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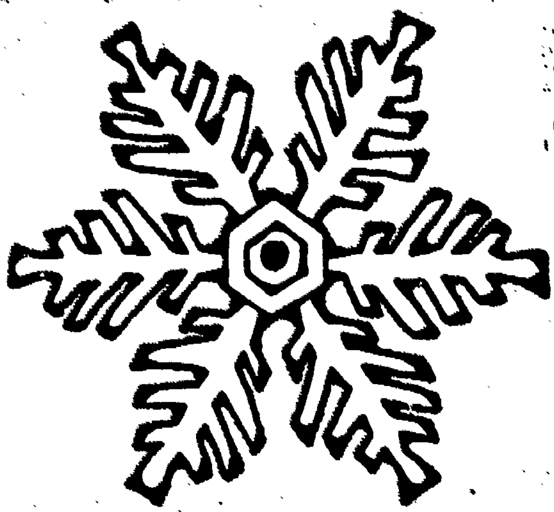
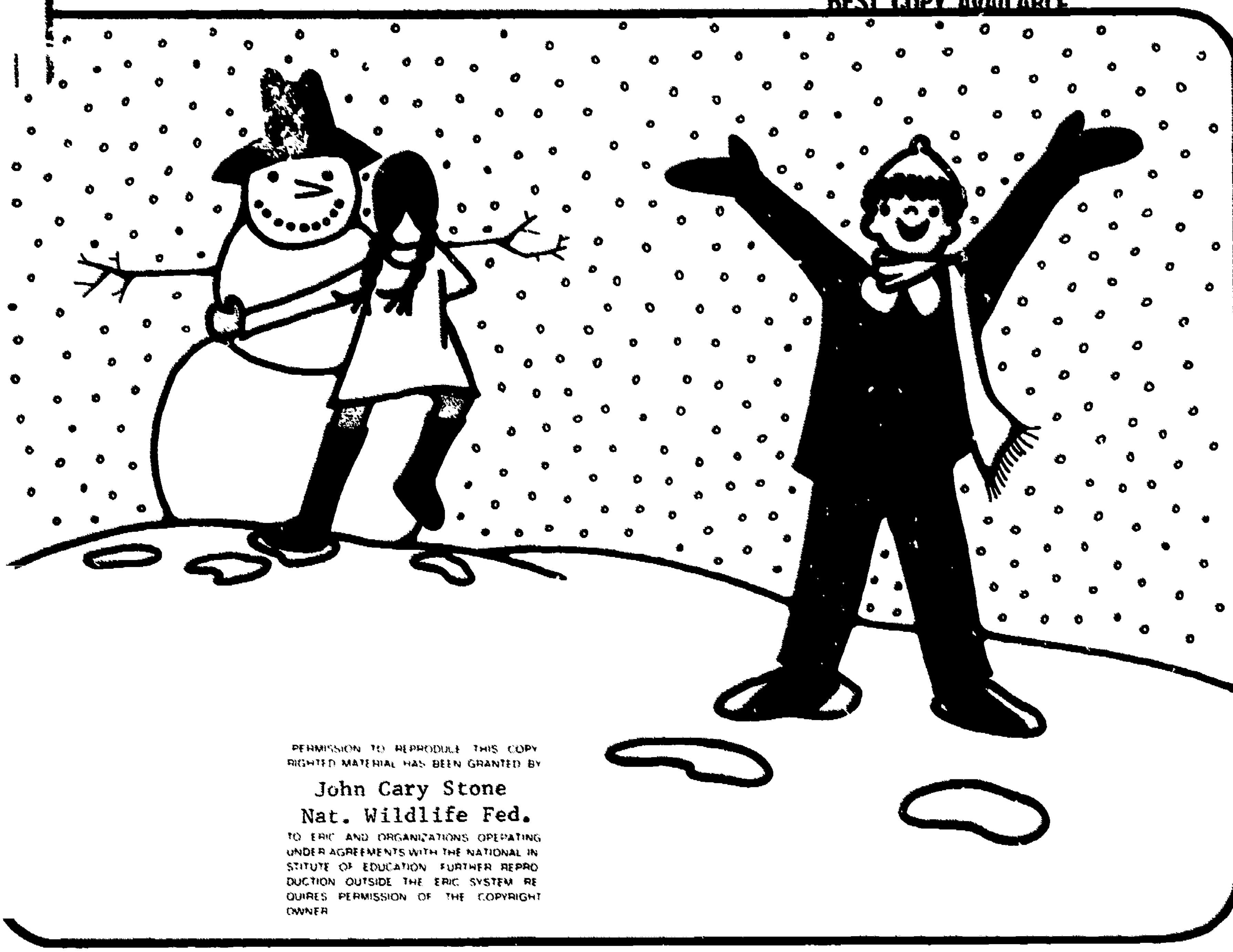
ABSTRACT

This environmental unit is one of a series designed for integration within an existing curriculum. The unit is self-contained and requires minimal teacher preparation. The philosophy behind the series is based on an experience-oriented process that encourages self-paced independent student work. In this unit, students study the physical properties of snow and ice in relation to water, heat, the environment, and themselves. It is a goal of this unit that, by learning more about the behavior of water and its environmental influences, the students will become involved enough to recognize water as a vital source of life and want to protect it. Activities, designed for the elementary grades, are generally done outside. Students observe snowflakes, make cross-sections of snow banks, study snow density and make snow paintings. Besides these, there are numerous other snow activities that guide students to the goal of this unit. Each includes a list of materials, background information, and directions for the teacher. (MA)



Snow and Ice

An Environmental Investigation



edited and published by

NATIONAL WILDLIFE FEDERATION

written by

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

THE ENVIRONMENTAL UNITS

This is one of a group of Environmental Units written by the Environmental Science Center and published by the National Wildlife Federation.

In both theory and practice education is the essential base for long-range local, regional and national programs to improve and maintain the quality of environment necessary for man's welfare and survival. Citizens must be aware of ecological relationships in order to recognize, appreciate and fulfill constructive roles in society. This awareness should be launched through the existing educational process—in classroom and related school activities. No special courses on ecology can replace the need to integrate ecological learning throughout the existing curricula of our school systems. Furthermore, the life styles and value-systems necessary for rational environmental decisions can best be acquired through repeated exposure to ecological learning which pervades the total educational experience.

It was with these thoughts that we developed these curriculum materials. They were designed for the classroom teacher to use with a minimal amount of preparation. They are meant to be part of the existing curriculum—to complement and enhance what students are already experiencing. Each unit is complete in itself, containing easy-to-follow descriptions of objectives and methods, as well as lists of simple materials.

The underlying philosophy throughout these units is that learning about the environment is not a memorization process, but rather an experience-oriented, experiment-observation-conclusion sort of learning. We are confident that students at all levels will arrive at intelligent ecological conclusions if given the proper opportunities to do so, and if not forced into "right" answers and precisely "accurate" names for their observations. If followed in principle by the teacher, these units will result in meaningful environmental education.

In the process of development, these units have been used and tested by classroom teachers, after which they have undergone evaluations, revisions and adaptations. Further constructive comments from classroom teachers are encouraged in the hope that we may make even more improvements.

A list of units in this group appears on the inside back cover.

About the National Wildlife Federation—1412 Sixteenth Street, N.W., Washington, D.C. 20036

Founded in 1936, the National Wildlife Federation has the largest membership of any conservation organization in the world and has affiliated groups in each of the 50 states, Guam, and the Virgin Islands. It is a non-profit, non-governmental organization devoted to the improvement of the environment and proper use of all natural resources. NWF distributes almost one million copies of free and inexpensive educational materials each year to youngsters, educators and concerned citizens. Educational activities are financed through contributions for Wildlife Conservation Stamps.

About the Environmental Science Center—5400 Glenwood Avenue, Minneapolis, Minnesota 55422

The Environmental Science Center, established in 1967 under Title III of the Elementary and Secondary Education Act is now the environmental education unit of the Minnesota Environmental Sciences Foundation, Inc. The Center works toward the establishment of environmental equilibrium through education—education in a fashion that will develop a conscience which guides man in making rational judgments regarding the environmental consequences of his actions. To this end the Environmental Science Center is continuing to develop and test a wide variety of instructional materials and programs for adults who work with youngsters.

