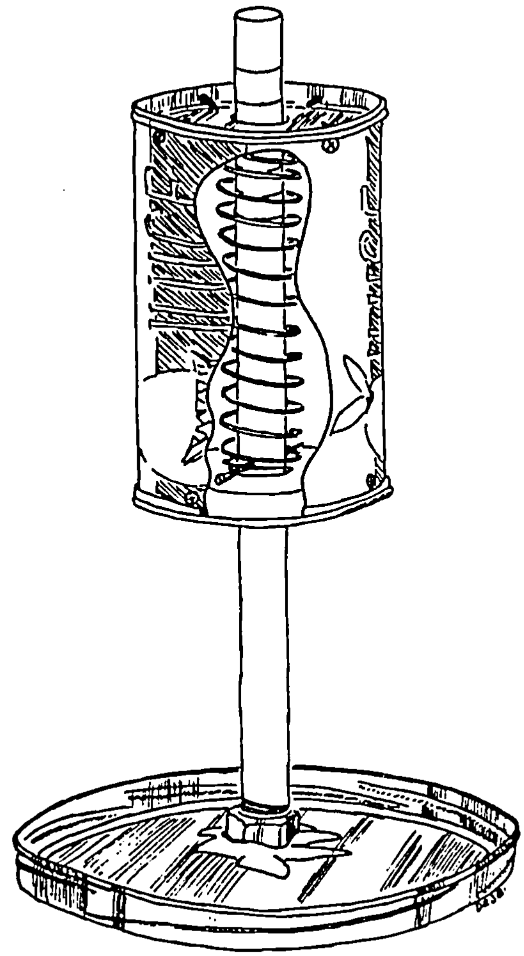
PRESSURE GUAGE PARTS



pressure gauge parts:
1 4oz metal fruit-juice can, both ends removed
1 plastic rod, at least 2 times longer than can, one end threaded to fit 5/16" - 3/8" hex-nut
2 baby food jar lids
1 spring, 5/8" - 3/4" diameter, slightly longer than can
small sheet-metal screws, 3/8" long
1 wire brad (small headed nail) 1¼ "
1 5/16" - 3/8" hex-nut, to fit rod
1 large peanut butter jar lid
epoxy glue
power drill and assortment of bits

DIAGRAM 2

DIRECT.ONS FOR BUILD.NG A SNOW FOOT

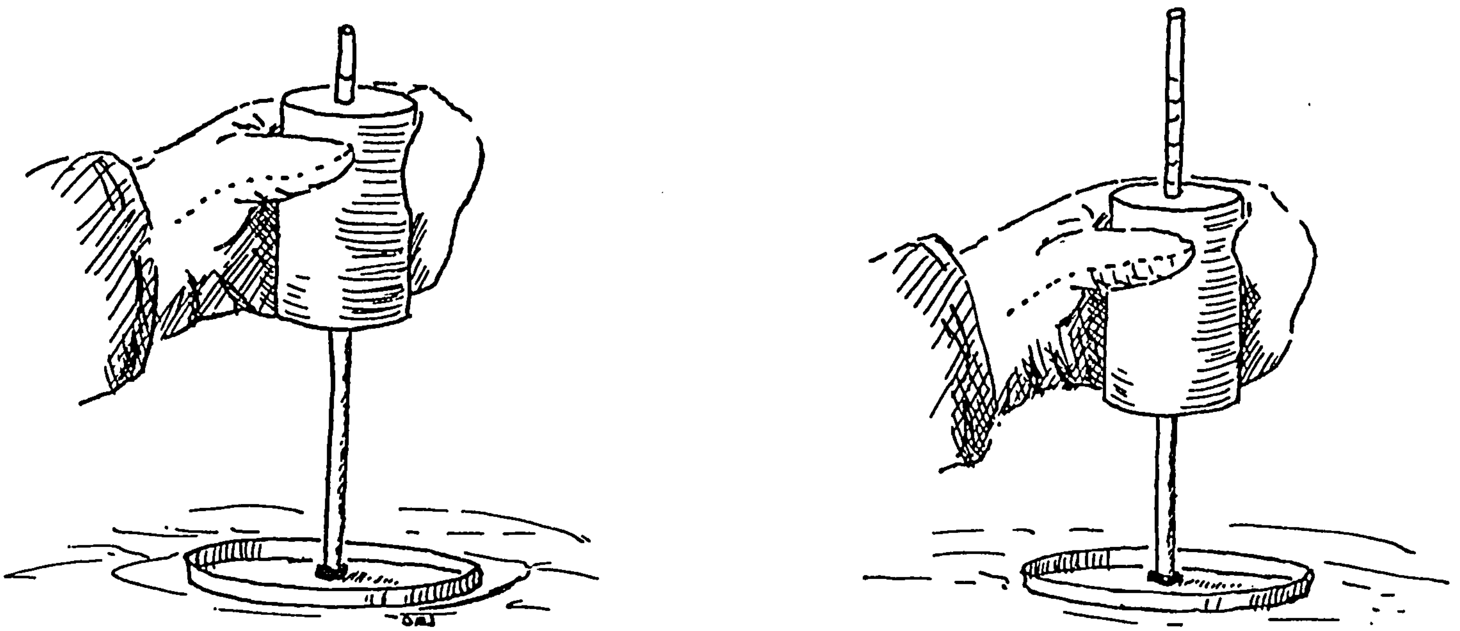


Completed pressure gauge fabrication procedure:

1. Drill holes in centers of baby food jar lids, 1/16" larger than rod
2. Place jar lids in juice can, tops to the inside; locate and drill holes for sheet-metal screws through both can and lids; install screws for one lid only. This will be the bottom.
3. Drill hole in rod for wire brad (the brad is the bottom stop for the spring). Use the can as a guide by sliding the rod through the can so the threaded end points out the bottom hole and the un-threaded end extends about 1" beyond the edge of the can. Mark the rod at the bottom edge of the can. Remove the rod and drill a tiny hole through the rod at the mark. Install and glue the brad so that the ends extend equally on both sides of the rod.
4. Scribe marks on the unthreaded end of the rod at 1/4" intervals for about 2 1/2" - 3".
5. Re-install the rod, threaded end to the bottom, with the brad inside the can.
6. Slide spring over rod inside the can so that it rests on the brad.
7. Install the top lid, compressing the spring if necessary.
8. Glue the hex-nut to the inside center of the peanut butter lid. Be sure to keep glue away from the inside of the nut.
9. After the glue has set, screw the rod into the hex-nut to form the base and the pressure guage is ready to use!

DIAGRAM 3

USING THE SNOW FOOT



1. Place the base of the gauge on the surface of the snow.
2. Grasp the can, and gently and slowly push the can down.
3. Count the number of marks on the rod exposed before the base breaks through the surface crust. The marks indicate the relative density of the snow layer. New, fluffy snow offers little resistance to the gauge so few marks will show before breakthrough. Old snow is denser and resists the push of the spring so several marks may be exposed. Use the gauge to test the density of the snow in different habitats. Use of different sized lids on the base allows exploration of foot size as it effects mobility through snow (smaller feet sink in more!).

BEST COPY AVAILABLE

DIAGRAM 4

from: Pruitt, William O., Jr. 1960. Animals in the Snow." Scientific American 202 (1): 60-68.

ENGLISH	KOBUK VALLEY ESKIMO (ALASKA)	DINDYE (FORT YUKON, ALASKA)	CHIPEWYAN (NORTHERN ALBERTA)
SNOW	ANNIU	ŽA	SIL(CH)
SNOW THAT COLLECTS ON TREES	QALÍ	DÉ-ŽA	DE-CHÉN-KAY-SIL(CH)
SNOW ON THE GROUND	APÍ	NON-KÓT-ZA	SIL'CH-DE-TRÁN
DEPTH HOAR	PUKAK	ŽAI-YA	YATH KIÓNA
WIND-BEATEN SNOW	UPSIK	SETH(CH)	SIL'CH-T'CH RÁN-AL
FLUFFY TAIGA SNOW		THEH-NÍ-ZEE	YATH-THEY-YÉ-REE-LAY
SMOKY SNOW OR DRIFTING SNOW	SÍQÓQ	ZA-HE-ÁH-TREE	NIL-CHI-SEE-NI-KIOTH
SMOOTH SNOW SURFACE OF VERY FINE PARTICLES	SALUMÁ ROAQ		
ROUGH SNOW SURFACE OF LARGE PARTICLES	NATATGÓNAQ		
SUN CRUST	SIQOQTOAQ	ŽA-ES-ICH'A	NA-HÓ-T'CH'IRAN
DRIFT	KIMOAQRUK	ZA-KÉ-AN-É-HAE	YATH-NÉE-ŽUS
SPACE FORMED BETWEEN DRIFT AND OBSTRUCTION CAUSING IT	ANMANA		
SHARPLY ETCHED WIND-ERODED SNOW SURFACE (SASTRUGI OR SKAVLER)	KAIOGLAQ		
IRREGULAR SURFACE CAUSED BY DIFFERENTIAL EROSION OF HARD AND SOFT LAYERS	TUMARINYIQ		
BOWL-SHAPED DEPRESSION IN SNOW AROUND BASE OF TREES	QÁMANIQ	IZHIE-QUÍN-ZEE	DAY-CHEN-YATH-DÓ-DEE
SNOW DEEP ENOUGH TO NEED SNOWSHOES		DET-THO-KI	YATH-THAY-T-R-ÁN-AI CH-HÁ
SPOT BLOWN BARE OF SNOW		SI CHI	CHI-BÉH
AREA OF DEEP SNOW THAT PERSISTS PERHAPS ALL SUMMER		ZA-KAY-TAK-KOK	YATH-THAY-(ÁN)

TERMINOLOGY OF SNOW is enriched by precise words from Eskimo and Indian lan-

dense or thick. The critical hardness, expressed in terms of capacity to bear weight, seems to be around 60 grams per square centimeter. The corresponding specific density ranges upward from 16 per cent of that of water to that of ice (which of course has a density somewhat less than that of water), and the fence-forming depth of snow is about two feet [*see illustration on preceding two pages*]. In the course of a winter the caribou herds may be seen to move about in accord with the shifting of the fences of unsuitable snow.

In contrast to the caribou, the moose is an exemplar of anatomical adaptation. Its long legs reach down through the snow cover to the firm ground beneath and carry its belly well above the surface. When the snow cover attains a thickness of about three feet, however, stilts no longer suffice. At such times the moose packs the snow in trails or "yards." The alternative to the stilt is the snowshoe, and the classic example of this adaptation is the oversize feet of the varying hare (*Lepus americanus*). But wherever the hardness and density of the snow fall below a critical level, the hare too turns to packing the snow to form regular trails and runways.

Temperature as well as snow cover is an important factor determining the behavior of animals in the northern winter. Only the larger mammals—the hare, fox, wolf, lynx and moose—are metabolically able to withstand the extremes of cold and live above the snow surface. Smaller mammals such as shrews, voles and lemmings have such a small body mass with respect to their heat-dissipating body surface (and such comparatively inefficient fur) that their metabolism cannot maintain normal body temperature. Their survival in the subarctic winter climate is made possible only by the behavioral adaptation that causes them to seek shelter under the taiga snow cover.

The snow is such an effective insulator that the temperature of the mossy floor of a mature spruce forest seldom drops below 20 degrees Fahrenheit, even though the air above may fall to 50 and 60 degrees below zero F. In the interior of Alaska I was once unable to detect any temperature change during a period of nine days at a spot in the forest floor under a cover of two and a half feet of snow, even though the air temperature above fluctuated between 24 degrees above and 28 degrees below zero F. Freshly fallen fluffy snow has a

CATCHING SNOWFLAKES

OVERVIEW

In this activity, participants preserve imprints of snowflakes on clear plastic slips. These imprints are permanent and may be examined with a hand lens at leisure. They may also be inserted into slide mounts and projected on a screen. Participants can then classify their snow crystals by comparing them with diagrams of classic types. They can also determine the temperature and humidity of the cloud where the flakes were formed.

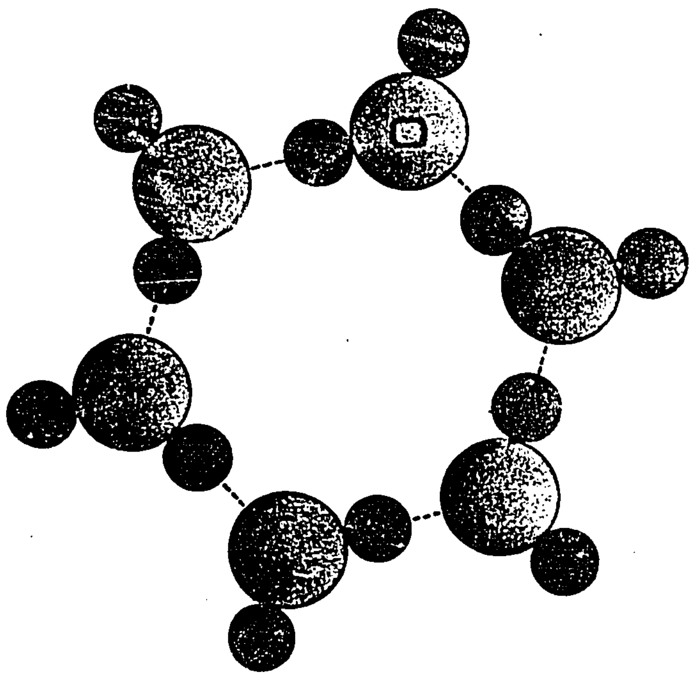
Time estimate: 30 minutes to explain, demonstrate, and practice;
30 minutes wait while lacquer hardens (do other activities)
30 minutes demonstration on mounting, discussion

BACKGROUND INFORMATION

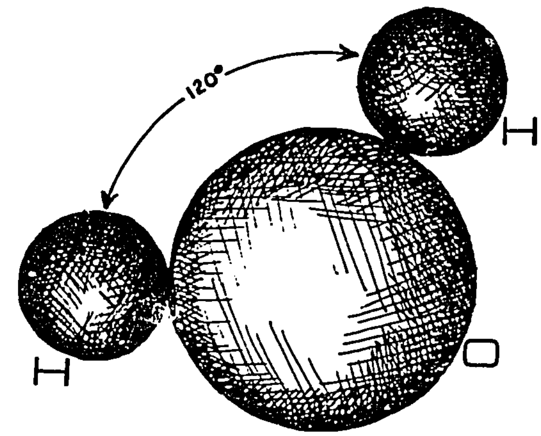
Field Guide to Snow Crystals

Snow is frozen water vapor. Sleet, on the other hand, is frozen rain; the hard pellets of sleet have none of snow's lacy texture. Hail is sleet that has been tossed through very cold clouds where it grows by picking up layers of ice.

Snow cyrstals are usually, but not always, six-sided. The reason for this is the shape of the water molecule itself. Water, with a chemical formula of H_2O, consists of a large oxygen atom flanked by two smaller hydrogen atoms. The hydrogen atoms are usually held at an angle of 120° from each other.



Crystal lattice of water, stable six-molecule pattern results in six-sided crystal structure.



Water molecule, 120° angle between hydrogen atoms.

The oxygen has a negative electrical charge and the hydrogens, a positive charge. The molecule of water is held together by these opposing forces. These forces can also bond two or more water molecules to each other. Because of the angles involved, when water molecules freeze, they usually freeze in a six-membered ring. Because of this tendency, snow crystals usually have at least some elementy of six-sidedness.

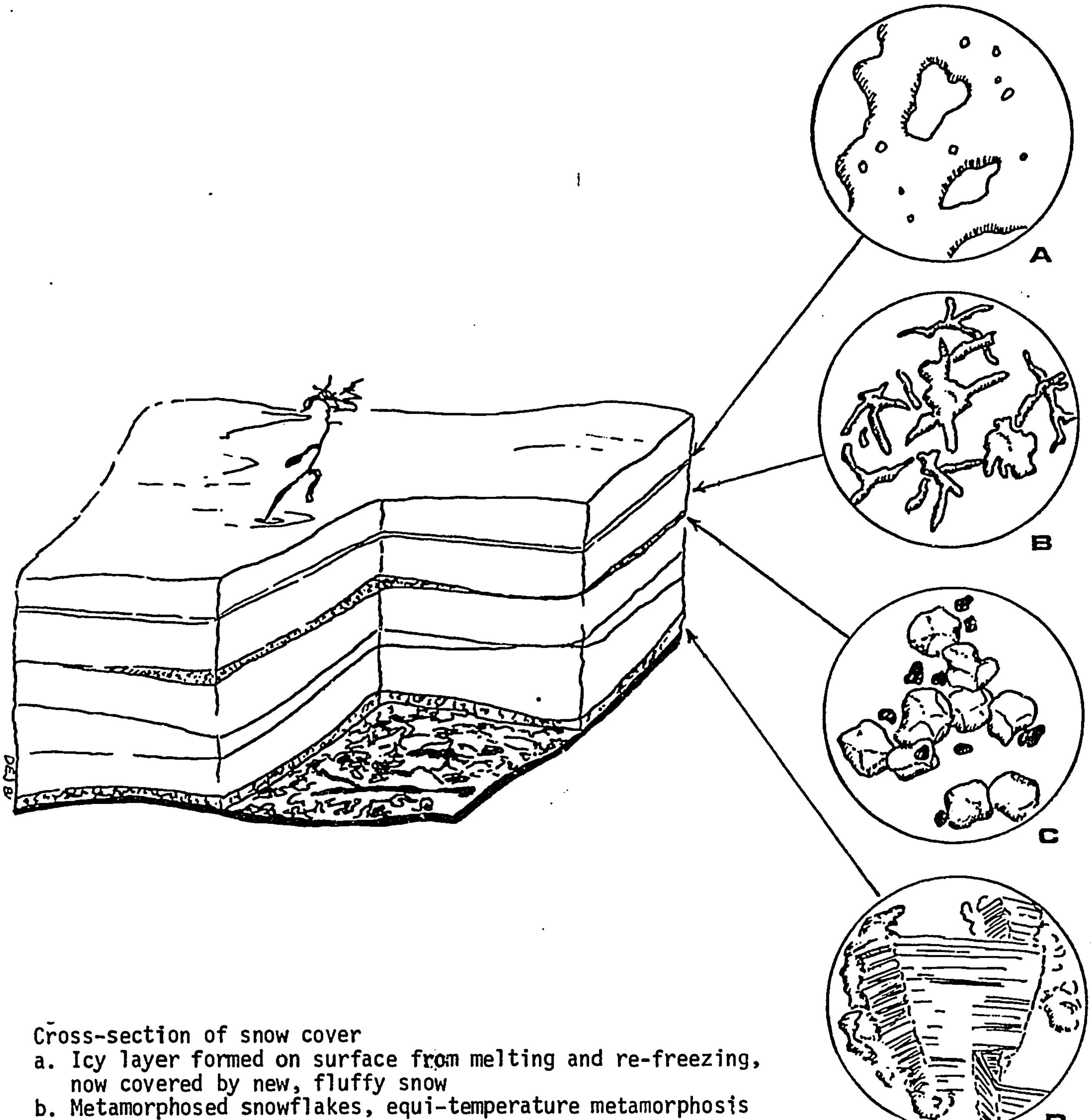
All snow crystals, however, are not six sided stars. They may, for example, be needles, but these needles are usually six-sided in cross-section. In other cases, six sided stars become covered with frost as they fall through humid clouds, obscuring the original star-shape. Then they fall as irregular lumps called "graupel."

Two Japanese scientists, Magono and Lee, have prepared a snowflake classification scheme that includes all the typical snowflake shapes. Magono and Lee have also performed experiments to see why the different flake shapes are formed. They have determined that the temperature and humidity of the cloud in which the flake is formed is what makes the difference. Once you have classified a snowflake, you can look at their chart of temperature and humidity and see what the cloud was like where your snowflake was formed.

Once the snowflake falls, it continues to change. For one thing, buffeting by the wind causes mid-air snowflake crashes that often break arms and fragile points. Even after the crystal hits the ground, it continues to change. For example, the lacy snow crystal will tend to "round off" and get simpler in shape. If you scoop up a handful of "old snow" and look at it with a hand lens, you will usually see rounded pellets. That is because the delicate six-pointed star is a difficult shape to maintain. Molecules on the tips tend to migrate toward the center, thereby rounding off the points and creating a more efficient shape. A technical term for this effect is "equi-temperature metamorphosis" because it is a change that does not require particular termperature gradients.

Often however, the ground will be considerably warmer than the snow surface. In other words, there is a temperature gradient between the warm ground and the cold snow. In this case, snow crystals near the ground may evaporate and the resulting vapor rise through the snow. When the vapor hits a colder snow crystal, the vapor will condense and freeze as frost, or "hoar." You can find these "depth hoar" crystals near the bottom of deep snowpacks and also in the snow on frozen lakes. You can recognize them by the crosswise bands typical of frost crystals. This is called temperature-gradient-metamorphosis.

An effect of this upward migration of water vapor is that a gap may be formed at the interface between the ground and the snow. If you make a trench through deep snow, and brush away the loose snow at the bottom, this gap is easy to see. It will be very delicate; bridged only by lacy crystals. The crystals may collapse at a touch.



Cross-section of snow cover

a. Icy layer formed on surface from melting and re-freezing, now covered by new, fluffy snow
b. Metamorphosed snowflakes, equi-temperature metamorphosis
c. "Snirt" - snow mixed with wind-blown dirt, usually from fall-plowed fields. Shows up as a grey band or dirty drifts.
d. Depth-hoar, temperature-gradient metamorphosis

Skiers may observe the slumping of this layer when they put their weight on the snow. For a moment, the snow will support weight, then abruptly "settle" an inch or two. This does not feel the same as a snow crust collapsing. In mountainous areas, avalanches are often precipitated by small jolts that cause collapse of the depth hoar layer. Depth hoar is also ecologically important for burrowing animals because it is easy to tunnel through.

REFERENCES

LaChapelle, Edward R., 1969. Field Guide to Snow Crystals. University of Washington Press, Seattle and London.

Krik, Ruth, 1978. Snow. Wm. Morrow and Co., NY, NY.

Bruitt, William O., Jr., 1960. "Animals in the Snow," Scientific American, 202(1):60-68.

OBJECTIVE

Participants will be able to:

-match and classify snowflakes.

MATERIALS

For each family:

- -1 homework packet (Catching Snowflakes, data sheet, question sheet, snowflake classification chart, temperature and humidity conditions of snowflake information chart)
- -2 21cm x 29cm (8½" x 11") sheets of medium weight clear acetate, available at office supply stores
- -1 can gloss acrylic spray (e.g., Krylon Crystal Clear, from hobby stores)
- -15 35mm carboard or plastic slide mounts, from photo store

For in-class demonstration and practice:

- -1 extra snowflake catching kit
- -1 grease pencil or china marker
- -household iron
- -1 daily newspaper
- -slide projector

ADVANCE PREPARATION

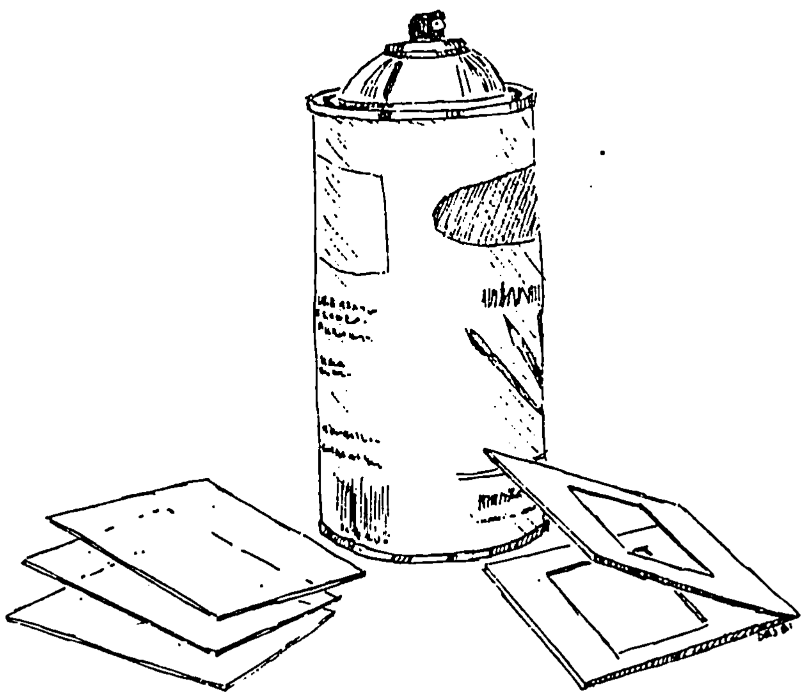
Assemble home activity packets and snowflake catching kits. For catching snowflakes in class, cut one or more sheets of acetate into small rectangular slips, about 2.5cm X 3cm (the exact size is not critical). About 28 slips can be obtained from each sheet of acetate. Use a grease pencil to mark these slips with consecutive numbers (so people can identify their own) and place them in a freezer or outside in the shade. They must be well below freezing. Have a few slide mounts ready for demonstrating mounting, and also chill at least one can of acrylic spray. Catch a few flakes ahead of time and mount them if you want to have more examples to show. It is helpful to have slips and chilled spray handy for every class meeting so you can take advantage of any snowfalls during class.

TEACHING SUGGESTIONS

When catching and preserving snowflakes is first mentioned, most people will be incredulous. Explain that every family will receive a snowflake catching kit. Their home activity will be to make snowflake record of a winter storm, that is, to catch and classify flakes at intervals to see how the flakes are similar or different from each other. We've all heard that no two snowflakes are the same. Is it true? This activity may lend some insight to that saying.

Explain the procedure once , then go outside so everyone can try one. The technique for catching snowflakes can be taught even if it is not snowing.

The general procedure is to spray one side of a frozen acetate slide with chilled acrylic spray. Allow a few flakes to fall on the sprayed surface then protect it from further flakes by putting it in a sheltered spot, or upending a jar or box over it. The slide must remain cold for at least 30 minutes. Then it can be brought inside and examined.



Catching Snowflakes Equipment

You're in luck if it happens to be snowing when you teach this. Otherwise, have everyone scoop up some snow from the ground and examine it closely. Does it look like a collection of snowflakes? Snow undergoes drastic changes once it lands on the ground, so it may not. However, the "old snow" crystals are also interesting and worth preserving. Try tossing some loose snow into the air. If the crystals separate and float down, they can be caught like fresh snowflakes. If the snow is too wet or sticky, small clumps of crystals can be crumbled onto the slides.

Since the slips must remain outside at least a half hour, this is a good time to do outdoor activities like "Determining Wind Chill" or "Snow Field Studies." When these are finished, have the class members pick up their slips on the way in.

Indoors, demonstrate affixing the slip in a slide mount. First select the flakes you want to show, and trim the acetate to just larger than the slide window. To use a cardboard mount, fit the acetate in and then iron the edges of the mount. Plastic slide mounts come with a little plastic wrench used to pry the mount open so the acetate can be slipped into the mount. Label the slide with the time and date of capture. Proejct the slide and show how to use the snowflake classification sheet. Then use the "temperature and humidity conditions of snowflake formation" chart to see what the cloud was like where the flake was formed.

Home Activity: Making a Snowflake Record of a Storm

The purpose of this activity is to become more aware of the variety, beauty and natural history of snowflakes. It might also be the start of an unusual hobby!

The home activity packet should consist of:

- snowflake catching equipment
- Catching Snowflakes direction sheet
- Snowflake record of storm data sheet
- Snow classification chart
- Question sheet
- Temperature and Humidity Conditions of Snowflake Information Chart

HOME ACTIVITY

CATCHING SNOWFLAKES

MATERIALS

-clear, medium weight acetate (available from office supply stores)

-acrylic spray (e.g., Krylon Krystal Klear - available from hobby stores)

Optional

-cardboard box to cover slides

-equipment for projecting slides

-35mm slide mounts (available from photograhic supply stores)

PROCEDURE

Prepare the acetate slips by cutting the acetate into small rectangles (about 2.5cm X 8cm). This is simply to make them convenient to handle. Number the slips with a fine china marker. Store the slips in the freezer; they must be cold when used. The acrylic spray should be stores in the refrigerator (above freezing).

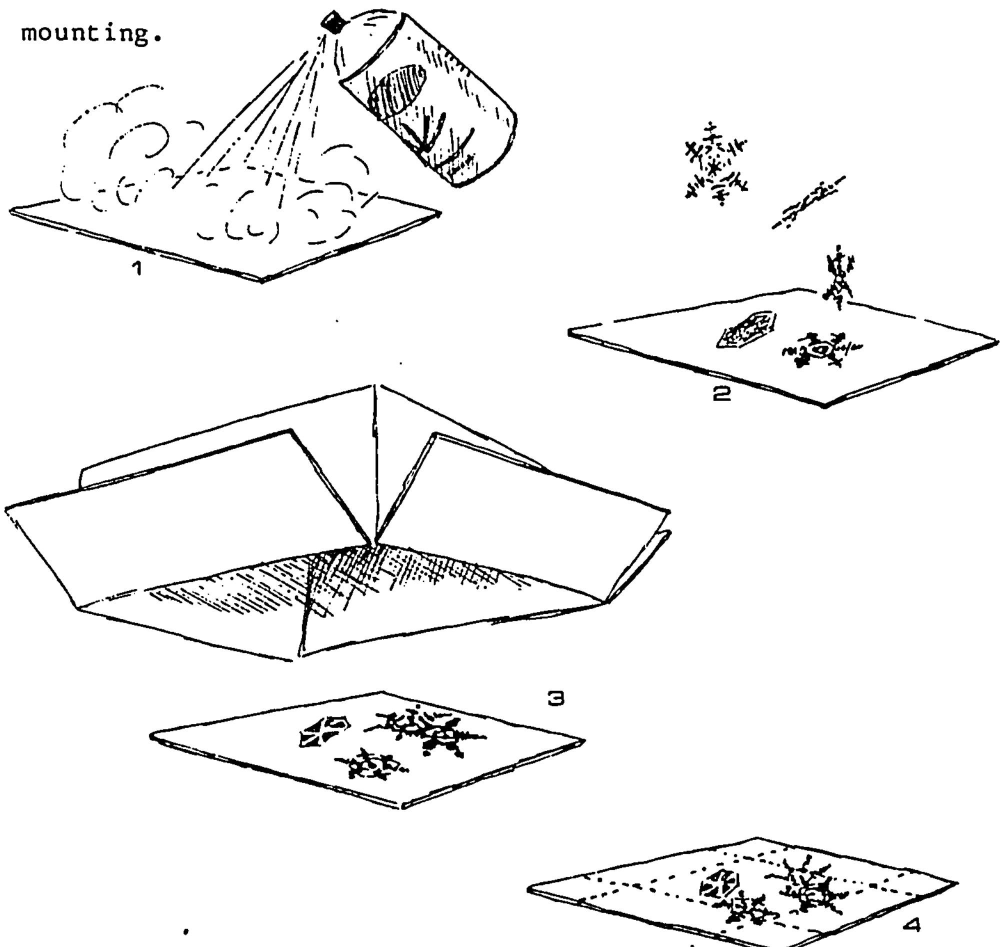
When you want to catch snowflakes, take the slips and spray can outside. Carefully remove one slip at a time, handling it by one corner so it doesn't heat up. Record its number along with the data, time and any other information you wish. Quickly spray one side of the cold slip with a light coating of spray acrylic. Allow a few flakes to fall on the sprayed surface.

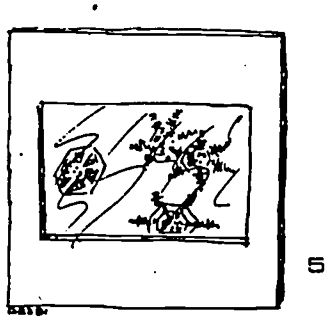
When you have as many flakes as you want, place the slip where it will stay cold but be protected from additional flakes. One way to do this is to place the slip on a cleared outside table and then upend a jar over it. Make sure it doesn't blow away! Leave the slip in the cold for about 30 minutes. Because not all the flakes will turn out, it is a good idea to collect several slips of flakes at once.

After the slips have had time to set up, bring them inside and examine your flakes. They can be viewed with the naked eye, or with a magnifying glass or microscope. They can also be projected on a screen with a slide projector. Store in labeled envelopes.

TO MOUNT SNOWFLAKES AS SLIDES

Purchase slide mounts from photographic supply stores. Either cardboard or plastic mounts can be used. Decide which portion of the acetate slip you would like to project, because the window of a slide is only 25mm X 35mm. Cut out the section of captured snowflakes slightly larger than this to allow for mounting.





Catching snowflakes procedure.
1. Spray cold lacquer.
2. Collect falling snow.
3. Cover until lacquer hardens, about 30 minutes.
4. Trim acetate slips to size of 35 mm film.
5. Mount acetate in cardboard or plastic slide mounts and project "captured" snowflakes.