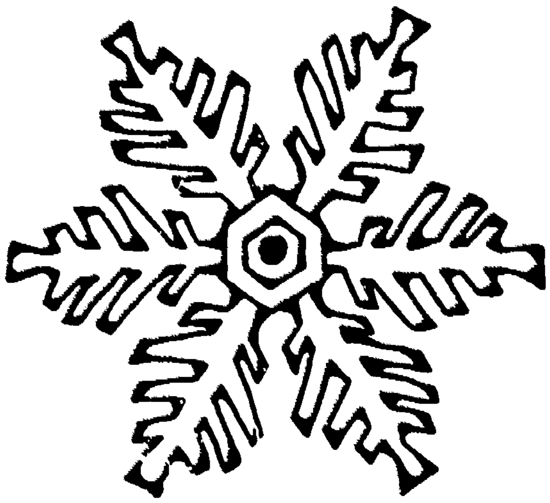
Snow and Ice

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.



Design and Illustrations by
JAN BLYLER

Through the activities in this unit, children will find out about many physical properties related to water and freezing.

But it is not necessary to dictate the explanations in terms of physics and chemistry. The children can get firm handles on understanding water's behavior without hearing any technical terms at all. In fact, they can have a lot of fun experimenting and investigating on an intuitive, game-oriented level.

Without the special behavior of water our world would be so different that we wouldn't recognize it—even if we could be alive to see it. The relationship between water and temperature (which alters the form of water, making it ice, snow, or steam) is therefore a vital concept to be grasped by all who must live in our environment. If the students can gain a knowledge of water's behavior, they can see a little more clearly how all the elements of the environment are intertwined, and how they relate to the world we all have to live in.

Water affects us, and we affect it. In fact, our very survival depends upon water to much the same extent that *its* survival depends upon *us*. The goal of this unit is to get children interested and involved with water to the point where they care enough to learn more and do more to protect it.

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INTRODUCTION

The importance of snow to living things in north-temperate America has been dramatically overlooked in our school curricula. Children have grown up with the idea that snow is fun to play in or a nuisance to shovel, and not much beyond that.

But snow and ice have great ecological significance. Many animals and plants will survive a winter only when there is deep snow. Soil doesn't freeze as deeply when there is a heavy snow cover as when there isn't. Snow saves up a good portion of a winter's water supply and releases it in the spring.

These facts comprise data for the larger concept that water in various forms is a vital and influential element of the environment. In this unit, the children will manipulate snow and ice in such a fashion that the relationships between water, heat, the environment, and themselves, become evident. They won't have to read, hear, or memorize facts—they will **discover** them through the various activities. We hope you will join them in the spirit of adventure.

MATERIALS

- wide-mouthed jar or tin can
- masking tape
- rulers
- pens, pencils
- ice cubes
- aluminum foil
- clock
- foam plastic cups
- thermometers
- large sponge
- sticks, stakes
- long, colored cords
- medium-sized cardboard boxes
- shovels
- yardsticks
- 2-inch screws
- falling snow
- dark background (e.g., cloth)
- hand lens
- drawing paper
- crayons, chalk
- glass slides or pieces of glass
- clear plastic or lacquer spray
- cardboard
- magnifiers
- candles
- matches
- containers—coffee cans, milk cartons, salt shakers
- powdered tempera paint
- dark paper
- clipboards
- ¼-inch graph paper
- scrap material
- plastic bags
- grease pencils
- paper towels
- glasses or cups
- marbles
- garden trowels
- foods to entice animals

Snow and Ice

ICE CUBE GAMES

MATERIALS

ice cubes	foam plastic cups
aluminum foil	thermometers
clock	large sponge
paper towels	

Games are fun for everyone. In addition, they often make a point. These ice cube games are simple to play, but should also convey intuitive messages to the children about the nature of water and temperature.

The first game is: Who can get an ice cube to melt really fast?

The second game is: Who can make an ice cube last really long?

A main goal is to have the children feel a need to collect information. The information collected will have to be selective, in order to be useful-that is, it will have to be relevant to their objective of melting or preserving an ice cube.

Those students who collect the most relevant information should be the most successful with their ice cubes. The information they use may have been gleaned from past experience or from the game itself, but in either case the students should realize they're basing their behavior on data they've collected.

State the object of one game to the children—for instance, melting an ice cube very quickly—and allow them to fend for themselves for a while, experimenting and testing as they please. After the game has been played once or twice, help the students compile the data they have collected. Useful data for the first game will fall mostly under two general categories: ways which are good to melt ice cubes, and ways which do not melt ice cubes very well.

Information from the students may look like this list:

Good Ways	Poor Ways
Put on radiator	Put on desk top
Put in mouth	Put in box
Put in pocket	Blow on cube
Crush cube	Put in cold room

Have the students play the game a few more times on the basis of the newly compiled information. Encourage the children to discover for themselves the various means of playing the game successfully. Don't give them clues. After they have compiled their own lists they should be able to refine their methods and shorten the time for melting the ice cubes even further.

When trying to prevent an ice cube from melting, the smallest space and best insulation should work the most successfully.

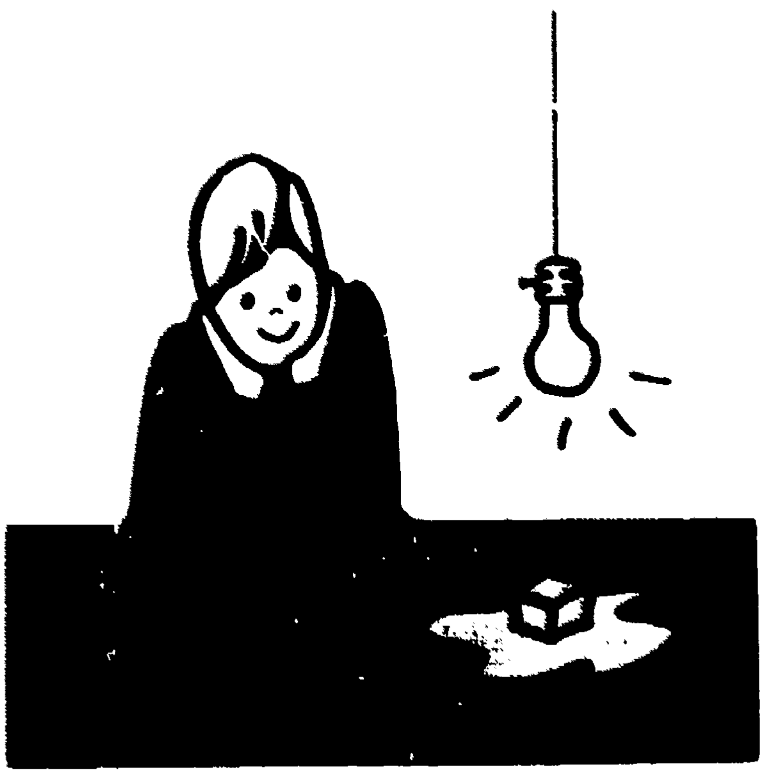
Provide the students with:

1. **Ice cubes,** two or three per student. For the best and quickest results, ice cubes should be small and uniform in size. Plastic trays can be purchased for party ice cubes of only ½ inch on an edge. The flat discs, squares, or hollow cylinders of ice made by some refrigerators also work well.
2. **Aluminum foil.** Have it available when the students want to make a container for their ice.
3. **Clock** for timing. Many students won't think of checking the time when they start. If you don't tell them to do this, they will learn it for themselves more impressively when they find that they are unable to compare their results with the other students' results.
4. **Foam plastic cups, paper towels,** and other **insulating materials.** Have them available around the room for students to discover when they want to preserve an ice cube.
5. **Thermometers.** Have them available for refined information gathering.
6. **A large sponge.**

A schedule something like the following could be used with the ice cube games:

1. Pose the problem: Who can get an ice cube to melt really fast?
2. Set rules (i.e., methods or objects which might be "off limits" for your classroom situation).
3. Distribute the ice cubes.
4. Have the class play the game—maybe twice to take care of blunders.
5. Have the children who got their ice cubes to melt fast explain how they did it.

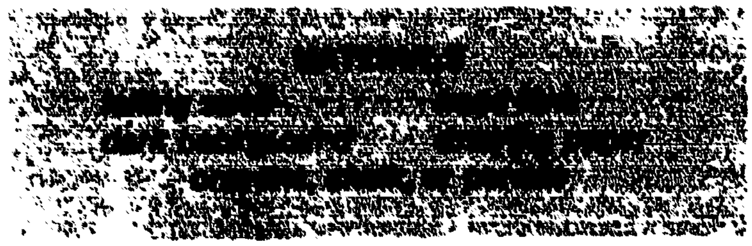
6. Have the children share ideas about the "real" goal of the game producing or reducing heat and the best way they found to reach this goal.
7. Collect some of their information and make a list.
8. Discuss the list why are certain things on it?
9. Try the game again with a little more emphasis on collecting data and keeping records. Introduce the thermometers for anyone who wants to use them.
10. Note the techniques of three or four of the fastest meltings.
11. Try the game again if students are still interested.
12. Have the students predict how long it would take an ice cube to melt in some new location that hasn't been tried yet—under the water from the drinking fountain or under a light bulb. Then test the predictions. You could establish four to ten stations around the room which have not already been used in the solutions. Have the class predict the time necessary to melt an ice cube at each station, after consulting the existing data and recording any new data which seems necessary.