To use cardboard mounts, insert the acetate between the layers of cardboard and then press the edges with a household iron on medium heat (or follow the directions that come with the slide mounts).

To use plastic mounts, you need a small plastic wrench which is sold with the mounts. Pry the mount open, slide in the acetate and let the mount snap shut.

Record whatever data you wish on the slide mount and project as any other slide.

WHY THIS WORKS

When liquid acrylic ic sprayed on a slip, it sets to form a clear liquid coating. Cold slows this process. If a snowflake falls on this acrylic layer before it sets, it will sink in a little bit just as a foot sinks in mud. The impact of the snowflake produces heat, sometimes enough to melt the flake. But as long as the temperature is a few degrees below freezing, the flake usually survives, lying on the acrylic while it sets.

After the acrylic sets, the slip can be brought indoors. The snowflake will either melt and then evaporate, or sublime. Sublimation is the process of going directly from a solid (ice) to a gas (water vapor). Watch for this when you bring your flakes in; they will disappear right before your eyes!

What you really catch with this process is the footprint of a snowflake, not the flake itself.

TROUBLESHOOTING

Sometimes the flakes are not preserved. Here are some things that might go wrong.

-nothing but water spots on the slide. Possible causes:

*the slip or spray was warm, melting the flakes.
*something warmed the slip after the flakes were caught but before the acrylic set (human breath, direct sun, warm fingers).

*the temperature was close to freezing, and the flakes melted as they hit.
*the acrylic layer was too thick, causing the flakes to melt.
*the slip was brought indoors before the acrylic had a chance to set.

-some, but not all of the flakes preserved, or parts of some flakes preserved. Possible causes:

*the spray coating was uneven leaving bare spots.
*some flakes lended at an angle, so that only part of the flake touched the acrylic.

SNOWFLAKE QUESTIONS

Did you catch more than one type of snowflake during the storm? What kinds?

Can you detect any pattern in the change of types over time? For example, were simple forms followed by complex? Or entire flakes followed by fragments?

Did you ever find more than one type of flake on one slide? If so, what might account for that?

What factors might cause a storm to produce different types of flakes?

Do you think it is true that no two snowflakes are the same? How could you prove your theory?

SNOWFLAKE RECORD OF A STORM

date:

Time:
Air temperature:
Wind speed:
Wind direction:

Slip #:
Sketch, or description:

Time:
Air temperature:
Wind speed:
Wind direction:

Slip #:
Sketch, or description:

Slip #:
Sketch, or description:

Slip #1:
Sketch, or description:

Slip #:
Sketch, or description:

Slip #1:
Sketch, or description:

N1a ...ementary needle		C1f Hollow column		P2b Stellar crystal with sectorlike ends
N1b Bundle of ...ementary needles		C1g Solid thick plate		P2c Dendritic crystal with plates at ends
N1c ...ementary sheath		C1h Thick plate of skeleton form		P2d Dendritic crystal with sectorlike ends
N1d Bundle of ...ementary sheaths		C1i Scroll		P2e Plate with simple extensions
N1e ...ng solid column		C2a Combination of bullets		P2f Plate with sectorlike extensions
N2a Combination of needles		C2b Combination of columns		P2g Plate with dendritic extensions
N2b Combination of sheaths		P1a Hexagonal plate		P3a Two branched crystal
N2c Combination of ...ng solid columns		P1b Crystal with Sectorlike branches		P3b Three branched crystal
C1a Pyramid		P1c Crystal with broad branches		P3c Four branched crystal
C1b Cup		P1d Stellar crystal		P4a Broad branch crystal with 12 branches
C1c Solid bullet		P1e Ordinary dendritic crystal		P4b Dendritic crystal with 12 branches
C1d Hollow bullet		P1f Fernlike crystal		P5 Malformed crystal
C1e Solid column		P2a Stellar crystal with plates at ends		P6a Plate with spatial plates

	P6b Plate with spatial dendrites		CP3d Plate with scrolls at ends		R3c Graupel-like sno... nonrimed exten...
	P6c Stellar crystal with spatial plates		S1 Side planes		R4a Hexagonal gra...
	P6d Stellar crystal with spatial dendrites		S2 Scalelike side planes		R4b Lump graup...
	P7a Radiating assemblage of plates		S3 Combination of side planes, bullets, and columns		R4c Conelike grau...
	P7b Radiating assemblage of dendrites		R1a Rimed needle crystal		I1 Ice particle
	CP1a Column with plates		R1b Rimed columnar crystal		I2 Rimed particl...
	CP1b Column with dendrites		R1c Rimed plate or sector		I3a Broken bran...
	CP1c Multiple capped column		R1d Rimed stellar crystal		I3b Rimed broken b...
	CP2a Bullet with plates		R2a Densely rimed plate or sector		I4 Miscellaneo...
	CP2b Bullet with dendrites		R2b Densely rimed stellar crystal		G1 Minute colum... G2 Germ of skeleton...
	CP3a Stellar crystal with needles		R2c Stellar crystal with rimed spatial branches		G3 Minute hexagona...
	CP3b Stellar crystal with columns		R3a Graupel like snow of hexagonal type		G4 Minute stellar ...
	CP3c Stellar crystal with scrolls at ends		R3b Graupel like snow of lump type		G5 Minute assembl... of plates G6 Irregular ger...

...rological classification of snow crystals according to the scheme of Magono and Lee. This scheme permits much more detailed classification than the Internati... one. It also applies to falling snow

Feature of the Month

JANUARY

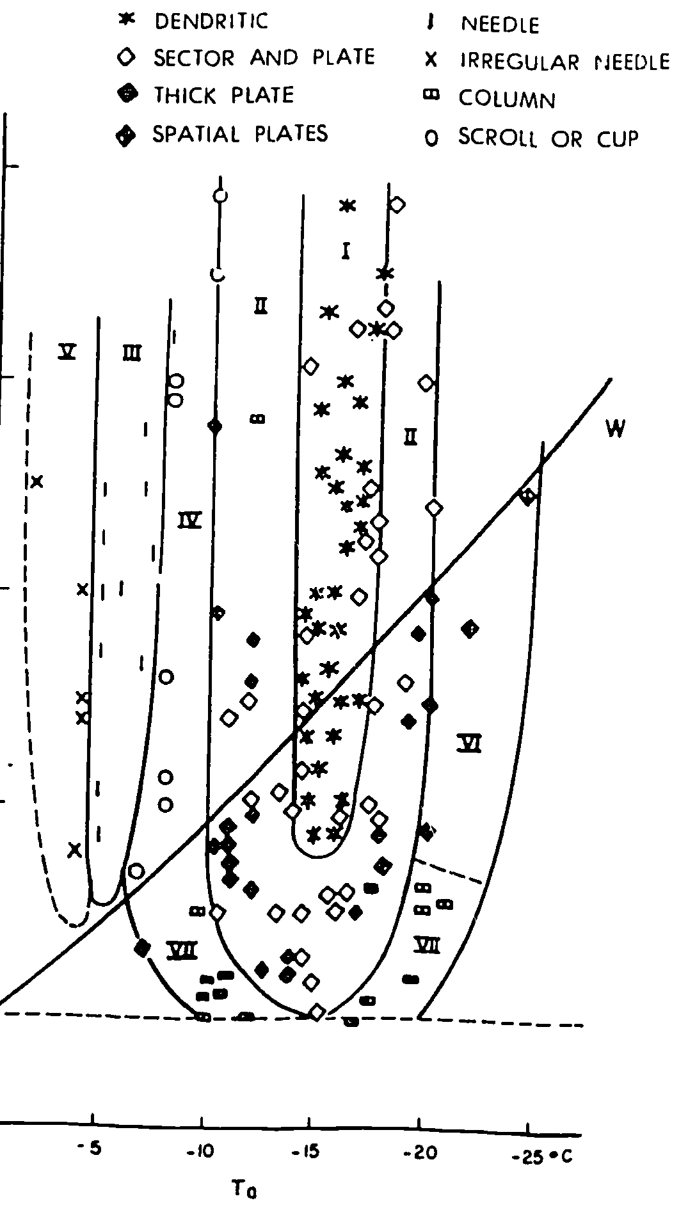
Wind Chill Table

WIND CHILL INDEX
(EQUIVALENT TEMPERATURE) – Equivalent in cooling power on exposed flesh under calm conditions.

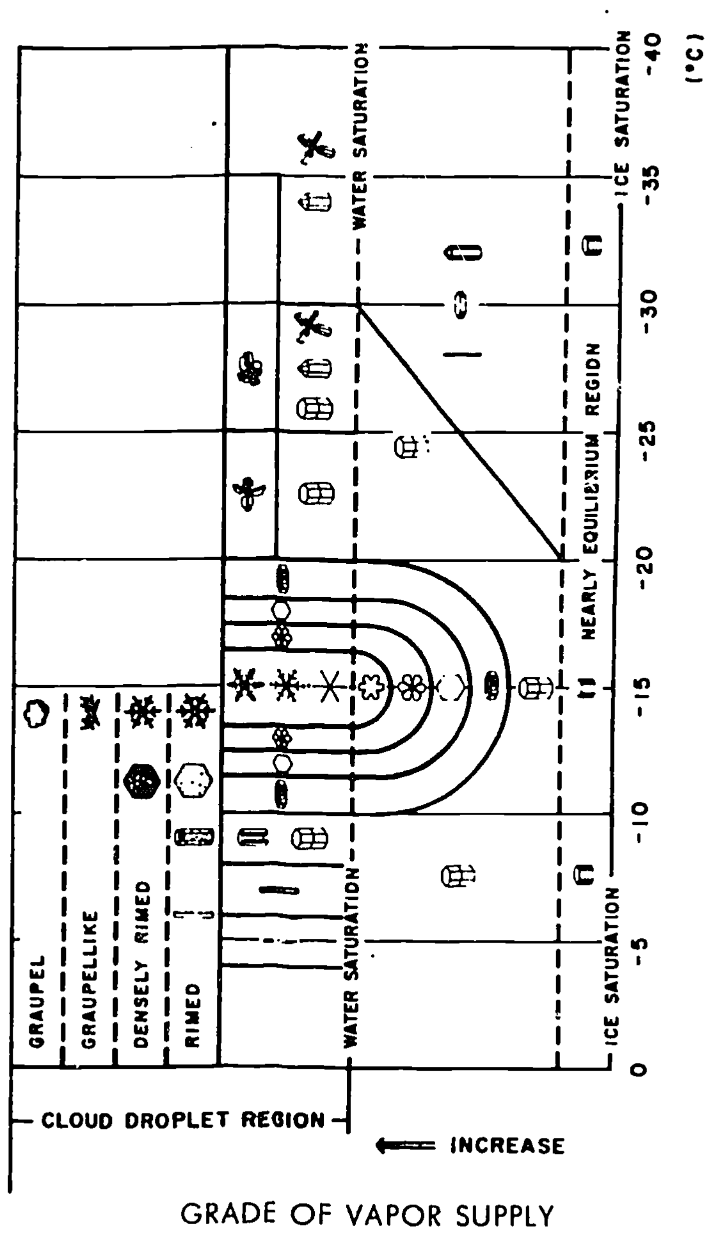
Wind MPH ↓ / Temp. →	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	35	30	25	20	15	10	5	0	5	-10	-15	20	-25	-30	-35	-40	-45
5	33	27	21	16	12	7	1	6	11	15	20	-26	-31	-35	-41	47	-54
10	21	16	9	2	-2	-9	15	-22	27	31	-38	-45	-52	-58	63	70	77
15	16	11	1	-6	-11	-18	-25	33	40	45	-51	-60	-65	-70	-78	-85	-90
20	12	3	-4	-9	-17	-24	32	-40	46	52	-60	-68	-76	-81	-88	-96	-103
25	7	0	-7	15	-22	-29	37	45	52	58	-67	75	-83	-89	-96	-104	-112
30	5	-2	11	-18	-26	-33	41	-49	56	-63	-70	78	-87	-94	-101	-109	-117
35	3	-4	-13	-20	-27	-35	-43	52	60	-67	-72	-83	90	-98	105	-113	-123
40	1	-4	-15	-22	-29	-36	45	-54	62	-69	-76	87	-94	-101	-107	-116	-128
45	1	-6	17	-24	-31	-38	46	54	63	-70	-78	-87	-94	-101	-108	-118	126
50	0	-7	-17	24	-31	-38	47	56	63	70	-79	88	-96	-103	-110	-120	-126

VERY COLD
BITTERLY COLD
EXTREME COLD

Wind speeds greater than 40 mph have little additional chilling effect.



ature—supersaturation diagram showing the conditions of for- ous forms of snow crystals. This is the well-known "Nakaya dia- on observations in the laboratory. W is a line giving the or pressure in respect to supercooled water. (After Nakaya, 1945; permission of Harvard University Press)



3. Temperature and humidity conditions for formation of natural snow crysta in the atmosphere. These co . s are similar to those shown in the Nakay diagram, but are based on ac . observations in snow-forming clouds. (Afte Magono and Lee, 1966; reproduced by permission of the authors)

Reprinted courtesy of the Author

DETERMINING WIND CHILL

OVERVIEW

The concept of wind chill is important to understand in cold climates. In this activity participants learn what wind chill is and how to determine it.

Time estimate: 20 minutes

Companion Activities: Snow Field Studies, Building a Snow House, Catching Snowflakes

OBJECTIVES

Participants will be able to:

measure wind speed and temperature, and then determine wind chill by using a wind chill chart.

MATERIALS

For each family:

- -thermometers
- -wind chill charts
- -hand held wind meter (a fixed wind meter can be used, but it might be less fun)

ADVANCE PREPARATION

None, except to have the materials ready for the first cold windy day.

TEACHING SUGGESTIONS

Although people may not be able to define wind chill, they usually understand it intuitively. Listen to phrases like "Let's go back into the woods - it's too cold and windy out here" or "Boy, it's nasty when the wind blows." That is when the wind meters and thermometers can be pulled out. People seem to get a certain pleasure from reporting to their friends back home how cold it was during class. This is a chance to make it sound really cold!

Each family should take their own measurements. To determine wind chill, you need to know wind speed and air temperature. First get the thermometers adjusting. For air temperature, suspend a thermometer in the air so the sun is not shining on it. Then demonstrate how to use the wind meters. Have people remember or record the wind speed just off the ground, as well as head high. Everyone should have about the same air temperature. For comparison you may want to take more recordings in a sheltered habitat like the woods.

Look at the wind chill charts. One axis will be temperature; the other, wind speed. Where they intersect is the wind chill for those conditions.

Feature of the Month

Wind Chill Table

WIND CHILL INDEX

(EQUIVALENT TEMPERATURE) – Equivalent in cooling power on exposed flesh under calm conditions.

Wind MPH ↓ / Temp. →	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	35	30	25	20	15	10	5	0	5	-10	15	20	25	30	35	-40	-45
5	33	27	21	16	12	7	1	6	11	15	20	26	31	35	41	47	54
10	21	16	9	2	-2	-9	15	22	27	31	-38	-45	-52	-58	63	70	77
15	16	11	1	-6	-11	18	25	33	40	45	51	-60	65	-70	-78	85	90
20	12	3	-4	9	17	24	32	-40	46	52	60	68	-76	-81	88	-96	103
25	7	0	-7	15	22	29	37	45	52	58	67	75	83	-89	-96	-104	112
30	5	-2	11	18	-26	33	41	49	56	63	-70	78	87	-94	-101	-109	117
35	3	4	-13	20	-27	-35	43	52	60	67	-72	83	90	98	105	-113	123
40	1	-4	-15	-22	29	36	45	54	62	-69	76	87	-94	-101	-107	-116	128
45	1	6	17	24	-31	38	46	54	63	70	-78	87	94	-101	108	-118	128
50	0	-7	17	24	-31	38	47	56	63	70	-79	88	96	-103	110	-120	128

VERY COLD — BITTERLY COLD — EXTREME COLD

Wind speeds greater than 40 mph have little additional chilling effect.

Explain to the class that wind chill is an indication of how cold your bare skin <u>feels</u> when it is windy. Emphasize that thermometer still tells the true temperature. You may want to review that a warm object in a cold environment will inevitably lose its heat to the surroundings. This is called heat loss. The wind just increases the rate of your heat loss. Ask - "Can an object sitting out in the cold and wind get colder than the air temperature?" (No). The reason it feels colder to you is that you are chilling faster.

If it is very cold out, you may want to postpone further discussion of wind chill effects until you get indoors.

<u>Discussion questions</u>: Why do you feel warmer in the woods than out in the open? (Less wind). Do you think animals are affected by wind chill? (Yes). How do they avoid wind? (Snow burrows, windproof nests, fur coats with guard hairs, staying in thick vegetation). How can a person avoid wind chilling? (Expose as little skin as possible, stay out of wind, keep wind to the back).

BUILDING A SNOW SHELTER

OVERVIEW

A completed snow shelter is an impressive display of the strength of metamorphosed snow. In this activity, participants will build and use a snow shelter.

TEACHER'S NOTE

There are two different types of snow shelters: igloos, made from blocks, and quinzees or snow caves made by burrowing or cutting into snow. Either type can be made if there is at least a foot of snow on the ground and the temperature is several degrees below freezing.

OBJECTIVES

Participants will be able to:

-study metamorphosis of fallen snow by building a snow shelter.
-use artifacts of various northern cultures, such as snowshoes, skis or snow shelters.

MATERIALS

For quinzees:

-snow shovels (at least one per family)

-broad, light ones

-pushers

-small folding military types (you will need at least one of these for the group)

For igloos:

One per family of each of the following:

-meter stick

-broad snow shovel

-booklet "Building Eskimo Snowhouses"

-snow saw - directions for making these are in the booklet

Optional for either kind of house:

- -scrap carpeting or tarp
- -thermometer
- -humidity tester (wet and dry bulb)

BACKGROUND INFORMATION

Originally, igloos were made in treeless artic regions where fine dry snow is firmly packed by the wind. Occasionally these conditions are duplicated in the northern United States. Usually though, the snow must be specially prepared ahead of time so it is firm enough to cut into blocks. It also takes a bit of practice to make a good igloo.

Quinzees are made by piling up snow, letting it set, and then burrowing into it. This shelter was used by woodland Indians in northern forested areas, where the snow is not usually wind driven, but remains light and fluffy. Quinzees are much easier to make than igloos, and take less time.

Both kinds of snow houses have periods in which only a few people can work at once, so you should have some other activities prepared. One alternative is to make a whole winter camp with a fire and something to cook over it. In trial classes, we invited a dogsledder and his team to show us dogsledding. Other companion activities might be catching snowflakes or animal tracking. It is also recommended to team families so that each 2 or 3 families work together on one house.

ADVANCE PREPARATION

Both of these shelters normally require some snow preparation. This can either be done ahead of time, or during the class itself. If done as a class activity, be sure to get started right away, because the snow will need some time to set.

TEACHING SUGGESTIONS

<u>Preparation for Igloo</u>: To prepare a site for an igloo, snow must be shoveled into a low, flat-topped mound. The mound should be a few meters away from the igloo site. The mound should be about a meter tall, and about 4 meters across. The process of shoveling disturbs the temperabure gradient between the upper and lower layers of snow. This mixing brings warm snow into contact with cold snow where it freezes and "sets." You are not packing the snow, but merely mixing it to speed up metamorphosis.

After the pile of snow has remained undisturbed for 45 mintues at temperatures at least a few degrees below freezing, it will be firm enough to cut into blocks. The mound can also stand overnight. Directions or preparing the stie and making an igloo are found in the booklet "Buildin, [illegible] Snowhouses."

<u>Preparation for Quinzee</u>: The quinzee site is prepared by shoveling snow into a smooth dome about 1½ meters tall and about 3 meters across. After about 45 minutes, it should be firm enough to borrow into.

Burrowing into the snow mound must be done carefully, especially when the snow has not had long to set. For strength, the walls should remain about 30cm thick. To prevent the walls from getting too thin, insert guide sticks from the outside, pushing them in about 30cm. The guide sticks will indicate when to stop shoveling from the inside.

To begin digging, mark the door first. The door should be a low oval. The tendency is to keep chipping away at the top of the door which can weaken the front. At first, only one person can dig, using a small folding pointed shovel. Especially the first people to dig should be wearing snowmobile suits or other snow-proof clothing so they don't get wet.

To save time, and give more people a chance to shovel out the house, make a front and a back door, opposite each other. The person digging uses the shovel to loosen the snow ahead then pushes the loose snow back toward the door. People waiting there can use their hands or shovels to clear the snow away. The best arrangement is like a conveyer system.

As soon as the inside is dug out enough for two people to fit inside, they can work as a team to clear it out very quickly. In trial classes, it took us about 30 minutes to dig out an area large enough for 3 people to sit inside.

After the snow house is built, consider putting down some scrap carpeting so it has a dry floor. Make sure everyone has a chance to sit inside and experience the under-snow conditions.

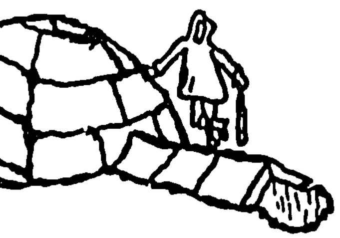
Some things to test: The temperature inside and outside the house, with the house empty versus full of people; the humidity inside and outside; the amount of light inside and outside; and the noise level inside and outside.

Discussion questions: What are the advantages and disadvantages of a house made of snow? How is it similar and how is it different form an animal's snow burrow?

REFERENCE

Smutek, Ray, 1975. "Building Eskimo Snowhouses." Off Relay Reprint Series, 15630 S.E. 124th St.; Renton, Washington., 98055.

BUILDING ESKIMO SNOWHOUSES



r Leopold McClintock was one of the first, if not the first, of polar explorers to point snowhouses are so comfortable that their use would make arctic exploration a simpler, d pleasanter occupation; but he went on to say that unfortunately white men cannot ent. . ."

–Stefansson, 1915
THE FRIENDLY ARCTIC

reasing popularity of winter moun peditions to the arctic ranges, the the classic, Eskimo snowhouse, the ble. We find more and more re- ise—on McKinley, in Greenland, in nter.

able structures have tremendous he typical tent shelter. They're ryer. They offer 100% protection The arctic explorer Stefansson, in that it could be as much as 100 ide of an igloo than outside. When ro outside, the temperature in the 40 below, 0 at the doorway, 20 ed) level, 40 above at shoulder as 60 above near the ceiling.

oo is comfortable enough to raise s precisely what the arctic Eskimos this, explorers like Stefansson and w they could travel faster and far- ice. Peary eventually reached the mped only a few miles from that loo.

g terrain differs little from the s windy, it snows a lot. Just as the the concept to their needs, the apt it to his.

ribed here is best termed "a deep igloo. It assumes a considerable ch permits building down as well echniques, though, are Eskimo in origin, and based on the descriptions first documented by Stefansson. With minor modifications, a similar igloo can be built in areas with much less snow.

Equipment

A snow knife is the only specialized piece of equipment needed. It is used to saw blocks for the actual construction. Several types are available, and have certain common features. The length is most important, since it determines the maximum size of the blocks cut. About twenty inches is optimum. Though less important, the blade should be wide enough to provide bearing area for tilting out snow blocks. About two inches is adequate. Serations, or teeth along one edge are helpful in icy or crusty snow, but are not essential under normal conditions.

A snow shovel is a near essential, in that it greatly simplifies certain phases of the construction. But an igloo can be built without one. A ski or snowshoe is useable, though less efficient substitute.

Some thought should be given to keeping dry during the construction. In digging the entrance way, cutting and handling blocks, and packing snow in gaps, you cannot help but get thoroughly snow covered. A shell parcha and wind pants, or equivalent rain gear, shed this snow better than a sweater or down jacket. The hands are particularly vulnerable. One solution is a large pair of rubber gloves with wool inner gloves. The hands will still get wet from perspiration, but the cold, snow water is kept out. Another approach is a totally breathable, non-absorbent mitt, such as the Helly-Hansen pol Vott and the M.S.R. modification of this mitten.

Snow Conditions and Preparation

An experienced igloo builder can build a snow house with any kind of snow. Good snow just makes it easier and faster.

The ideal snow is windpack. If your boot leaves only a slight imprint, no further preparation is needed. Just start cutting.

Most of the time, however, the snow is deep and loose, a seemingly impossible construction medium. But even in waist deep snow, an igloo is possible provided certain preliminary steps are taken.

Tramp down an area somewhat larger than the intended snow house, first wearing skis or snowshoes, then on foot. Finish up by tramping it down and smoothing it with the back of a snow shovel. The top few inches may not consolidate and may remain a powdery, granular mush. Don't worry about it, you will discard it later. The good snow is down below.

After the consolidation step, allow the reworked snow to set. In about twenty minutes, new bonds form between the snow particles, and the mass becomes quite cohesive. Depending on the snow conditions, temperature, etc., the top layer may or may not be useable. But the deeper you go, the better and more cohesive the snow will be.

If the snow is particularly poor, it's a good idea to prepare two areas. One serves as the building site, the other as a source of blocks. If a secondary source is used, parallel it with a trench so that you can cut the blocks out more easily.

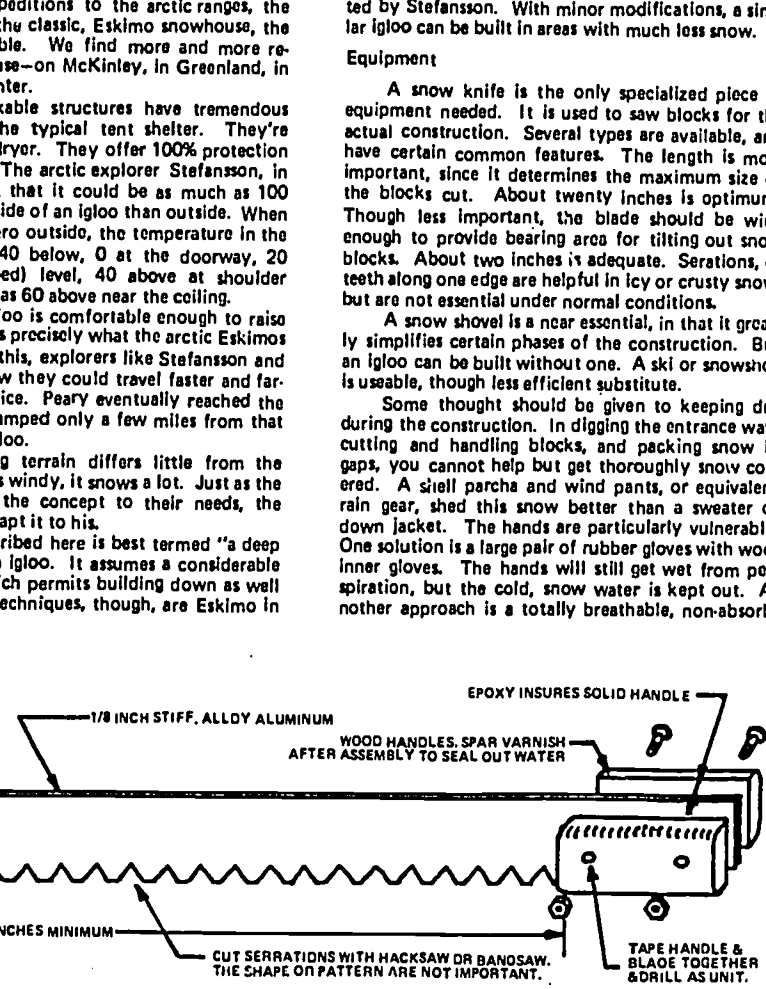
Once a site is selected and, if necessary, prepared, don't walk on it. Your body weight will cause hidden cracks in the consolidated area and the blocks will mysteriously part as you cut them free.

Site Selection and Layout

Contrary to popular opinion, the site need not be level. Igloos can be built into the side of a hill, with the excavated area providing the building blocks. But this is a bit tricky for a beginner. A level, or near level site is recommended as a starter.

First lay out the circle. About six feet is ideal: ten feet is a practical limit. The finished igloo will have an inside floor space about two feet larger, since you cut down and out as you build.

At the same time, lay out the entrance corridor. It should be located at right angles to the prevailing storm winds. If it faces the wind, a storm would pack



SNOWSAWS CAN BE HOMEMADE (LEFT), PURCHASED COMMERCIALLY (ABOVE RIGHT), OR IMPROVISED FROM OTHER TOOLS (BELOW RIGHT).

A – SMC. B – MSR. C – ARMY SURPLUS MACHETTE. D – IMPORTED FOLDING SAW.

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19

OOS CAN BE BUILT FROM
MPOSSIBLE SNOW, BY
A SOURCE OF BLOCKS.

TINO SNOW BLOCKS
TE SHOWN ABOVE,
ARATION".

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f all the houses (igloos) was that
ts longest diameter the floor was
The highest point of the central
ly ten or eleven feet from the
two bed platforms each ten or
the front and eight feet wide. A
reception was held for us in this
visitors, family, and intimate
anese fashion on the bed plat-
oom for about seventy-five peo-
ly packed on the floor space in
narvel to me that a hundred peo-
der one snowhouse roof.

—Stefansson, 1916
THE FRIENDLY ARCTIC

it with snow. If it were in the lee of the wind, it would drift over. At 90 degrees to the wind, falling snow is blown free.

Cut Your Way In

Start by digging a hole where the tunnel entrance will be. Go down two blocks in depth, about 40 inches. Then cut your way into the igloo circle, setting the blocks aside. If the snow is particularly poor, the top layer of blocks may not be useable. Don't panic. The layer below will be better, and the layer below that still better.

Cutting the blocks is one of the two tricky aspects of igloo building. Simple as pie if done correctly, a disaster if not. The key is to truly cut the block free, and not to pry on it, or try to break it free.

Begin by making the long vertical cut. Use a sawing motion, and do not force the knife. Once inside the igloo circle, this cut may be several blocks long. It's best to go through several times to make sure the cut is a full blade deep.

Next make the two, short axis, vertical cuts. But use your hand as a depth stop. If you go in too far and nick the next row, blocks cut from it will break at the nick. These two cuts should taper outward very slightly, so that the block will tilt out without catching on the edges.

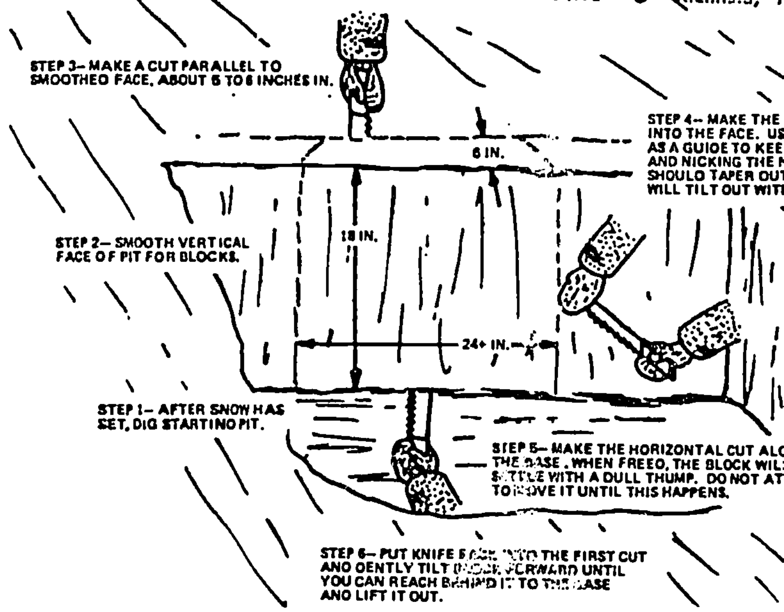
The final cut frees the bottom edge. If everything has been done properly, the block will settle with a dull "thump," as it comes free. No thump means that somewhere the cut is incomplete. Trying to pry the block out will only break it. Recut all edges.

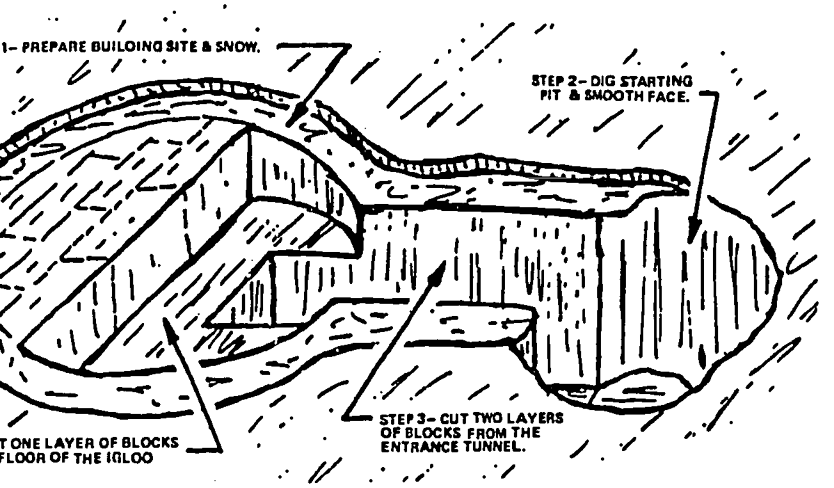
Place the knife back into the first vertical cut, and tilt the block towards you. Then reach in, curl your fingers around the bottom, and lift it out.