13. Try the reverse game of preserving an ice cube as long as possible. Use the same procedure as above.
14. You might want to bring a large block of ice to school and set it in one part of the room. Ask each child to estimate when he feels there will be no more ice left. If he thinks it will happen overnight, on what morning does he think all the ice will be gone?

SNOW CRYSTALS

I. Falling Snow Crystals



Background:

Snow crystals begin to develop about 35,000 feet (6 miles) above the earth, in a layer of the atmosphere where there are cirrus clouds and a comparatively small amount of water vapor. The wind carries salt particles from the sea spray up to this height. The snow crystals begin to develop when water molecules form in a pattern of ice around these microscopic particles of salt or dust.

At first a snow crystal is a plain hexagonal crystal of transparent ice. As this flat, barely visible crystal floats around, more water molecules adhere in the shape of stubby arms. Then ice develops to fill in the spaces between these arms. The temperature at this height is between 30° to 35° F. below zero.

The snow crystal falls to about 20,000 to 25,000 feet, arriving at the top layer of altostratus and altocumulus clouds, where the temperature is about 20° F. The snow crystal falls through this cloud layer and continues to warm. As the crystal falls, it picks up more water molecules and develops six more legs with odd, pear-shaped decorations on them; more thin ice forms between these legs.

The snow crystal slowly becomes a larger plate with thickened edges and sharply pointed corners. The crystal churns about and slowly sinks into lower, active stratocumulus clouds, which are about 12,000 feet above the earth. The temperature here is about 0° F. The crystal continues drifting downward, acquiring six broad plate-like extensions at each corner.

As the crystal floats downward it grows more and more rapidly because of the increasing abundance of water droplets in the air.

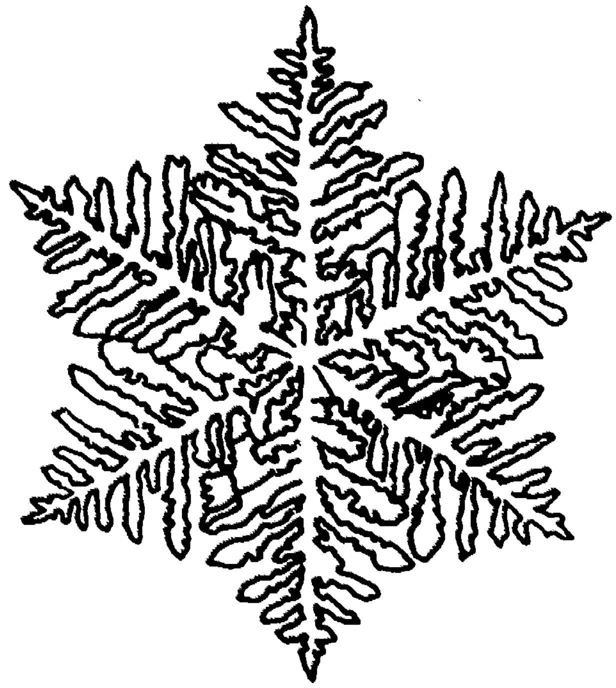
The crystal then falls through nimbostratus clouds where the temperature is between 5 and 10 degrees above zero. Needle-like arms shoot out and branching crystals grow from them simultaneously. The crystals touch and join while ice forms along the pointed arms.

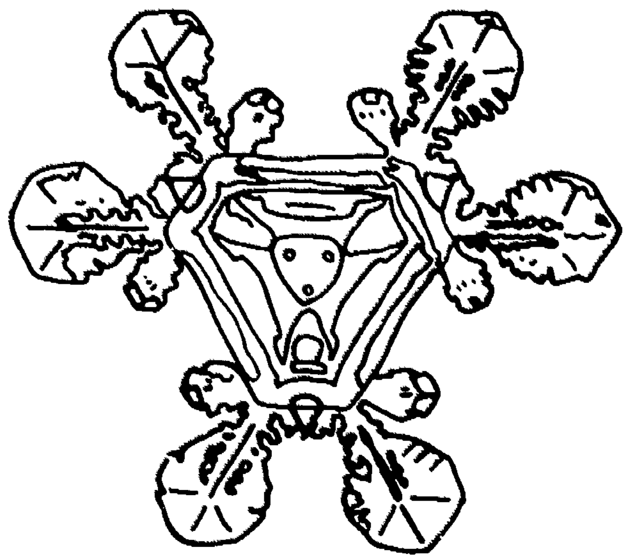
The flat crystal revolves and skims back and forth on the air as it floats downward. The points continue to extend, ice branching from them, and hexagonal plates forming at the end of each point. This continues until the crystal approaches about 3/16 of an inch in size. The flake is now heavy enough to leave the cloud and fall rapidly to earth.

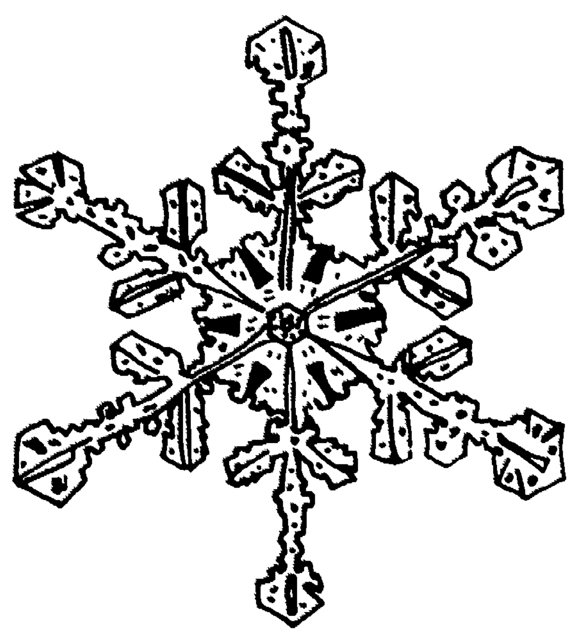
Activities:

Have the students **catch** falling snow on a dark cloth, or **locate** newly fallen snow on a dark surface.

Then have them **examine** the newly fallen snow.







Ask:

Is each crystal unique?

Are there basic types of snow crystals?

Can you find snow crystals with a distinctly different pattern?

Are any snow crystals broken?

What might break them?

Have the children **draw** or sketch some snow crystals from their observations.

Discuss with the students whether they have recorded the important characteristics of snow crystals in their drawings.

Have them **list** the important characteristics of snow crystals.

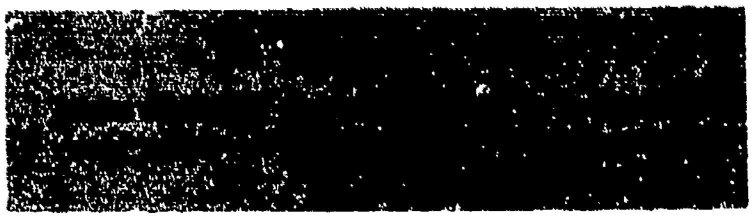
With the class, **examine** slides of preserved snow crystals (instructions follow). Also examine the illustrations included by copying them on a transparency and projecting them. You might want to secure additional pictures of snowflakes from *Snow Crystals*, Bentley and Humphries, 228 pp., 2,450 photos of snow crystals; "Snowflakes," *National Geographic*, Jan., 1970; and/or *Ranger Rick's Nature Magazine*, Dec., 1970, pp. 14-16.

Have the class **draw** or sketch snow crystals again, including the additional information which the students have accumulated.

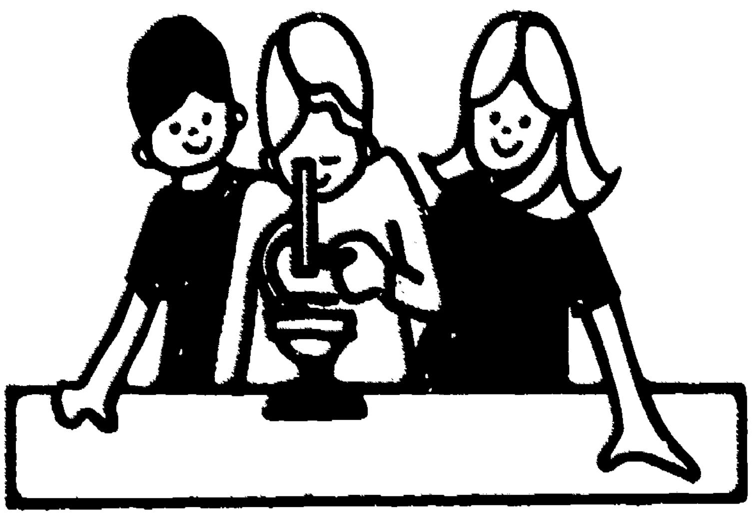
Snow forms in many crystal shapes, each dependent upon temperature and other air conditions. Not very much is known yet about the weather conditions which produce different kinds of snow crystals. The most common snow crystal, however, is the six-sided fern patterned one.