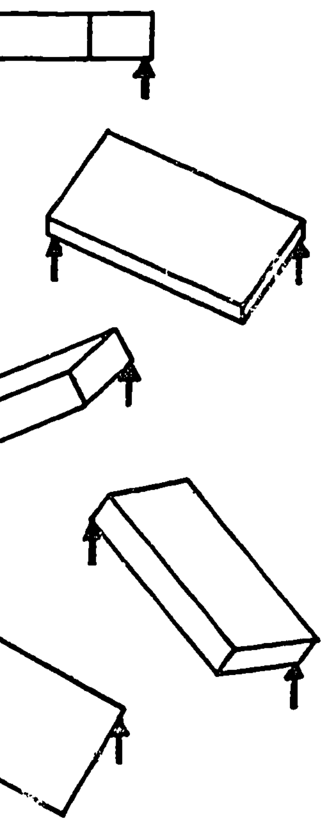
A common mistake made by beginners is to cut the blocks too small. They should be as large as you can lift. Large blocks simplify the construction of the house.

WOOD LAKE NATURE INTERPR

735 Lake Shore Drive ○ Richfield,







NCIPLE—A RECTANGULAR BLOCK CAN BE ANY POSITION BY SUPPORTING IT AT ONLY THE DIAGONALLY OPPOSITE CORNERS.

Also, to judge whether a block is firm enough to use, hold it horizontally, supporting it along the edges only. If they break, go deeper.

Starting to Build

Construction begins with the largest block, which is used to span the entrance tunnel. Tilt it inward, using another block as a temporary support if necessary. Right-handed persons then build to the left (counter-clockwise); left-handed persons build to the right (clockwise). In this way, the odd hand is in a position to hold the new block, while the strong hand wields the snow saw and trims the joint.

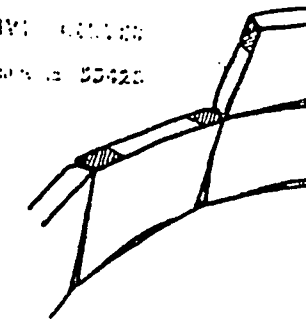
The placement of the block is the other tricky aspect of snowhouse construction. But it too is simplicity personified once you understand the basic principle, which is: a block can be held in any position, including horizontal, by supporting it by two diagonally opposite corners. A third point of support will eliminate any tendency to rotate. These principles are put into effect by using a standard, block placement procedure, which applies no matter what tier and no matter how tilted the block.

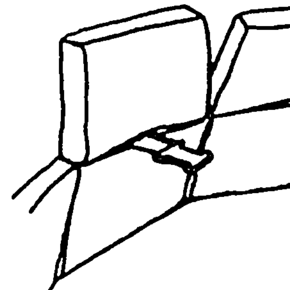
First of all, stand the block vertically with its base in the proper position. The block should still be rectangular, as cut. The shaping comes later. It's also important that the block be placed vertically, no matter what the tilt of the adjacent block you're fitting it to. Insert the knife in the base seam and whittle away until *the weight of the block rests only on two small patches at each end.* Then tilt the block forward and whittle away at the vertical edge. Tilt some more and whittle some more, until finally, the block fits into place, *contacting the adjacent block only at a small patch near its outermost corner.* Nudge it into the adjacent block with a slap on the other edge; than give the upper edge a thump to set it firmly.

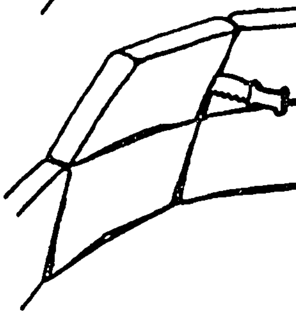
The weight of the block is now supported by the diagonally opposite corners, while the third point of support prevents rotation.

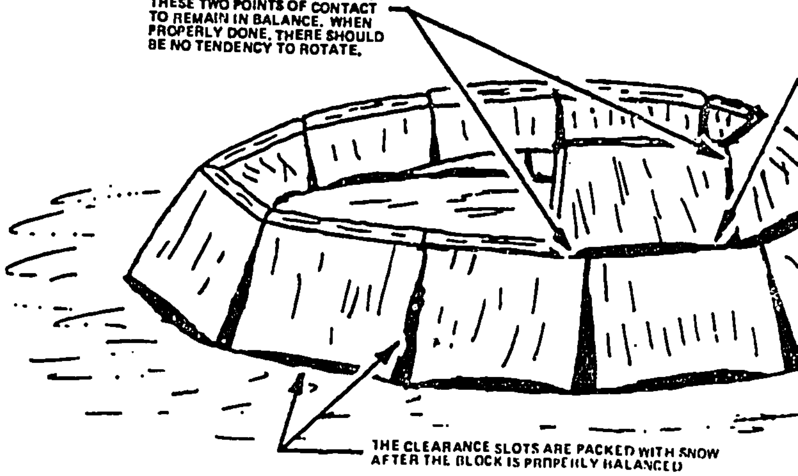
"There are no Eskimos in the Antartic whom we could hire, as Peary did, to make snowhouses for us."

–Shackleton, 1909







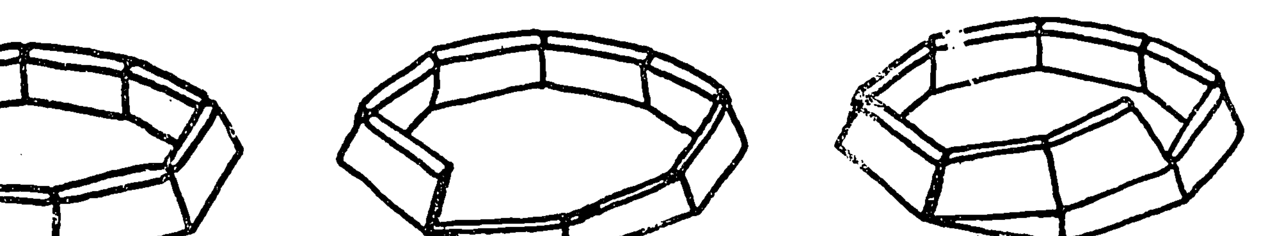


ABOVE – THE FIRST BLOCK SPANS THE ENTRANCE TRENCH. SUBSEQUENT BLOCKS SPIRAL UPWARD. NOTE THE OBVIOUS THREE POINT CONTACT.

*of the houses were single domes, but others were constructed by building two
es so that they intersected, and then cutting out the intervening walls. Whether
nsisted of one, two, or three domes, there was usually but one entrance. This
an alley-way, in some cases six or seven feet high, and varying in length from
nty feet. But the door by which one entered from the alley-way into the house
lways so low you had to go in on hands and knees, and the upper edge of the
w inches lower than the top of the bed platform when you came in.*

–Stefansson, 1916
THE FRIENDLY ARCTIC

BELOW – AFTER COMPLETING THE FIRST CIRCLE, ESTABLISH A SPIRAL BY TAPERING TWO OR THREE BLOCKS.



Onward and Upward

Building the first tier is no problem, but once it's completed, there is no longer an "adjacent" block to fit to. Starting a new row is not practical, since the blocks now need about a forty-five degree lean.

The solution is simple, and permanent in that it not only solves the problem for this tier, but also for subsequent tiers. *The top edge of the blocks are shaved to establish a spiral.*

This is not a geometrically perfect spiral. It need not extend around the full circle. A short ramp, using one-quarter to one-third of the circumference will suffice. It merely provides a means of starting the next row. To make life simple, cut the spiral in a sector which will result in no downhill sweep. It is very difficult to set blocks downhill.

Once the spiral is established, construction procedes uninterrupted. Two more tiers, and only a small, irregular opening remains at the apex of the igloo. Most people think closing the dome will be difficult. They equate this top block with the keystone of an arch or vault. Actually, it's the easiest block to place, and structurally not very significant. The snowhouse built so far is quite solid without it.

*"Of these huts, built entirely c
add that they were all lighted by a
of clear ice fixed about half way up
side of the roof.*

–Jc
A SECOND VOYAGI
OF A NORTH-WE

To close the hole, cut a slightly
Tilt it on edge to pass it out through
drop it into place. As you lower it, t
fit.

The job is finished by going outs
snow into all the open joints.

The Entranceway

The classical tunnel entrance is
except during a storm. Its purpose is
snow out of the entrance crawlway.

The simplest approach is to d
trench deeper, and roof it over wi
"A-frame" fashion. Wider entrance
three block "arch."

If strong winds are anticipated,
ment is essential. Coarse, windblow
pellet will erode the walls of a sno
a long, winter storm, they can cut cor
the blocks. A low wall, a couple of
ward, eliminates the problem. It sh
and though it will eventually erode, e
have drifted in behind it to protect th

The Living Quarters

When the shell is done, some
work is necessary. For the most par
ing out the construction debris, smo
and widening the bed platform.

There are two basic sleeping ar
most common interior is all bed plat
the small hole leading down under th
and into the tunnel. This allows max
of floor space, but getting in and ou
lem, particularly if the entrance tre
enough! In the other arrangement, t
platforms on either side of an ex
trench. There's room for sleepi
pants can sit in "chair" fas
very cold feet. Getting in and out i
trench is a good place for packs and o

With this type of deep snow i
is no problem. Since the entrancew
the bed platform, it can be left open

*". . . I crept through a winc
that I went on all fours and kn
against wet and wriggling hairy b
dogs. They had taken shelter in
against the greater cold outside.
would they have stirred out of n
and among them I crawled until I
igloo."*

"When they leave the iglo
voyage, the last thing the trave
themselves, using it as a comfor
—Pete
BOOK C

LEFT – CONTRARY TO POPULA
FINAL BLOCKS ARE THE EASIE

BELOW – CUTAWAY VIEW OF A
DOME SHAPE. NOTICE THAT TH
BEGINS WITH THE FIRST TIER C

out loss of heat. But if a stove is used, an upper vent is essential. Stoves use up oxygen at a high rate and all produce carbon monoxide to some degree. Monoxide is lighter than air, and will accumulate in the igloo, rather than flow out the door. Cut a small vent, a few inches in diameter, somewhere in the upper third of the dome. If it gets too cold later, it can be partially closed with a mitten.

During the day, plenty of light diffuses through the snow. At night a single candle provides enough light for most chores. With two, you can read a book.

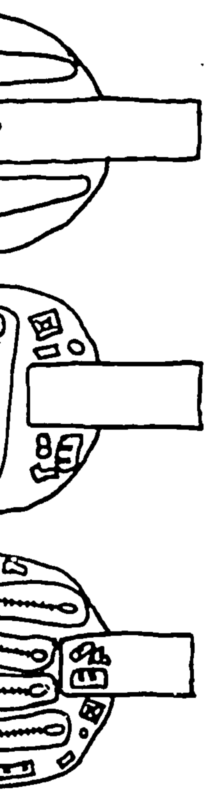
Variations on the Theme

While the igloo is the classic snowhouse, it is by no means the only one applicable to mountaineering. The trench house, for example, can provide a quick emergency shelter for two. And it is a house which is easier to build on a hillside than on the flat.

In essence, the trench house is an igloo entrance tunnel without the igloo. A trench is started by digging, then extended by cutting blocks. The trench is then roofed over with the blocks cut, starting on the downhill side. By making the initial trench narrow, a simple, two block "A-frame" roof will suffice. Later, when it's closed over and you're out of the storm, you can widen it out, snow-cave fashion.

"As for the house (expedition winter quarters), they (the eskimos) were interested to see how the pieces were fastened together with iron nails, but they had not been with us many hours before they began to comment to each other on how damp it was and how skin clothing would spoil if kept in such a house.

—Stefansson, 1916
THE FRIENDLY ARCTIC



IGLOO FLOOR PLANS

LOU ANOERSON

LEFT – ROOFING THE ENTRANCE TUNNEL.

RIGHT – THE NEXT MORNING, IGLOOS HAVE BECOME UNBELIEVABLY STRONG. FIVE PERSONS ARE STANDING ON TOP OF THIS ONE.

BELOW – IGLOO CLUTTER.

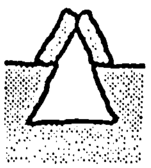
THE IGLOO TROUBLE SHOOTER

Blocks break during handling: Did not prepare block site. Walked on block site causing hidden cracks. Nicked block when cutting previous row. Hoarfrost layer in snow (discard upper half and go deeper). Pried instead of cut blocks free.

Blocks fall down when placed: Flat spot in circle (blocks can only be set in a curving wall). Too large a circle (effectively a flat spot). Improper points of contact (blocks not in balance and rotate out). Previous block improperly placed (it falls out). Previous block not welded (wait a few minutes between blocks). Blocks are too small (use largest blocks you can handle).

Snow not deep enough: Cut blocks from another site (a snowdrift) instead of the floor. Use a moveable block at the door instead of a crawlway (but don't forget to ventilate. In shallow snow, cut blocks horizontally instead of vertically.

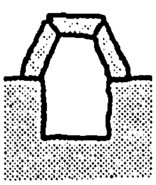
Some suggestions: Blocks which sit a while before use gain strength. Pack the gaps formed by each block as soon as it is properly placed. The delay allows time for welding and the packing strengthens the bond between blocks. Begin the inward lean with the very first row. The lean tightens the radius and makes placement easier. It also insures a dome rather than a cone shape. Cone shaped igloos take longer to build, require more blocks, and are not as stable. Cone shaped igloos often cannot be completed, because the ceiling gets too high to work on.



THE SIMPLEST AND FASTEST SNOW SHELTER IS A ROOFED OVER TRENCH. THEY CAN EVEN BE BUILT ON A HILLSIDE.

FOR THE COMPLEAT IGLOO D

igloo:	an Eskimo snow h
igloopac:	a large igloo, called used for meetings.
torsho:	the entrance cor igloo.
katak:	the entrance door.
kringak:	the smoke and ven
taglu:	snowshoes
krepik:	sleeping bag (deersk
ncke angiyuk:	literally "the big l near the entrance and fish are kept age.
katta:	cooking pot
unaikto:	"it is cold," similar to our "nice day."
pollak pack tutin:	"have you come igloo?"
kammakto:	daybreak, dawn.
akrale!:	mild expletive suit when igloo being collapses domino-st

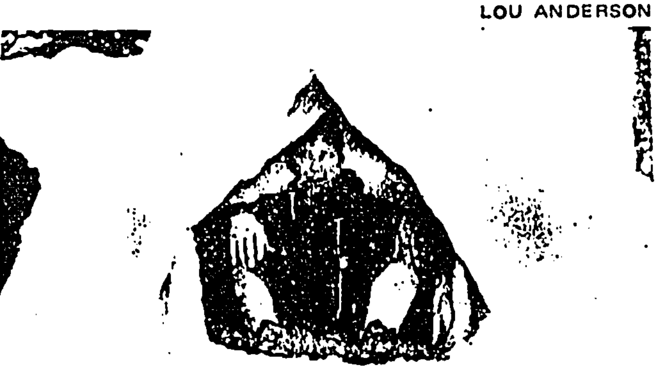


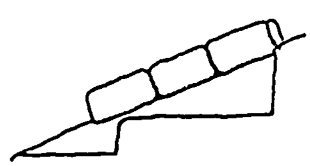
"If it is anticipated that an igloo will have to be used for a longer period, it can be secured in the following manner: The man fights a fire inside it. He closes the hole in the ceiling, leaves the igloo and walls up the entrance. As the heat builds up inside, the walls melt, and the water from them is absorbed by the porous snow. Then the igloo is opened again, the fire is put out, and the full cold of the outside is let in. The watery walls freeze to almost solid ice that can withstand any gale."