II. Preservation of the Snow Crystal Shapes

It is possible to preserve snowflakes by using a clear lacquer spray on a slide.



Store the slides and lacquer in the freezing compartment of your refrigerator. Wait until it is snowing, then quickly take the slides outside so they don't have a chance to warm up. Hold each slide on a small piece of cardboard or wood so that the heat from your hand does not make the slide warm. Spray a thin coat of clear lacquer on the slide, and then hold the slide out in the snow until several snowflakes have fallen on it. Keep the slide outside in the cold, but protected from the snow for an hour while it dries. After the hour is up and the slides are dry, bring them in and examine them with a microscope or hand lens.



* Instead of using microscope slides, lantern slides (for a 35 mm. slide projector) might be used. When the activity is completed the slides can then be projected and the children can look at all of the snowflakes at the same time.

III. Old Snow

Background:

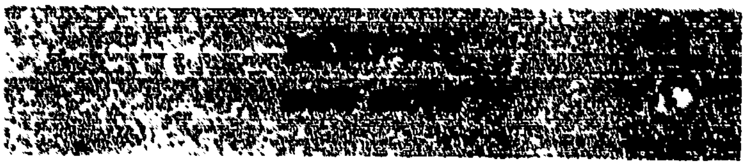
Snowflakes begin as delicate crystals but are soon transformed into the granular crystals which are found within and at the bottom of a layer of snow. They change their form during the evaporation of the many fine points that form angles between the delicate crystals. This evaporation makes the air around the crystals very moist. The moisture recondenses (because of the coldness) and deposits particles of ice onto the flatter, smoother surfaces of the crystals. It is this continuous evaporation from sharp points and condensation onto flat places which transforms the crystals into little lumps of ice.

This kind of snow makes the best sliding and skiing conditions because the small, rounder crystals roll easily under the object which travels over them. It is not easy to slide or roll across new snow with sharp edges. Try this out with skis or a toboggan with riders and then without riders.

Activities:

Ask the class how a freshly fallen snow crystal could be distinguished from an old snow crystal that has been lying on the ground for a while. Have the students collect a few examples of each type of crystal and examine the crystal shapes with magnifiers. The children should take samples of the crystals of the accumulated snow from all the way down at the ground, and note any difference in the crystal form between these and the crystals on the top. Ask the children if they suppose that the snow which fell first, and is closest to the ground, fell as the crystal form they now observe.

IV. Cross Section of a Snow Bank



1. Have the class locate an undisturbed snow bank.
2. Using a snow shovel or similar object, have a student slice straight down as far as possible, making a clean cut to the soil level.
3. Have the class examine the various levels of snow which are exposed. They may locate:

thick layers	dirty layers
thin layers	icy layers
clean layers	crusty layers

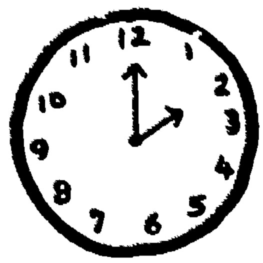
4. Have the students try to determine what conditions created these layers.
5. They may want to examine weather records to determine the age of the snow in the various layers.

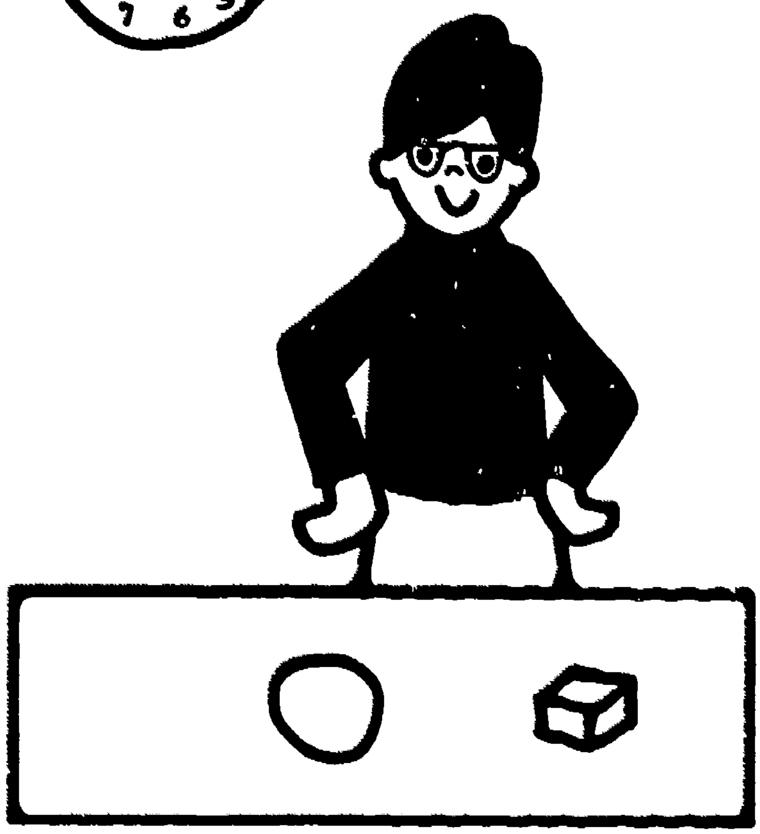
V. Snow Density

Your class should now have enough background to delve into more thorough investigations and activities.

Problems to pose:

- Which melts faster, an ice cube or a snowball, both weighing the same amount?





- How much water, at different temperatures, does it take to melt a cup of snow? (Water at 40 F. will melt only 5.5% of its weight in snow; at 60 F. it will melt 20% of its weight in snow.)
- How many cups of snow are needed to make one cup of water? (Snow will be fluffy and packed more loosely at the top of an accumulated layer on the ground. This freshly fallen snow has a lot of air between the crystals. Ten cups may be needed to make a cup of water. But snow found within an accumulation will be packed by both the weight of the snow above it and by the recrystalization into more dense particles, which has already been explained. It may take only three to five cups of the denser snow near the ground to melt down to a cup of water.)
- Will a foot of newly fallen snow be equal to a foot in depth one week later?

Activities:

- Drifted snow will contain broken crystals of newly fallen snow. Since a drift is made up of these very fine particles of crystal fragments which are small enough to fit together tightly, the drift may get very densely packed. When snow crystals are packed tightly together and then evaporate and recrystalize, they are prone to freeze together where they touch. It could be said that this snow is "cemented" together. It holds together well enough to be cut into blocks with a shovel or blade. The class may want to experiment with these snow blocks by building snow houses, forts, or windbreaks. Unfortunately, cemented snow is not always easy to find. If your search is successful, have the class test this snow for density by seeing how many cups it takes to make a cup of water.

- When snow begins to melt it does not drip and run like an ice cube. The porous nature of snow allows the water to soak in between the crystals, like ink on a blotter. A good guessing game could be that of sticking a snowball on a pencil in a heated room and asking the students to guess how long it will be before the first drop of water falls off the snowball. (It may take as long as one hour.)

SNOW TEMPERATURES

Background:

Snow is a good insulator. Heat can't move through it because of the reflection from snow's shiny crystals and the air spaces between the crystals. Since snow is able to "trap" heat in this fashion, a blanket of snow is a relatively warm blanket. A layer of snow covering the ground will keep the soil temperature fairly constant during the winter, even if the air temperature changes greatly.