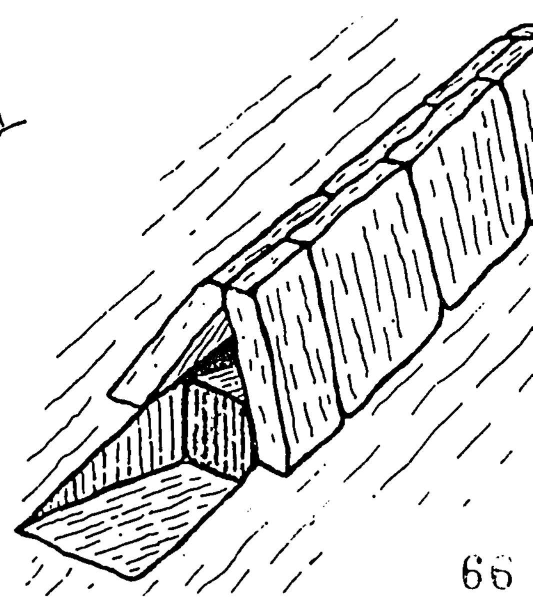
—*Peter Freuchen, ca1920*
BOOK OF THE ESKIMOS

LOU ANDERSON

LOU ANDERSON







SNOWSHOEING/SKIING

OVERVIEW

Participants use skis or snowshoes to travel over the snow. As well as practicing a skill, they should discuss the use of skis and snowshoes doing activities.

Companion activities: Animal tracking, snow studies, or other activities that do not require carrying too much equipment.

TEACHER'S NOTE

Most participants enjoy using skis or snowshoes. They would probably be happy just "playing" with them the whole class period. But considering time constraints, you will probably want to combine the use of skis or snowshoes with other activities. Scheduling this activity can be tricky; the snow conditions must be suitable for these conveyances to work well.

OBJECTIVE

Participants will be able to:

-use artifacts of various northern cultures such as skis, snowshoes, dogsleds or snow shelters.

MATERIALS

This activity assumes that you can provide equipment for the group. Chances are good that several of the participants already have such equipment, but many will not. It is best if the entire group uses either skis or snowshoes so that the pace will be similar. Skis and snowshoes are often available free or at low cost from nature centers.

ADVANCE PREPARATION

Make arrangements to use skis or snowshoes. If you are using them on an area other than your own, make sure you know trail policies.

TEACHING SUGGESTIONS

Show an example of a snowshoe and a ski and ask in what ways they are similar and different. Does anyone know what cultures developed them? (Skis are Northern European; snowshoes are North American Indian.) For historical background, see references at the end of the activity.

If you have access to examples of different types of skis or snowshoes, show these to the class. Ask in what ways they differ from each other. For what snow and vegetation conditions might each be most suitable? Be sure to note overall shape, surface area, upturn of the toe, and in the case of snowshoes, webbing fineness and presence or absence of a tail. This can be tied in directly to snow field studies as follows

> Concerning showshoes, North American Indians developed developed distinctly different types according to the snow characteristics of their region. For example, the bear paw style was used by Indians of the northwestern US and Canada where snow is deep and often dense because of alternate freezing and thawing. The northeast is also characterized by thick forests and brush, where a long snowshoe would be an encumbrance.
>
> On the other hand, the long almost ski-like design of the Alaskan (or pickerel or Yukon or train) snowshoe was used by more western Indians moving in open areas with firmer snow and less brush. The common Michigan style is a compromise between the two extremes.

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On the other hand, the long almost ski-like design of the Alaskan (or pickerel or Yukon or trail) snowshoe was used by more western Indians moving in open areas with firmer snow and less brush. The common Michigan style is a compromise between the two extremes.

After discussion, put on equipment, teaming up families so they can help each other. Give simple instructions for use. Explain that flashy technique is not important today; this is just another way of enjoying winter and getting efficiently from place to place.

If you have deep snow, the class may enjoy a "race" between a person on snowshoes and one on foot. After the race, ask: How far does each sink in? Why do snowshoes hold you up in the snow? Are there winter-active animals whose large feet also function as snowshoes? (lynx, wolf, snowshoe hare) Are there winter-active animals with small feet in proportion to their body size? (Deer, moose) How do they get through deep snow? (Wade or bound through it; their long legs hold their bodies above the snow) Consider a deer being chased by a wolf. If the snow was extremely deep, which do you think would have the advantage? (The wolf with its "snowshoes") If the snow was shallow, which might have the advantage? (The deer with longer legs)

REFERENCES

Osgood, William and Leslie Hurley, 1975 (second ed.). The Snowshoe Book. Stephen Green Press, Bratticboro, VT.

DOGSLEDDING

OVERVIEW

Participants ride on a dogsled and discuss the use of sleds by Eskimos and other northern people.

Time estimate: at least 1½ hours, although more time could easily be used. You may want to combine dogsledding with other activities so the dogs get a chance to rest and also so that people not riding have something to do.

Companion activities: building a snow shelter
skiing/snowshoeing
animal tracking
or just for fun, a winter picnic!

TEACHER'S NOTE

This is a very enjoyable activity if you can find a dogsledder willing to help you out. Sledders may be located by calling nature centers, state departments of natural resources, chambers of commerce, etc. Sledders may often have their own organizations and newsletters in which you can advertise. Considering the cost of keeping and transporting dogs, expect to pay for the program!

OBJECTIVES

Participants will be able to:

-describe adaptions of winter-active birds and mammals.
-use artifacts of various northern cultures, such as skis, snowshoes, dogsleds or snow shelters.

MATERIALS

Non other than the dogsledder's equipment.

ADVANCE PREPARATION

The search for a dogsledder willing to do a public program may take a while, so start early and make your arrangements well ahead of time. Discuss the family nature of your group with the sledder. Also discuss the class interest in the adaptations of the dogs to snow and cold, as well as the use of sleds as a cultural adaptation of northern Indians and Eskimos. The sledder may have a set program that is just what you need. Otherwise, here are some teaching suggestions. The sledder will no doubt have other ideas as well.

TEACHING SUGGESTIONS

Most people are fascinated by the size and beauty of sled dogs. Ask the sledder to talk about the dogs; breeds, disposition, willingness to pull, etc. Can they be petted? Do they suffer from the cold? What adaptations do they have that make them well suited to life in the north? What wild animal is their closest relative? Which is the lead dog and why?

Also look at the sled. Is it more similar to the Eskimo "komatik" designed to travel over windpacked tundra snow, or to the Woodland Indian toboggan, designed for snow that is too fluffy for runners? What type of a hitch is used? Is it a traditional one? How was the sled used in the old days? What did it enable people to do? How does the driver control the dogs?

Take the musher's advice as far as rides are concerned. He or she knows the capacity of the dogs. It may not be possible for everyone to get a ride if the snow is heavy or sticky. While some people are getting rides, others may be building snowhouses, skiing or snowshoeing or involved in other activities.

ICE ECOLOGY

OVERVIEW

In this activity participants investigate lake ice and the water below it. They also take samples of water, mud and vegetation to make a home aquarium.

Time estimate: 2½ hours

Companion activity: Acid Snow

OBJECTIVES

Participants will be able to:

- describe lake ice formation after measuring thickness and temperature of ice, and state some effects of ice on the water below.
- observe small squatic organisms living under lake ice.
- describe the changes that have taken place in a jar of water taken from under the ice of a winter lake after the jar of water has been kept at room temperature for a week or more.

MATERIALS

One per family:

- manual ice auger, preferably double-bladed
- ice skimmer
- meter stick
- clipboard, paper, pencil
- 3 meter pole; metal or wood (thin wall conduit works well)
- 2 plastic 1 gallon buckets
- 1 gallon glass jar (often available free from restaurants)
- Pond Life field guide
- small white bowl or pan
- microprojector, microscope or hand lenses
- slides and coverslips
- eye droppers

Optional:

- -small grappling hook
- -secchi disk
- -ice fishing house for observing in the dark
- -ice chipper

ADVANCE PREPARATION

It is very important to select a location for this activity where the lake, pond or marsh is deep enough not to freeze to the bottom, but shallow enough that the bottom can be reached with a 3m pole.

To successfully look under the ice, devise some method of blocking out light from above. A dark house is very helpful for observing. Spear-fishing house is ideal; several people can fit inside and look through the large rectangular hole. However, the hole will have to be chipped and skimmed -- either by you ahead of time or by the class members. If class members do it, be sure to warn them that a sharp ice chipper can cut off a toe before they know it! If a dark house is unavailable, a jacket or blanket pulled over the head and shoulders of the kneeling or prone observer is the next best thing.

Also sharpen the augers for class use; a dull auger is frustrating for anyone. Make sure you have guards for the auger blades to protect people as well as the blades.

TEACHING SUGGESTIONS

Explain the purpose of the activity: to find out what the ice is like, what lies below it, and what effect the ice has on the life forms of the lake.

Hand out the clipboards, paper and pencils. Ask each family to make some predictions and record them on the paper: How thick do you think the ice will be? Do you think the lake will be frozen to the bottom? If not, how cold and how deep do you think the water will be? What kind of life do you think exists under the ice?

Each family should:

-take an auger, meter stick, pole, 2 buckets, thermometer and writing materials

-using these tools, check the predictions

-collecting two samples of lake water: one from near the ice, with relatively clear water and any swimming organisms you find, and one from the lake bottom with mud and living plants. These samples will be for the home squariums.

Demonstrate the use of the augers. Be sure to warn people that the edges of the augers are very sharp. When starting to drill, set the blades down gently so the blades don't chip or bend. Taller people may be more comfortable starting the drilling, while shorter people may prefer drilling after the auger has worked its way into the ice a bit.

Give directions for boundaries within which to work. Go ahead and have the families pick up their equipment and get started. Naturalists can circulate around, helping where necessary.

After people get their ice holes drilled and skimmed, encourage them to try to see down into the water. To see clearly they will have to block out some of the incoming light. One way to do this is to look through the hole with a jacket pulled over the head. It will take a few minutes for eyes to adjust to the darkness. The best way is to use a dark house. Note the amount and color of the light that penetrates the ice. Watch for movement also. Listen for sounds. What is it like under the ice? When everyone has taken their ice measurements, looked through the hole, and collected smaples then head back.

Indoors, ask people what they found out about the ice. Was there snow on top of the ice? How thick was it? How thick was the ice below? Was this surprising? What effect might snow have on top of ice? (Insulation as well as blocking light). How does the ice form on top of the lake rather than the bottom? (Water expands when it freezes, so ice is lighter than water). What would happen if ice was heavier than water? (Lakes might freeze solid). How would that affect aquatic organisms? How cold was the water? In the summer, the water is much warmer. What effect might this drop in temperature have on cold-blooded animals? (Slows metabolism). Is there an advantage for cold-blooded animals to spend the winter in water or mud rather than in the winter air? (It's a lot warmer - above freezing!)

Also have people examine their water samples carefully, using the white bowls or pans to look at a little at a time. Is there any sign of life? Isn't a winter lake supposed to be dead? Have them look especially carefully at any vegetation they might have found.

If you are using a microprojector, have people make slides of water, plants and mud. When everyone has made at least one slide, project them. Use Pond Guides to help with identification and determination of ecological niche. Microscopes or hand lenses can also be used to examine the samples.

Home Activity: The Winter Lake

Explain the home activity. To prepare the home aquarium, have families fill their 1 gallon glass jars with mud, water and plants. Ask for some predictions: do you think the aquarium will look the same in a week? In what ways might it change? What might cause some changes? Hand out the home activity sheets.

REFERENCES

Elverum, Kim, 1979. "Danger - Thin Ice," Minnesota Volunteer, December, 1979.

HOME ACTIVITY

THE WINTER LAKE

In this assignment, you will have your own sample of lake water to observe. The purpose is to become more familiar with the elements of a lake system and how they interact.

The set-up is simple; just put your water (and lake mud, a.d green plants) in a clear glass container. Place it in a sunny window and observe it for a few minutes every day. Jot down your observations in a notebook or journal that is kept within reach. After a week, sit down with everyone who has been observing and discuss what has happened.

<u>Questions to consider</u>:

Did the system change in the first few hours after you set it up?

Did the system keep changing or did it seem to become stable?

Can you see small animals moving around in the water? Sketch them if you can. Can you figure out how they move through the water?

Look carefully at the sides of the "aquarium." Is anything growing on them? If there is, touch it with your finger. You may want to remove a patch of this coating to make a "window" into your lake. Leave some, though; watch it carefully for signs of grazing by small animals.

After a week, there may be great changes in your "lake."

Does your system have:

- -a source of energy to power the plants?
- -something able to generate oxygen so small animals can survive in the water?
- -something for animals to eat?
- -something in which plants can anchor themselves?
- -something that eats plants?
- -something that eats small animals?
- -something that can recycle the bodies of dead plants or animals?

Have you noticed that one type of plant or animal has "taken over" the lake? Might this happen in a real lake? Why or why not?

Do you think a lake is healthier with a wide variety of plants and animals in it, or with just a few?

Reach in and remove a small sample of mud from the bottom. Smear it in a thin layer so you can see what it is made of. If you were able to keep a system like this going for a long time, do you think the mud layer would get thinner or thicker? What would the eventual result be?

What does this mean for Minnesota lakes in the far, far future?

ACID PRECIPITATION

OVERVIEW

Acid rain and snow have increasingly been in the news. In this activity, participants test the precipitation in their own area for acidity, and then discuss the importance of this environmental factor.

Time estimate: 30-45 minutes

Companion activities: ice ecology

snow field studies

pond study

TEACHER'S NOTE

This activity can be done in any season when you can get samples of precipitation. If you have snow cover, it is especially convenient because samples can be obtained anytime.

OBJECTIVES

Participants will be able to:

-test samples of precipitation for acidity and discuss the effects of acid precipitation.

MATERIALS

1 for every 2 families:

-pH testing equipment (this should be accurate to .5 pH value. Hach is a good supplier)

-baby food jar or other small container for collection

-unlabeled baby food jar each of:

vinegar

household ammonia

tap water

-paper/pencil

ADVANCE PREPARATION

For this activity, it is vital that the instructor have an understanding of acidity and acid precipitation. Some resources are listed at the end of this activity, but since the field is rapidly changing as more research comes in, they may become out of data. Contact the United States Environmental Protection Agency (Washing, DC 20460) for the latest information.

TEACHING SUGGESTIONS

The physical part of this activity is very simple; families, working in small groups, collect rain or snow and test it for acidity. The effectiveness of the activity will depend on the discussion before and after testing.

Begin by clarifying the concept of acidity and pH. After discussion, split into groups of two families each (or larger groups if equipment limits you) and pass out the jars of ammonia, vinegar and tap water as well as pH testing equipment. Demonstrate testing for pH, and then have the families test the unknowns. The pH results should be quite consistent; if they are not, check the techniques and equipment. Have the people try to identify the unknowns, using odor as well as acidity as clues.

Ask the groups to predict the pH of the local precipitation. Then have the groups move outside to collect samples. In the case of combining this activity with ice ecology or snow field studies, just have them pick up samples of snow on their way in. Provide bowls of warm water for melting the snow samples. Have the groups test their samples for pH.

As a rule of thumb, "clean" rain or snow will have a pH of about 5.6. A lake is considered endangered if its pH is 4.5-5.5, and critically endangered if its pH is less than 4.5.

DISCUSSION IDEAS

The acids in acid rain are formed by water reacting with oxides, such as carbon dioxide, and also sulfur oxides and nitrogen oxides. What human activities release sulfur and nitrogen oxides? (Burning of fossil fuels in power plants, industry, cars and trucks.)

Some areas are much more susceptible to acid rain damage than others. In the United States, the worst problems in the eastern half of the country, especially in the vicinity of industrial areas; and also in high or northern areas. Why? (There is a greater amount of burning of fossil fuels in industrial regions, but also rocks in this region have been rubbed clear of buffering substances by ancient glasiers).

The sources of the pollution are usually far from the affected areas, especially when tall stacks are used. The pollutants ignore national boundaries. Currently, the U.S. "exports" 4-10 times the acid producing pollution to Canada than Canada "exports" to the U.S.

EFFECTS OF ACID RAIN

- severely affected lakes cannot support fish. This has already happened in Scandinavia and the Adirondacks of the U.S. These "dead" lakes have clear, beautiful blue water but no fish.
- whole aquatic ecosystems are disrupted when acid slows decomposition, kills eggs of fish, salamanders and frogs, and kills aquatic invertebrates.
- acidity causes some metals, such as aluminum, magnesium, and mercury, to dissolve in water and become toxic to fish and anything that eats fish.
- soils are altered when minerals dissolve and wash away, and when decomposition slows.
- forest trees as well as vegetables and other crops may be injured directly or show decreased vigor and quality of fruit.

-man-made objects such as statues and stone building deteriorate much more quickly than normal when exposed to acid rain. Even metals and paints are affected.

-humans may be affected when their water supplies are acidified and then contaminated with metals that are then soluble.