Consider these measurements taken in a schoolyard with a snow cover of about 18 inches (zero degrees Centigrade is the freezing point of water):

Snow Depth of 18 Inches

	Air Temperature Above the Snow	Soil Temperature			
		2' From Bldg.	5' From Bldg.	10' From Bldg.	25' From Bldg.
1st Day	5 C.	· 3	· 2	1	2
2nd Day	21 C.	· 2	0	2	4

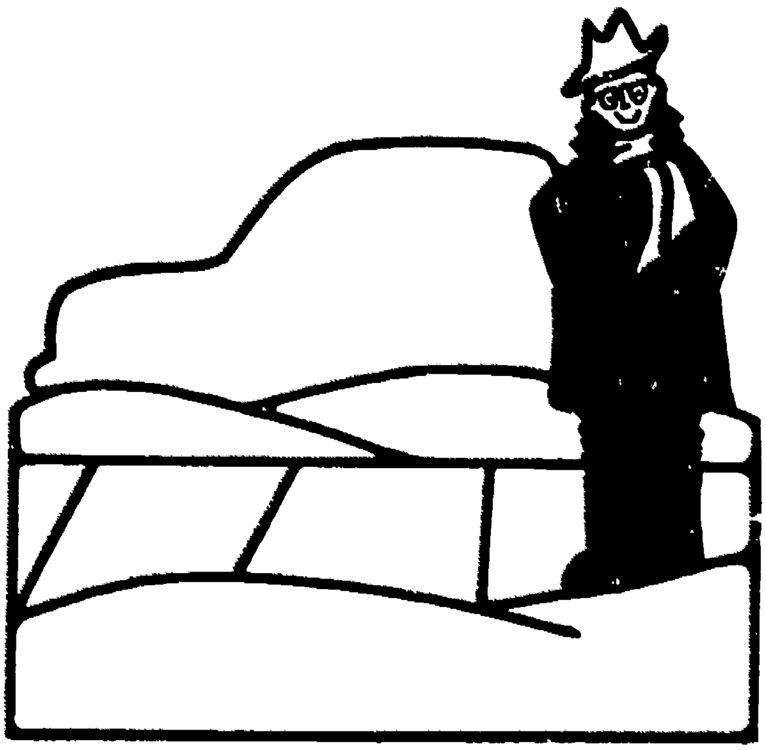
This chart shows that the heat in the ground, part of which comes from the foundation of the building, is able to keep the soil from freezing under a cover of snow, even in very cold weather. This would not be likely to happen without snow.

Also, the snow helps maintain a 17 degrees C. difference between air and soil on the coldest day. This means that the soil is only slightly below freezing when the air is 21 C. (5 F.). If the air temperature should rise above freezing, say to 5 or 6 C. (41 to 43 F.), then the snow would keep the soil cooler than the air. (A great deal of additional heat would be unable to penetrate a snow cover, just like most of the heat which was already in the snow cover couldn't escape in the previous case.) On warm thawing days in winter, temperature readings would therefore show a reversal of the temperature difference on the pr ceding chart.

These temperature differences under snow have a marked effect on the survival and behavior of animals and plants. Obviously, organisms will be kept warmer, on the average, and will not be subjected to extreme fluctuations of temperature, when they are covered with a layer of snow. Also, organisms are protected from wind chill and wind drying when covered with snow. The children may be able to suggest some additional effects, and elaborate.

Snow also affects human behavior in the winter. Have the children discuss the following situations:

- Mr. Novak's car was completely snowed in during a big snow storm. Mr. Novak was sick when this happened, and didn't get his car shoveled out until a week later. On the day Mr. Novak shoveled out his car it was very cold. All the people down the street were having trouble starting their cars because of the cold. Mr. Novak's car was a kind similar to other people's cars, but his car started right away.



Ask the children if this story gives any clues as to why Mr. Novak's car started easily.

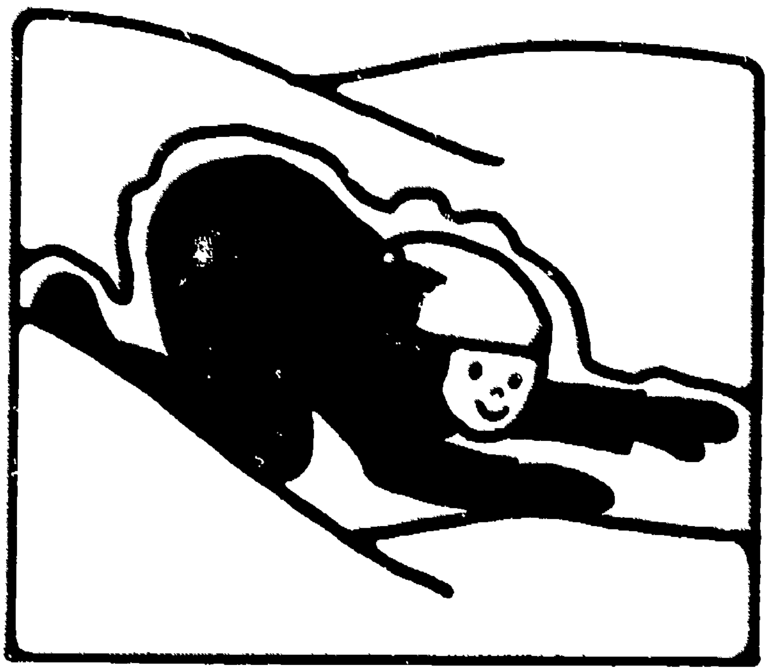
- Every winter Mrs. Wellington hires a boy to shovel a big pile of snow up against the north wall of her house. Why does the class suppose she would do this?
- It was 15 C. (or 5 F.) out one day. That is way below freezing. There was snow covering the ground all over. But there was wet mud right in the schoolyard.

  Does the class know where? Ask the children if they know how that could be in such cold weather. (You'd better check first. but most likely the soil within one or two feet of the school building foundation will not be frozen if there is a cover of snow of at least four to six inches.)
- In many places where there are wild plants growing, there are some kinds of spring flowers which will send up leaves or blossoms before the snow is gone from the ground. If the snow is frozen, and if plants cannot grow when they are frozen, how do the students think that the spring flowers can grow through the snow? (The soil is not frozen.)
- Mr. Jasper waits for the bus every morning. On the corner where he waits, Mr. Simonton shovels away the snow very carefully so that the bus riders will have a place to stand. But Mr. Jasper will never stand and wait in the shoveled place. He always goes and stands in a pile of snow, up to the tops of his overshoes. Mr. Simonton thinks that Mr. Jasper is a strange old man. Why does the class suppose that Mr. Jasper stands in the snow pile to wait for the bus?

Activities:

The children can test the snow cover outside to see whether there is a difference in conditions above and below the snow by:

1. Burrowing in just to test the feel of it. It will seem more sheltered under the snow. There will be less biting chill on noses and cheeks as long as snow does not touch skin. (If it touches the skin, it will draw off skin heat in the process of melting, and make it seem colder than it is.) It also may seem damper under the snow.



2. Digging down to note the condition of the soil. Is it frozen or not? Is the grass still green?
3. Studying temperature differences—
   a. The children can take random measurements at first, or maybe play a game to see who can find the warmest or coldest spot. A discussion of what was discovered could lead to a desire for a more organized collection of data so that some conclusion might be reached about snow temperature.
   b. Preparation for thermometer measurements—

- Select a number of stations. Mark them with a stick or with dry tempera color sprinkled on the snow. Select stations that will provide the widest possible divergence of results such as:
  — near the school building and away from it
  — in deep snow and in shallow snow
  — under bushes and in the clear
- Put long, colored cords on thermometers so they won't be lost in the snow.
- Have the children work in pairs or in groups. For fast work in cold weather, each pair of children could be responsible for only one reading.

c. Measurements with a thermometer—
- Measure air temperature in at least three locations.
- Measure the temperature halfway down in the snow.
- Measure the temperature at soil surface.
- Collect data on a big picture chart.
- Form conclusions. Can any of the problems in the previous situations for discussion about how snow affects humans be solved now?

I. Snow As an Insulator

The purpose of this section is to determine temperature differences between air inside boxes which are exposed to the wind on the north and south sides of the building, and boxes which are covered with a thick or thin layer of snow.

Background:

1. Have the children cut a small door on one side of each of six boxes. The doors should be only large enough to permit a hand and thermometer to enter. The students should cut only along three sides of a door so that it can be swung shut after each temperature reading. A 2-inch screw could be placed in each door to use as a handle.
2. Have the children seal the box tops closed with masking tape.
3. It may be necessary to place one or two heavy stones in each box as weights against the wind.
4. Have the class plan locations for the boxes.
   a. One box should be placed flush against the building, but exposed to the wind and temperature. It would be wise to select a spot where the snow does not tend to drift. Keep this box free of snow at all times.
   b. The second box should be placed on the same side of the building as the first box, but buried under a foot of snow and kept at that depth at all times.
   c. The third box should be placed in direct sunlight for as much of the day as possible.

   d. The fourth box should be placed in as little sunlight as possible (shaded all day).
   e. The fifth box should be buried under about four inches of snow on all exposed sides. Keep it covered to this depth as much as possible and check the snow depth every morning with a yardstick.
   f. The sixth box should be placed under one foot or more of snow on all exposed sides. Keep it covered at this depth, and check the snow depth every morning with a yardstick.

All six boxes should be placed directly and squarely on the soil, either underneath all the snow or in an area which has been cleared. It is important that they all touch the soil.

Activities:

1. Have the students check and record the temperature of the air near each box.
2. Have them check and record the temperature of the air inside each box. This will probably take between five and ten minutes. The colder it is, the longer it will take to get an accurate reading. You will probably want to have a child check the thermometer periodically the first or second time that a reading is taken, to establish a proper time duration for an accurate temperature measurement. It will be necessary to dig in at the side of the buried boxes where each door is located, in order to get a thermometer inside. Have the children lay it down inside each box. Be sure to replace the snow cover at the proper depth for the boxes which are buried.
3. Have the class repeat this reading under varying weather conditions over a one- or two-week period.
4. When all the information is gathered, have the class examine the results.
5. Discuss the findings. Have the children make predictions and generalizations about snow temperature. Did they find that snow is a good insulator? How much effect did they find that the sun seems to have upon winter temperatures? Did they discover that the depth of the snow cover makes a difference in the insulation which is provided? Have them suggest what other factors may have influenced their findings. Have the class invent other activities to go with the problem.

II. Snow Cave Investigation

Problems to pose:

- How warm is it in a snow cave?
- Is it warmer in a large snow cave or a small one?
- What factors influence the warmth?
- How much warmth will one candle generate in a snow cave?
- What are the factors which influence the amount of heat given off by a candle in a snow cave?

Activities:

Snow caves can best be dug out of snow banks at the edge of sidewalks where the snow has accumulated from shoveling to a height of four feet or more, with one edge cleared (as you would find along a sidewalk).

If you cannot find such an area, it will be necessary to pile up the snow and pack it down as you go along.

Dig the entrance to the cave with a shovel or by hand (other tools such as garden trowels, jar covers, and so forth could also be used).

The children will probably want to check temperatures in the following areas:

- an unoccupied cave
- a cave occupied by one or more individuals
- a cave insulated with inventive techniques
- a candle-heated cave
- a little cave
- a big cave

It will become evident that records are needed. These may be made as the activities progress or may be decided upon before the activities begin.

ICE THICKNESS

Problems to pose:

- How fast does ice develop?
- What factors influence this development?
- How thick does the ice become in a container?
- What factors influence the thickness of ice?
- Does ice ever get thinner?

Activities:

You will want to pose the problems and then allow the class time for contemplating them. One way they might devise to investigate the problems would be to place the same number of cupfuls of water in several containers. In a separate container they might want to double the amount of water. Each container should be numbered with crayon on the outside, and each should have the water level marked on the outside also. All the containers should be brought outdoors on a cold day and placed in a location where they won't be blown away. The children could then observe and record what happens.

There are a number of factors which you may want to encourage the class to test.

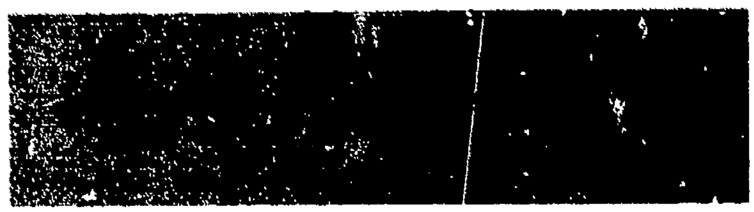
- influence of air temperature on ice thickness
- influence of water temperature on ice thickness
- size of the container
- amount of water
- temperature of water under the ice
- thickness of the ice
- time needed to develop ice
- influence of time on ice thickness
- location of ice formation—top, sides, or bottom of can
- portion which freezes last

To study the problems, and to look at all the influencing factors, many tests will need to be set up under different environmental circumstances.

Encourage the children to keep readable and useful records.

SNOW ART

I. Snow Paintings



It's fun to use powdered tempera paint sprinkled out from a container with holes in it, to create a picture in the snow.

The powdered paint can be placed, for instance, in a salt shaker or babyfood jar with a hole or two punched in the top.

A day without wind is necessary to avoid having the paint land on the children. Painting along the edge of walks is easiest. Tracks in the snow will mess up the paintings if the child walks into the area he is painting.

It may be possible for a child to "shake paint" in a larger area by incorporating his tracks into the picture, or it may be possible to put the shaker on a long stick for a larger picture.

II. Frost Drawings

When you have frost on your windows it can be fun to mark off square inches on the frosted window and have several children draw what they see.

Cut a square inch out of the center of a large piece of **dark** paper. Prop this paper against the window or tape it from the frame. It will expose a pattern in the one inch area which was cut away.

Have one child reproduce this design in pencil, crayon, or chalk on another piece of paper. Then move the dark paper to expose another inch for another child to draw. The whole window can be reproduced this way and the parts displayed together, in sections, or separately, by those who are interested.

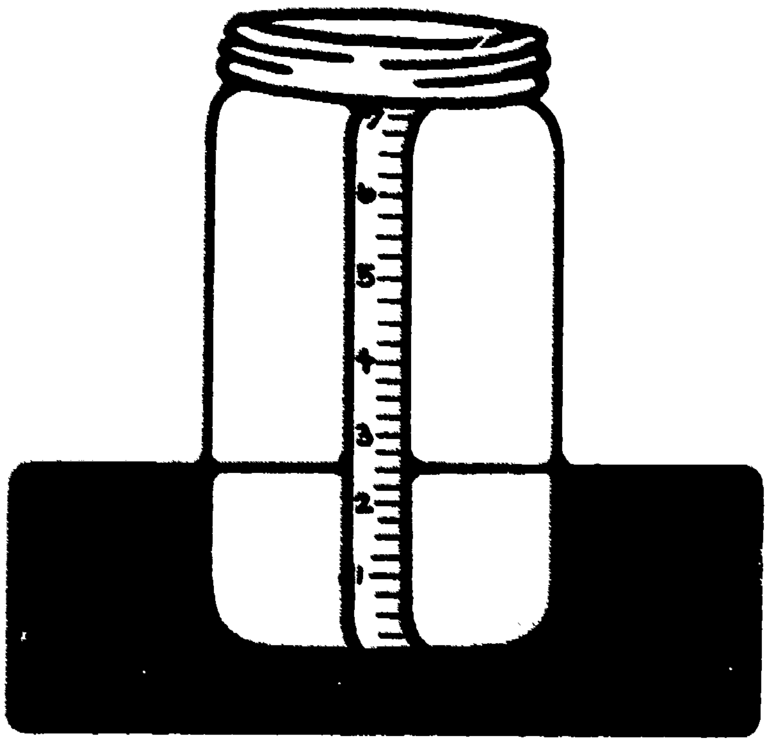
WIND AND SNOWDRIFTS

Snow depth and drifts are of concern to many people and organizations. The highway department tries to control the drifting of snow by constructing snow fences, thus making its snow removal job less difficult. The farmer knows that a heavy snow coverage is good for his soil because it keeps the ground from freezing to as great a depth as it would without the snow. His soil, therefore, remains more porous and can better receive and hold spring rains. Foresters have begun creating drifts to hold the snow on the tops of mountains. The result is many more days of spring runoff for the valleys below.

The effect of wind on snow can be related to the effect of wind on soil. Wind erosion of the land takes place in a way similar to that of the formation of snowdrifts, but at a much slower rate. You may wish to relate the children's work with snow to the problem of the erosion of soil by the wind.

I. Making a Snow Gauge

A snow gauge can be made from a large, wide-mouthed jar or a tin can. Place a piece of masking tape on the outside of the jar, or the inside of the can, from the top to the bottom. Mark this tape in inches and half inches beginning at the bottom.



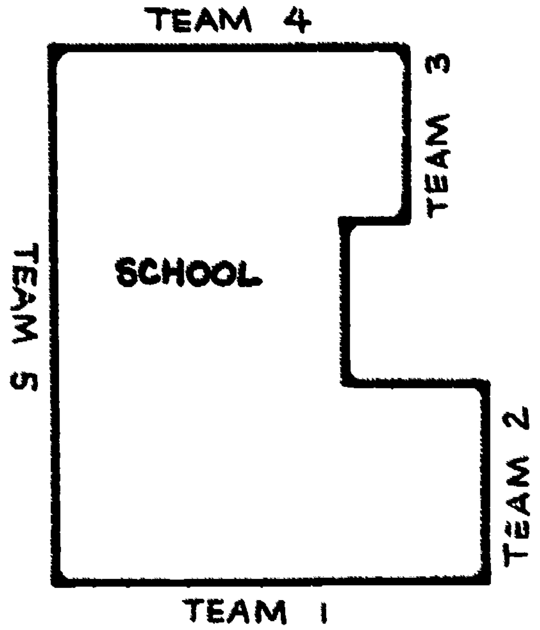
Place this gauge outside away from buildings and trees. After each snowfall check the amount of snow in the gauge. Record and compare these measurements with the weather bureau's reports. Empty the jar each time a recording is made so it is ready for the next snowfall.