How could the pollution that leads to acid precipitation be lessened? (Energy conservation, using less sulfur and nitrogen-rich fuels, or burning them more cleanly so emissions are less dangerous). Who cares? Why do you care?

REFERENCES

Luoma, Jon R., 1980. "Troubled Skies, Troubled Waters." Audubon, 82:6, November, 1980.

United States Environmental Protection Agency, 1980. Acid Rain. Washington, D.C. 20460. EPA 600/9-79-036.

ANIMAL TRACKING

OVERVIEW

In this activity, participants visit several habitats looking for animal tracks and other signs of animals. When tracks are found, they are followed, analyzed, and identified if possible. More important than identification though, is the determination of what the animal was doing. From there the class can conjecture about the animal's physical and behavioral adaptations as well as relationships with other animals.

Time estimate: 1½-2 hours

Companion activities: Snow Field studies

OBJECTIVES

Participants will be able to:

identify typical animal tracks.
describe adaptations of winter-active birds and mammals.
find evidence of predator-prey relationships.

MATERIALS

Optional: For each family:

- local track guide
- centimeter rule and meter stick
- animal feet or molds of tracks if they are available

ADVANCE PREPARATION

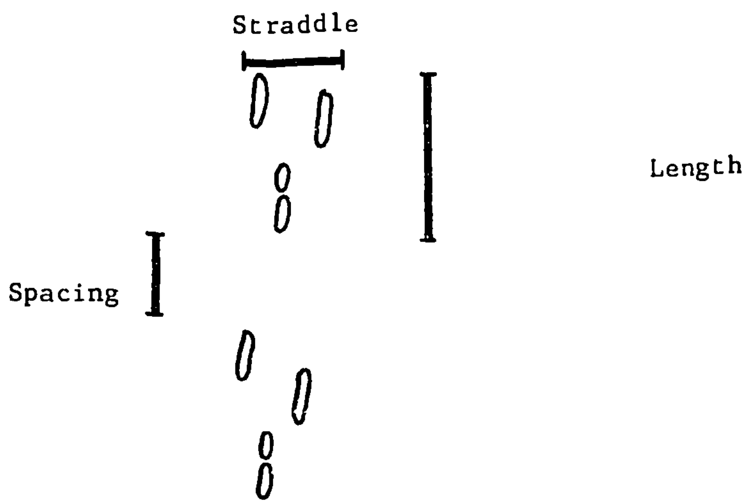
None, except to scout the area beforehand for concentrations of tracks.

TEACHING SUGGESTIONS

Tracking is best done in small groups; everyone can see the same track, and there is less tendency for people to accidently step on them. Ideally, you would have good trackers leading small groups; if this is not possible, you may have to go in a large group at least initially. After you have figured out the most typical tracks, you can split up into two-family units to follow particular tracks farther. If you do split up, be sure to specify boundaries and times to return.

When someone finds a track, avoid identifying it immediately. It is easy to jump to a name and skip over the thought process. Instead, see what the participants can determine about the animal. For example: can you tell what direction the animal is going (See claw marks, or observe on what edge of the track the snow is thrown up - if there is any question, make your own tracks and look at them carefully). How many legs does the animal have? (Look for evidence of overlapping tracks. You may have to explain "registration" in which an animal puts its hind feet in the tracks of its forefeet). How might this be adaptive? How many toes does the animal have on front and hind feet? Are there any claw marks? What could account for the absence of claw marks? Was the animal walking or hopping? (Someone can demonstrate the difference to make it clear that walkers leave a line of prints while hoppers leave clusters of prints with spaces between).

If the animal was hopping, which feet would you expect to be larger? (The hind, for power). You may have to point out that many animals, when moving fast, reach with their hind legs beyond their front legs. This results in the hind prints <u>in front of</u> the forefeet tracks. A limber person can also demonstrate this! Can you estimate the length of the animal's leg by the distance between tracks? Can you also estimate speed? Experiment by pressing down on the snow to get some idea of the animal's weight. Also consider the force involved in pushing off. If the prints are very clear, can you get some idea of what the underside of the animal's foot is like? Is it furred, hard, soft? Can you tell if the tracks are old or new? This is easier to tell if you can see examples of different aged tracks. Feel them to see if the snow has metamorphosed. When do you think the animal was there? Especially if you are using track guide you may choose to measure the tracks. If you do, be sure to measure these three features:



Follow the tracks as far as you can. If the animal moves through different snow types, note how the tracks appear different. Take care to observe where the animal goes. What does it do when it comes to obstacles? Does the animal seem to interact with other animals? What can you tell about the animal's behavior by following its tracks? Speculate about how the animal's behavior might be adaptive.

Also note any other signs such as droppings, gnawings, scratchings, rubbings, nests or burrows. What further information do these give about how this animal lives?

REFERENCE

Murie, Olaus, 1954. A Field Guide to Anim Tracks. Houghton Mifflin, Boston.

BIRD FEEDER OBSERVATIONS

OVERVIEW

In this activity, participants watch a bird feeder not only to learn to identify winter birds, but also appreciate their energy budget. Participants practice using field guides for identification.

Time estimate: 30 minutes (Observations may be made several times during the course)

Companion activities: bird banding (or can be tucked in anytime the feeder is busy and you have a little time)

OBJECTIVES

Participants will be able to:

observe and identify typical winter birds as feeders.
describe adaptations of winter-active animals.
discuss energetics of animals in cold weather.

MATERIALS

For homework (bird feeder preference study): For each family

-1 16" X 24" piece of plywood (note that one 4' X 8' plywood sheet can be cut evenly into 12 rectangles)

-5 empty tuna or other low cans, or milk cartons cut off about 2" tall (participants can provide these)

-5 short nails

-4 m strong cord

-home activity packet

For activity:

-an established bird feeder, seed and suet

One per family:

-bird field guide (if you cannot provide bird guides, see if some families can provide their own; also borrow library copies)

-"Birdfeeder birds" handout

-pencils

Optional:

-binoculars, spotting scopes

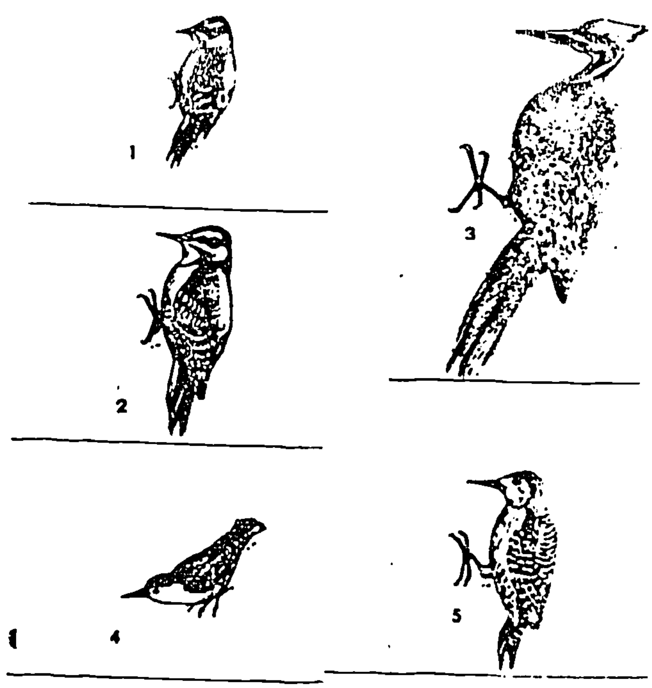
ADVANCE PREPARATION

This activity assumes that you have access to an established bird feeder, and a comfortable indoor observing area. If not, you can certainly set up a feeder, but allow two weeks for birds to find it. Observe the feeder so you are confident of identifying the visiting birds. The given version of "bird-feeder birds" may not be appropriate for your area. If it is not, you should prepare a new or additional sheet that includes the most common birds at your feeder. Be sure to allow room for the watcher to write in the name of the bird. This handout will serve as a field guide for the home activity.

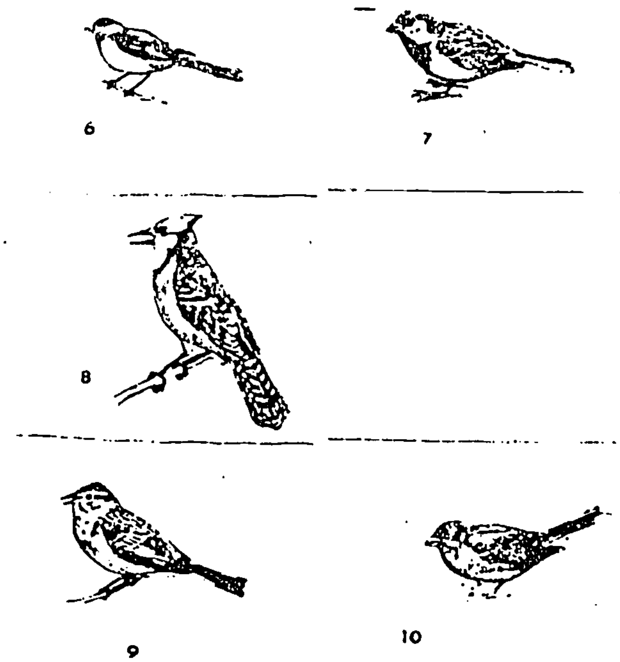
TEACHING SUGGESTIONS

Hand out field guides, "Birdfeeder birds" handout, and pencils. Point out the family organization of the field guide. When a bird approaches the feeder, first ask the class to describe the bill, the posture, markings, etc. Then have the class find it in the field guide. When there is agreement about what the bird is, have the people write the name of the bird under its drawing on the handout. After identifying a few as a group, allow individual families to work on their own. You may want to help any families that have no experience in birding.

Birdfeeder Birds 1



Birdfeeder Birds 2



After the most common birds have been identified, call attention to particular adaptations. Note the relationship between beak shape and seeds eaten. For example, the grosbeaks have powerful, wedge-shaped bills for cracking seeds, while the woodpeckers have straight sharp bills for chipping at wood and extracting insects. Notice tail length and shape. Watch for feeding behavior such as the chicadee working a limb upside down, the ground feeling tendencies of the junco, and the blue jays habit of carrying large seeds away to store.

Concerning energetics, ask:

What are the basic needs of birds? (Food, cover, water, which can come from metabolism of foods).

What are particular problems they face in winter? (Cold, snow making food difficult to get, no new food being produced).

Consider cold. What are a bird's defenses? (Feathers, especially down) Do feathers produce heat, or just insulate? (Insulate) Where does a bird's heat come from? (Fuel being burned in the body-fuel is food).

Ask if anyone knows the relationship between an animal's body size and normal temperature? (The smaller the body, the higher the temperature. Small birds such as sparrows, have a body temperature as high as 44C or 110F) If a bird has enough high-energy food to eat, it will not die of cold. However, this means that a small bird has to eat a lot. If a bird needed to eat ¼ cup of seeds a day in the summer to maintain itself, what about in winter? (Much more) Why? (Because it must keep warm as well as maintain itself.)

Cold is very stressful to small organisms. When do small birds typically forage, night or day? (Day, when it is easy to see, and also warmer) What do you know about the length of day in the winter, and how would that affect the energy budget of a small bird? (They need more food, but have less time to forage for it.)

Now consider seasonal availability of food; when are [illegible] available? (Warm seasons only; not when the ground is frozen). What f[illegible]s robins to migrate? (No cold, but [illegible]cessibility of worms.) How about ducks that eat aquatic plants? (Must migrate, food is not available. Note that many species of waterfowl will overwinter if food is provided!) How about woodpeckers? (Since they eat insects in tree bark, they can overwinter.)

How about seed eaters? (They can overwinter) Under what weather conditions may even seeds be unavailable? (Very deep snow, sleet) In these circumstances, small birds starve very quickly.

For speculation: how do you think home bird feeders have changed ecological relationships? Some ideas: some birds seem to be expanding their winter ranges northward, for example, years ago, the cardinal was considered to be a rather southerly bird. Also, mockingbirds and tufted titmice are moving northward. Are their other factors that bird feeding that might account for this phenomenon? (Maybe ornamental plantings, diversity of urban habitat?)

Another discussion point: some people feel that feeding the birds is inexcusably wasteful. Think of the land used to grow bird seed that could grow food for people. In 1980, it was estimated that Americans spent 340 million on bird seed! Another estimate is that it requires 375,000 gallons of diesel fuel yearly just to truck the midwestern-grown bird seed to New England! And don't forget the use of farm fertilizer and fuel for farm machinery. Comments?

HOME ACTIVITY

BIRD FEEDER OBSERVATIONS

The purpose of this activity is for you to become acquainted with bird-feeding as a winter hobby and also a way to gather information about birds. Even if you are already an experienced birdfeeder, you can practice keeping accurate records of your observations. You will also have the opportunity to conduct an experiment and draw your own conclusions.

Your packet should consist of:

-direction sheet "Building a Platform Feeder"

-materials for building a feeder

-equal amounts of millet, sunflower, safflower, cracked corn and whole corn

-common birdfeeder birds identification sheet

-birdfeeder data sheet

-birdfeeder study questions

PROCEDURE

Do you think different birds will prefer different seeds? Discuss this with your family. Decide on a statement that expresses your opinion and write it down. This is your hypothesis. An example might be, "I think all birds prefer sunflower seeds." You may all agree on a hypothesis or have different ones.

Now build your feeder, set up the experiment and see what happens. Read over the data sheet and question sheet to get ideas for things to watch for. If you have not been feeding the birds, it may take them a week to find your feeder.

Since no one can watch the feeder all the time, decide who would like to watch the feeder when, and for how long. You have three weeks until the end of class. Try to set up a schedule that occasionally allows for midday as well as morning and afternoon observation.

The data sheet is a tool to help you observe. When a bird arrives at the feeder, record the time, what kind it was (you may not be able to identify all you see), sex (if known) and which can(s) it ate from. Check whether it fed alone, with others of the same species, or in a mixed group. Also check its feeding habits. You may want to jot down other notes too.

NOTE: If you have severe problems with squirrels, try decoying them away from the main feeder by spreading some whole corn on the ground a short distance away. It should work for a while.

After about two weeks of observing, look back at your hypothesis. Did your observations support it or not? Are there other hypotheses that you would now propose? Bring your ideas to the last class meeting.