Prepare ten or more gauges to establish snowfall over a large area, for use with the other "Wind and Snowdrifts" activities.

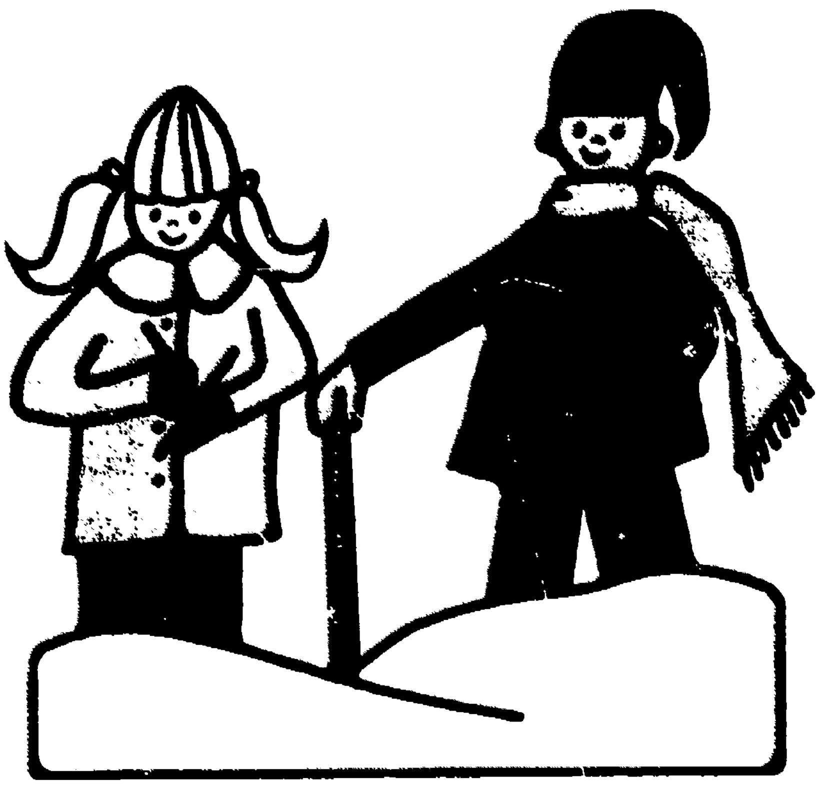
II. Drifts Around the School Building

The purpose of this section is to raise a question in the student's mind as to why drifts occur and why they are of different shapes and depths.

Have the class investigate the shape of the snowdrifts on opposite sides of a building in the following way:



1. Have the students check the depth of the snow right next to the building. To check the snow depth, have them stick the yardstick straight down into the snow (1" end down!) until it hits the ground. The number that is level with the surface of the snow is the depth of the snow at that point.



2. The next reading is taken two feet further from the building. Children proceed in this fashion, recording each depth on the clipboard until they have taken fifteen readings, each two feet apart, on an imaginary line which is perpendicular to the building. When all the measurements have been collected, return to the classroom.
3. Tell the children they will now make a picture of their snowbank as it would appear if they sliced it in half and looked at it from the side.
4. Have the children tape sheets of ¼-inch square graph paper together until they have enough paper on which to record the drift; ¼ inch will represent 1 inch for both the bottom (inches from building) and side (inches of snow depth) of the graph. Since they covered about 30 feet from the building they will need enough graph paper to represent 360 inches, or about nine sheets taped end to end.
5. Have each team construct a graph representing the profile of its drift. Tape the graphs on the classroom wall. Group together the graphs which represent the same side of the building.
6. Combine teams into discussion groups of four students each. A team from one side of the building might be combined with a team from another side of the building. Have them discuss their two graphs and try to account for the differences between them. Each group should prepare a list of differences in the drifting pattern (depth, length, etc.) between the two sides of the building, and try to account for these differences to the class. When they give reasons for the differences, the students might refer to wind, wind direction, wind speed, obstacles, and so forth.
7. Cautions
   a. If you have a choice, the best building for the drift study is a square one because it creates the most predictable wind eddies.
   b. The best grounds are flat and bare, extending for a sizable distance in all directions from the building. However, a slight slope will have little effect on the results.
   c. If possible you should have the children avoid areas containing snow cleared from walks and drives by the snow blowers.

III. Creating a Snowdrift

The purpose of this section is to study the effect of the shape of an obstruction on the formation of drifts by the wind. Hopefully, the class will also gain a feeling for what happens to the wind as it hits an obstruction.

In the following activities the children will discover how obstructions to the wind cause wind eddies which in turn build and sculpture snowdrifts.

1. Explain to the children that they will attempt to create some snowdrifts like those they studied around the school building, only on a smaller scale.
2. Select a flat area such as a baseball field which is free of obstacles and barriers. The snow in this area should be smooth and even in depth. It is desirable that the area not be heavily trafficked.
3. Using various shapes and sizes of objects the children will create barriers to the wind by inserting them into the snow with about half the object above the snow level. They might use objects which they find around the schoolyard. They might bring boxes or boards or other objects from home to use. The only rule is that they must let the wind do the work of moving the snow around.
4. If the snow is light and dry, the drifts will occur easily and dramatically. If it is wet and heavy the drifts will occur more slowly and be less evident. It may be necessary to wait for a new snowfall.

5. When enough time has been allowed for the drifts to form, ask the children to find the answers to the following questions.
   a. Who had a long drift? Why was it so long? (The end of a drift is that point where the snow levels out and maintains a consistent depth. The depth can be measured using the technique in "Drifts Around the School Building.") The length of the drift will depend upon the height of the obstruction, how directly it faced the wind, and its shape.
   b. Who had a wide drift? Why was it so wide?
   c. Did anyone cause the wind to dig a hole in the snow? Rounded objects will cause the wind to whip out the snow and create a hole.
   d. Who had a deep drift? This will depend not only on the height of the barrier, but also on how directly it faces the prevailing winds.
   e. Who had a tiny drift?
   f. What happens when the wind blows snow around something with no corners? The children may answer this by using round objects such as basketballs, tires, etc.
   g. What happens when the wind blows snow around a cube-shaped object? Someone may shove the open end of a cardboard box into the snow and observe the drifts that develop around it.

You might want to break the class into teams and have each team work on one of these problems:

a. creating a very long drift
b. creating a very wide drift
c. causing the wind to dig a very deep hole in the snow
d. creating a very deep drift
e. creating a tiny minidrift
f. creating a great number of different kinds of drifts using an object of one shape and size. (They might use shoe boxes for this one.)
g. creating a very odd-shaped drift. (A very asymmetrical object such as a toy doll might be suitable.)

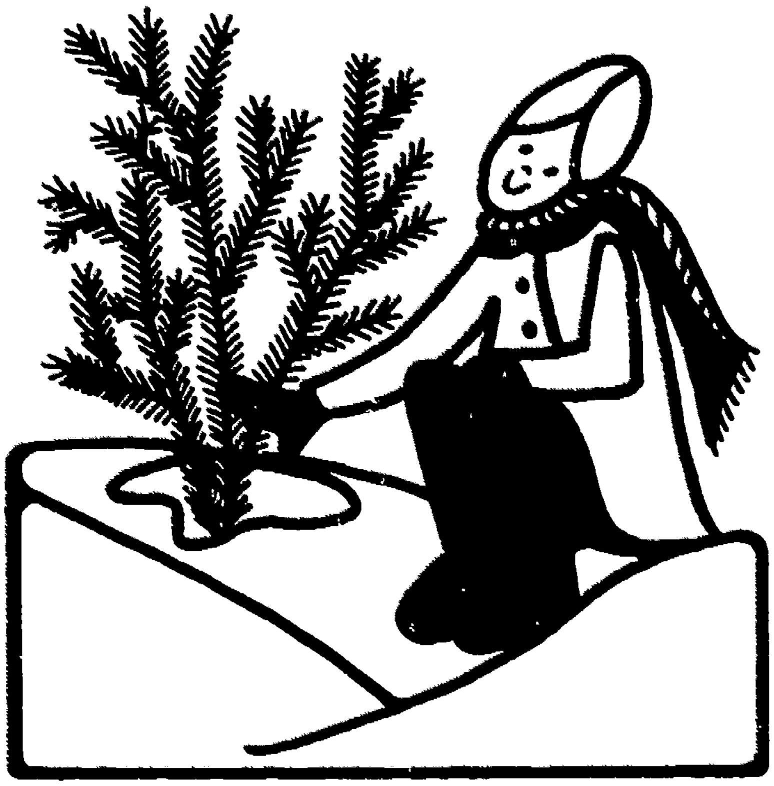
Make sure that the students pick up the items they used for creating the drifts!