BIRD FEEDER DATA SHEET

TIME	BIRD	SEX	WHICH CAN(S)	TOLERANCE			FEEDING HABITS			O O T
				ALONE	SAME SPECIES	MIXED GROUP	EAT THERE	ON GROUND	FLY WITH FOOD	

BUILDING A PLATFORM FEEDER FOR A FOOD PREFERENCE STUDY

MATERIALS

-plywood for base; about 1½' X 2'

-5 empty tuna, catfood or other low cans, with the lid removed

-5 short nails

-4 m strong cord, cut in half

TOOLS

-drill with ½" bit

-hammer

OPTIONAL

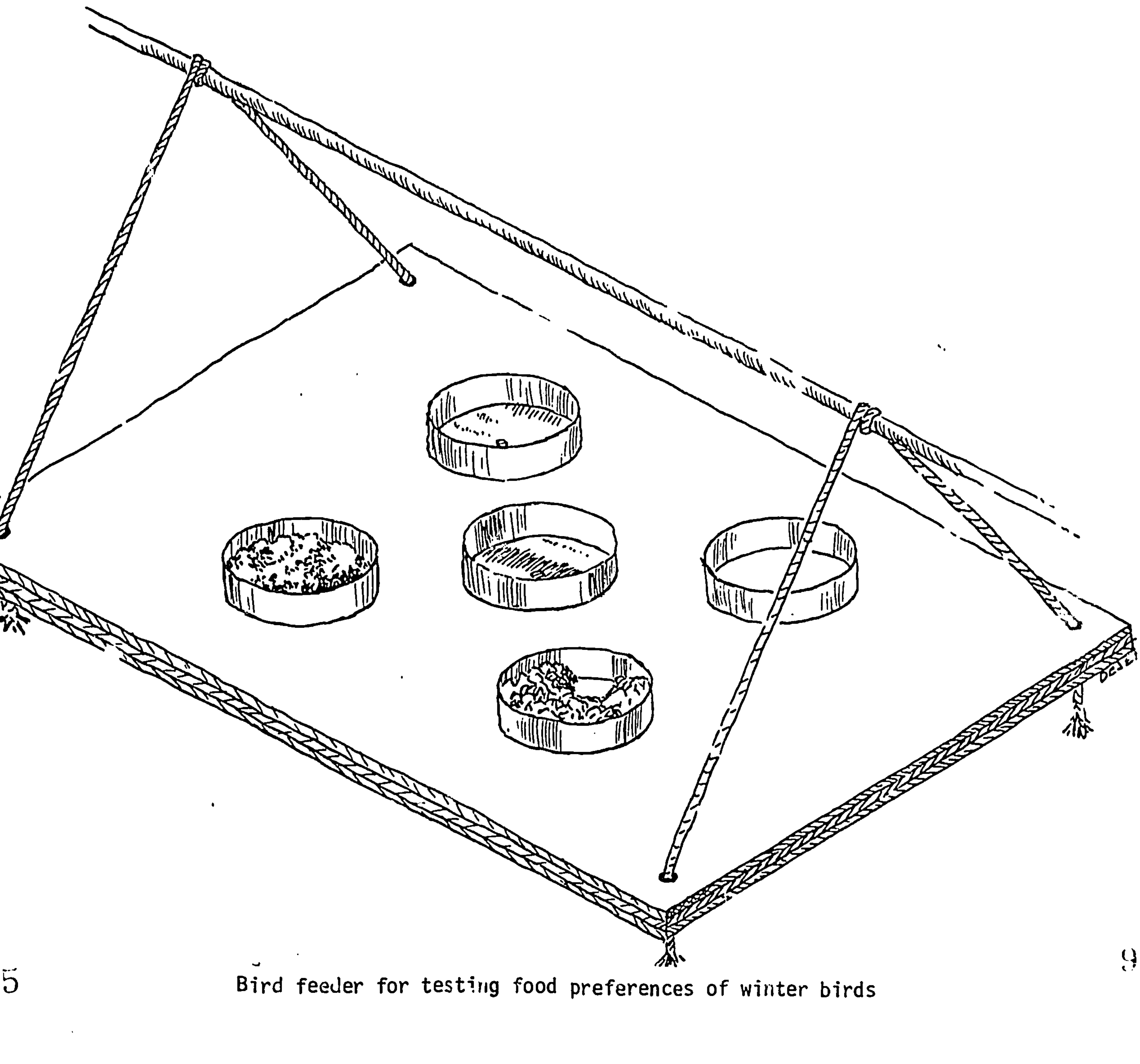
-paint, stain or varnish to protect feeder

PROCEDURE

Decide where you want to set up your birdfeeder. It should be close enough to bushes or trees so birds have a place to perch, but not too close to dense shrubbery cats can hide in. It should be easy to see from a convenient window for observing.

The feeder can hang from a treelimb or other horizontal, such as a laundry pole, or from an overhanging eave. If you use an eave, be sure the feeder can't swing enough to hit the house! The feeder can also be nailed on top of a wooden post. As a last resort, the feeder can simply be placed on the ground.

Also, decide how to identify the five cans. Each will contain a different bird seed, and you should be able to tell which can a bird is using from your observation window. Paint, tag, or label the cans accordingly. Also, paint, stain, or varnish the feeder platform if you wish.



Bird feeder for testing food preferences of winter birds

Kathy taught each family how to set and bait a Potter trap on a bird feeding platform. There are enough platforms so every family had one to use. The families' responsibility was to select a platform, set and bait their trap and then watch it from inside the building. When a bird was captured, the family asked an assistant to remove the bird from the trap and place it in a small holding bag. The assistants and the bird bander were the only ones who actually handled the birds.

The family then brought the bird to Kathy, who was at a table in a central location. She identified and measured the bird, and recorded the data, banded the bird, and placed it in a wire cage. As she worked, she explained what she was doing, and why. When she was done, the family brought the bird outside, and released it. They were also responsible for keeping an eye on it as long as possible to make sure it was all right. One family was also responsible for watching a woodpecker trap, baited with suet.

After about an hour of trapping, Kathy set up a mist net, and withdrew for a few minutes. She explained the difference between netting and trapping, the pros and cons of each, and when each was appropriate. Then the class watched her remove and band the captured birds.

After the outdoor part of the program, participants may want to know how they could become bird banders. The bander can explain the licensing process. The minimum age for licensure is eighteen, although younger students can assist licensed banders.

REFERENCES

Robbins, Chandler S., Bertel Bruun, and Herbert S. Zim, 1966. Birds of North America. Golden Press, NY, NY.

Stokes, Donald W., 1979. A Guide to the Behavior of Common Birds. Little, Brown and Co., Boston.

Welty, Joel C., 1975 (second ed.). The Life of Birds. W.B. Saunders Co. Philadelphia.

To prepare the feeder for hanging, drill a hole about 3 cm. in from each corner. Arrange the metal cans on the platform, and tack each one down with a short nail. To hang the feeder, pass one end of a 2 m cord through one hole, tie a bulky knot at the end, and tug upwards to make sure the cord will not pull through. Pass the free end of the cord over the limb. Wrap the cord once around the limb so the feeder will have less tendency to tip. Pass that end of the cord through the nearest corner hole and secure the end as before. Repeat for the other two holes. Level your feeder by shortening a cord if necessary. If you are hanging the feeder from a eave, suspend it from screw eyes.

BIRDFEEDING STUDY CONCLUSIONS

1. Which birds are attached to which foods?

2. Which food was consumed the fastest? Slowest?

3. If you were to design an ideal mix for the birds you want to attract, what would you use? Would their costs make a difference? Check local prices.

4. Which birds fed in groups?

5. Which birds fed alone?

6. Which birds were the most intolerant of others?

7. Which birds flew away with food?

8. Which birds preferred to feed on the ground?

9. For those that sex could be identified, were there any differences in feeding habits?

10. Which birds found the feeder first?

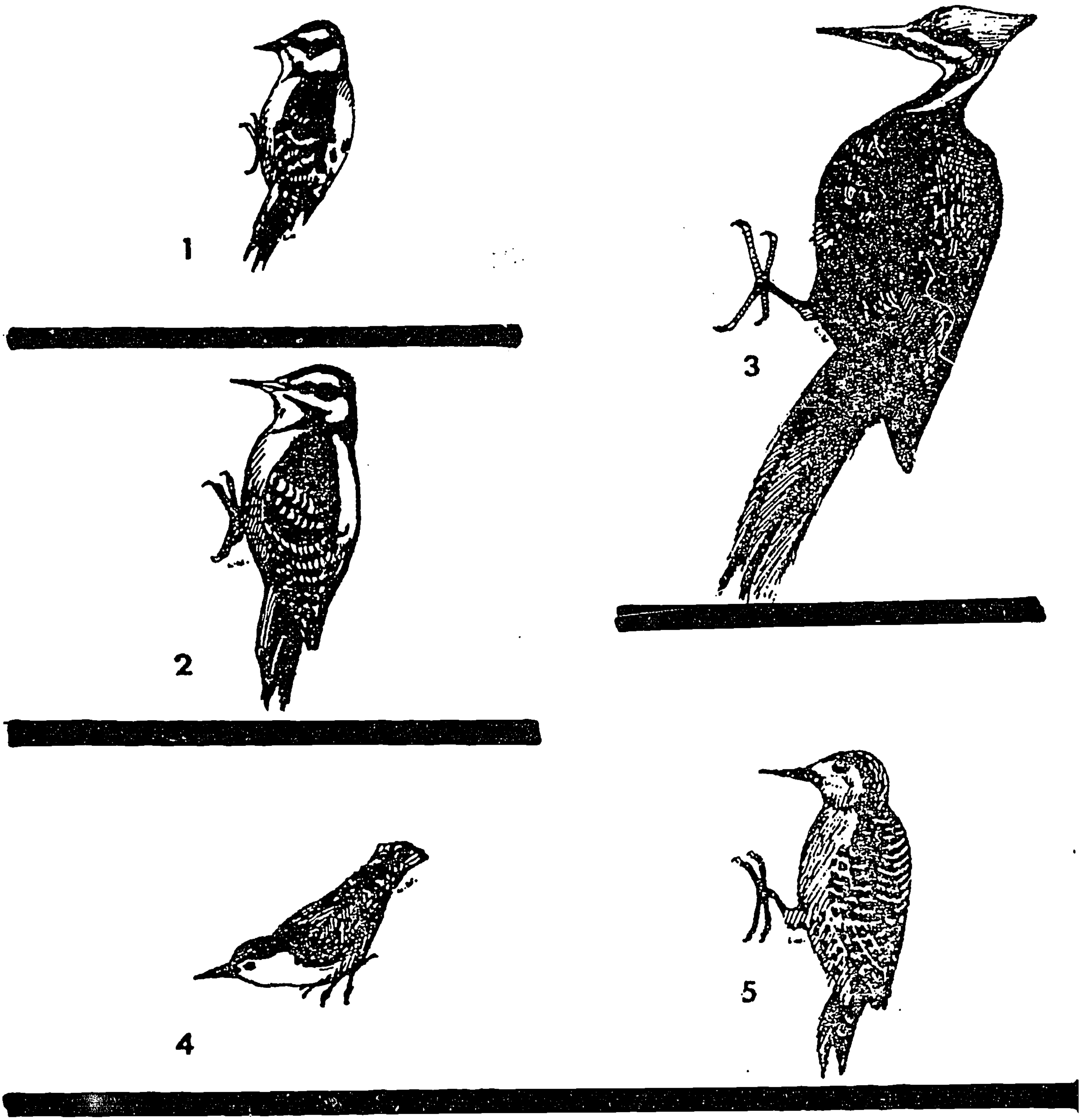
11. Which foods did the squirrels prefer?

12. Which birds were the quickest to leave when squirrels came?

13. Were you able to identify any birds as individuals? If so, what did you learn about their habits?

14. Some naturalists feel that it is ecologically unwise to feed birds in winter. Why do you think they feel this way? What do you think?

Birdfeeder Birds I



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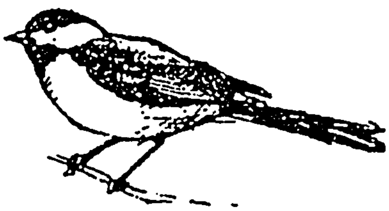

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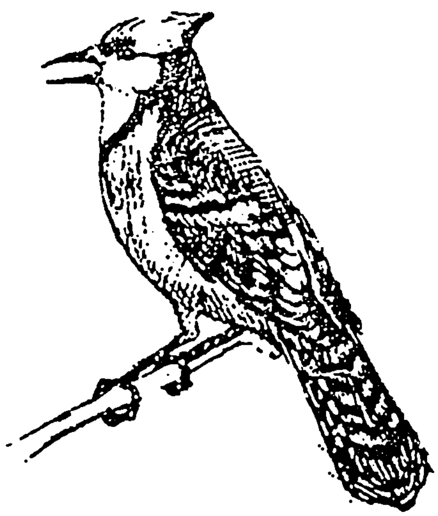

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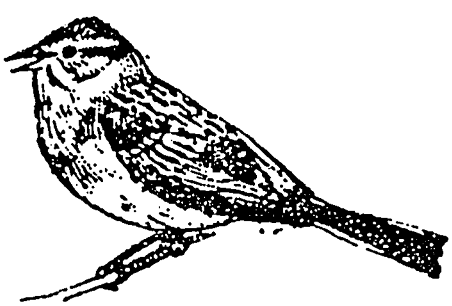

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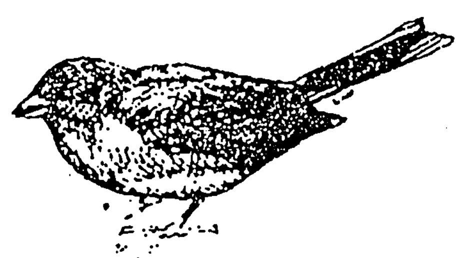

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BIRD BANDING

OVERIEW

Seeing a bird close-up is one of the best ways to spark an interest in ornithology. In this activity, participants observe a licensed bird bander at work and help with some phases of the process. They may be able to see a bird in the hand, and watch measuring, sexing and recording of data. Participants discuss the reasons for banding and results of some banding studies. This activity can be done in any season.

Time estimate: 2 hours

Companion activities: (depending on the season)

winter bird feeding

bird feeder observations

bird watching

red-winged blackbird territoriality

TEACHER'S NOTE

Bird banders are licensed by the federal government. I am assuming that you are not a licensed bird bander yourself, but can find one willing to help with your program. Banders can usually be located by calling nature centers, Audubon clubs, state departments of natural resources, or federal fish and wildlife offices. Banders may be willing to donate their time while others may expect to receive a fee.

The bander you contact may or may not be experienced in working with groups of people. He or she may even have a set "program." If not, he or she may appreciate some ideas of how a bird banding activity can be conducted with family groups.

OBJECTIVE

Participants will be able to explain how birds are studied by banding.

MATERIALS

The bird bander will have nets, traps, holding bags, bands and other tools of the trade. You may want to provide bird field guides for each family.

ADVANCE PREPARATION

Contact the bird bander well ahead of time to discuss goals of the session, time and place, fee if any, and procedure. Be sure to discuss the family nature of the group. The bander may have to arrive early to set up nets or traps, so you may want to offer to help with this.

TEACHING SUGGESTIONS

First of all, see that the class understands what a band is, and why they are put on birds. The bander should let the class handle some bands to see what is written on them, and to see that each has a different number, and that they come in different sizes.

You might ask the class why ornithologists band birds. The most important idea is that bands allow individual birds to be identified. Why this is important becomes clear if you ask the class how many blue jays, for example, visit their home bird feeders. Many people may think they have one or two. But how do they know that it is the same one or two? A banding study in Wisconsin revealed that one yard was visited by 167 blue jays in one day, even though only a few were seen at any one time! One reason for bird banding then, is to get some idea of population size.

Another thing you can learn from banding is where birds go. For example, waterfowl banding has revealed the existance of several different "flyways." Waterfowl and also small birds follow these traditional trails through the sky to get to and from their wintering grounds. In some cases, these wintering grounds have been shown by banding to be amazingly distant; for example, the purple martins and yellow warblers of Seattle fly deep into South America every winter. To get this information, the bands must somehow be recovered.

Banding also answers the question "Does the same robin return to my yard each spring?" Since bands can be used to identify individuals, the robin, once banded, can be recaptured and checked. In fact, banding has showed us that migratory birds are often "true" to their home yard, and may return to the same tree year after year.

That brings up another point: How long do wild birds live? Through long-term banding studies, we have learned that, despite their active and stressful lives, small birds may live quite a few years. For example, a muthatch was found dead that had been banded 9 years and 5 months earlier. On the other hand, banding has also showed us that the first year of a bird's life is by far the most risky; most do not survive it.

Participants should also know what to do if they find a dead banded bird. The band should be removed, flattened, taped to a card and mailed, along with any information they have about the bird's death, to the Bird Banding Office, United States Bureau of Sport Fisheries and Wildlife, Washington, D.C. The finder will receive a certificate of appreciation, as well as information about the bird. The bird bander will also get information about when and where the band was recovered and anything else known about it.

After preliminary discussions, the bander will no doubt want to demonstrate banding techniques, including data collecting and recording as well as putting bands on. One teaching set-up that was particularly effective for family groups was used by Kathy Heidel of Lowry Nature Center in Carver Park Reserve, Excelsior, Minnesota.

Kathy taught each family how to set and bait a Potter trap on a bird feeding platform. There are enough platforms so every family had one to use. The families' responsibility was to select a platform, set and bait their trap and then watch it from inside the building. When a bird was captured, the family asked an assistant to remove the bird from the trap and place it in a small holding bag. The assistants and the bird bander were the only ones who actually handled the birds.

The family then brought the bird to Kathy, who was at a table in a central location. She identified and measured the bird, and recorded the data, banded the bird, and placed it in a wire cage. As she worked, she explained what she was doing, and why. When she was done, the family brought the bird outside, and released it. They were also responsible for keeping an eye on it as long as possible to make sure it was all right. One family was also responsible for watching a woodpecker trap, baited with suet.

After about an hour of trapping, Kathy set up a mist net, and withdrew for a few minutes. She explained the difference between netting and trapping, the pros and cons of each, and when each was appropriate. Then the class watched her remove and band the captured birds.

After the outdoor part of the program, participants may want to know how they could become bird banders. The bander can explain the licensing process. The minimum age for licensure is eighteen, although younger students can assist licensed banders.

REFERENCES

Robbins, Chandler S., Bertel Bruun, and Herbert S. Zim, 1966. Birds of North America. Golden Press, NY, NY.

Stokes, Donald W., 1979. A Guide to the Behavior of Common Birds. Little, Brown and Co., Boston.

Welty, Joel C., 1975 (second ed.). The Life of Birds. W.B. Saunders Co. Philadelphia.