You may want to end this section by reading the first three stanzas of John Greenleaf Whittier's "Snowbound" to the class.

IV. Natural Drift Patterns

Each team of students should locate and study a number of natural drift patterns using the graph of the drift profile as a tool. They might study large drifts formed by snow fences, shoveled snow, bushes, etc. They might study small drifts such as those formed around stones, chunks of snow, tree trunks, telephone poles, etc. More than one profile should be taken for each drift studied.

Each team should always attempt to answer the question, "From which direction was the wind blowing?" by studying the graphs.



V. Changes in Drifts

Have each team select a fairly large drift to study. You may want to assign several teams to a drift. The best time to begin this study is following a fresh snowfall. Over a period of a week have the teams examine their drifts for changes.

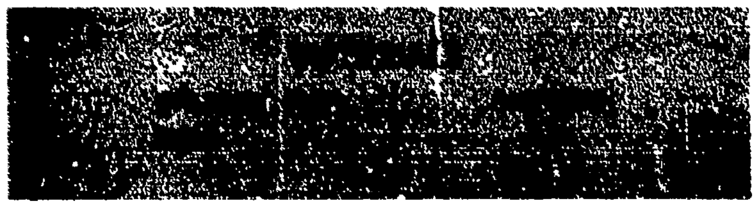
A. Change in profile

1. Each team should make an initial profile graph.
2. Each following day, at about the same time, they can make additional profile graphs, being careful to take their depth measurements directly beside the one from the preceding day.
3. At the end of the week the teams should study their graphs, noting changes in length of drift and in depth of drift. Do they have any ideas as to why these changes took place? Most of the changes will be caused by consolidation of the snow. If no team presents this idea as a reason for changes in depth, the students might repeat the activity calling for examination of the shape of snow crystals at different depths in the drift (see the section on "Snow Density"). Other conditions which the teams might suggest caused the changes are: the melting of the snow which made up the drift, or the additional accumulation from a new snowfall.

B. Change in surface appearance

These changes are unpredictable. New patterns might appear as the condition of the snow or wind changes. The class might make sketches of any surface patterns. Another change which the students might want to consider or investigate is the development of a crust.

C. Change in compactness



As the drift settles and as changes take place in the lower layers, the drift becomes more compact. This can be tested simply by the following method:

1. Provide each team with a glass or cup, all of which have the same diameter bottom, and marbles.
2. Have the children mark their glass or cup with tape, a half inch up from the bottom.
3. Each team should then set the cup on the drift and place marbles inside it until the cup sinks to a level where the mark on the side of the cup meets the top surface of the drift. The measure of compactness equals the number of marbles which had to be added. If the cup sinks to the mark without adding marbles, the measure of compactness is zero.

4. Have each team measure the compactness of a drift every day or so for two weeks after a snowfall. Ask the children to try and account for the differences. Ask them if the number of marbles they add increases each day.

CLUES TO LIFE IN THE SNOW

I. Tracks in the Snow

There are many small animals that live in and around buildings and grounds, even in the city. Most of these animals stay active during the winter.

If your school grounds include an open field of weeds and tall grasses, or a low, swampy area, mice, shrews, and moles may be present. If the grounds border on a woody section, add birds and squirrels to the list of possible animals.

Although most of these animals are very secretive in their habits, you may find their tracks in the snow. Take your class to the study area when the weather has been above 20° F. for a few days. (These animals come out of their burrows more often during warm weather.)

Have the children bring paper, pencils, and a ruler along. Examine the area closely for tracks on the snow. The children may find tracks of birds or squirrels, possibly rabbits, and quite probably the small, delicate markings of mice. Ask them to look closely at a group of footprints and draw four of them carefully. Someone may measure the size of the tracks and include this with the drawing.

When they return to class, ask the children to write a story about the animals. It may be purely imaginative or it may contain some of the factual information they gained on the field trip.

Refer to an animal tracks handbook from the library for identification sketches of tracks. (*A Field Guide to Animal Tracks*, by Olaus Murie, Houghton-Mifflin, 1954).

II. Homes in the Snow

The meadow mouse is a creature that stays active all winter long. He stores winter food in underground storerooms and spends the winter in his underground tunnels. On warm days the meadow mouse will come out of his tunnels and scurry across the surface of the snow. The class may have found his tracks during the preceding study. An area which contains a meadow mouse population will be honeycombed with surface runways tunneled beneath the snow at ground level. The best conditions for the study of these tunnels are found in early spring when the snow has begun to melt. Ideally, there should be about two inches of heavily crusted snow on the ground. If these snow conditions do not exist, you may have less success locating the runways.

A. The study area

The presence of meadow mice is likely if you have access to a field which is low and moist during the summer, with grasses and vegetation. If you are not this fortunate, do some imaginative "poking around." These creatures exist in many situations. Investigate any areas whose vegetation has not been severely manicured. Ditches, the periphery of baseball fields, and the railroad rights-of-way are a few possibilities.

Look for entrances. Sometimes these are round holes in the snow, but more often they look like cracks and are identified only by lifting back the snow crust, and exposing the round pathway beneath.

B. Who is it?

1. When you have located the study area, divide your class into groups of four students.
2. Tell them they will be going outside to investigate an animal that lives under the snow.
3. Ask them to make up a list of things they will want to look for which might serve as clues as to how the animal lives.
4. The class should discuss the lists and make up one composite list of clues which everyone will seek.

5. Take the students to the area and allow them to investigate until someone locates a tunnel under the snow. They may want to see where it leads. Let a few students uncover the tunnel and follow it until they lose it.
6. Return to the classroom.
7. Has anyone guessed what creatures made the tunnel? Make up a list of all the different animals the children suggest. Ask the children to examine the list. Are there any members of the list they can scratch off after observing the tunnel? (For example, maybe some animals on the list are too large to fit in the tunnel.)

C. Eating habits

1. Have the children make a list of different foods they think the creature might eat. Their first suggestions will probably include foods children eat. Remind them that animals often eat things we would not think of eating. Maybe they can suggest a few more foods which animals eat but human beings might not want to eat. A good list of foods to entice the animals might include: cereals, fruits, vegetables, meats (cooked and raw), eggs, candy, paper, marshmallows, coffee, tobacco, toothpaste, etc. Ask the children to bring some of these items from home. Each team could be made responsible for collecting and investigating one or two of the food items.
2. Have each team locate a tunnel entrance (trying not to trample the area).
3. Have each team place one of its assigned foods into the tunnel entrance. The students should place a stick or other marker at the tunnel entrance in case it snows.
4. Allow about two days to pass before checking the food. The children can record if the food is completely gone, if it has been chewed, if it has been moved, or if it is undisturbed. Have them list the items and describe what happened to each one. Based on this one test, what kinds of foods does the class think the animal seems to prefer?
5. Re-examine the list of possible animals. If the children cannot narrow it down to the mouse, provide them with pictures of the meadow mouse from science books.

EXTENDED ACTIVITIES

I. Different Views of Snow

There are many ways to look at snow other than from a scientific viewpoint.

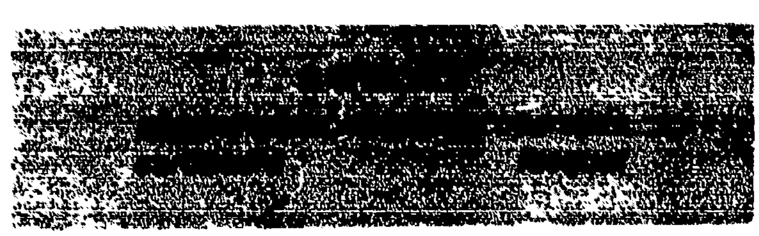
When snow is viewed as a part of our environment, almost everyone considers it a beautiful sight. The type of beauty they see, however, is modified by their individual point of view.

The scientist may see the perfection of the hexagonal crystal; the artist may see the glistening cover; the poet may see feathery icelets in the air; the skeptic may see a whitewash of the world. This list can go on and on—the child can see snow as his new playmate; his father can see it as something cold which slows his ride to work.

As the children involve themselves in these snow activities it would enrich their experience to discuss how various people view snow, and then have the children imagine themselves to be that other individual.

- Have the children draw a picture (as they think an artist would see snow).
- Have the children write one or more poems (as they think a poet might express his feelings for snow).
- Have the children draw or write about children's fun with snow.
- Have the children collect newspaper and magazine pictures and articles which depict people dealing with, enjoying, or being hampered by snow.
- Have the children collect ideas or pictures illustrating why man needs snow.
- Have the children read poems and stories involving snow and ice.

II. Preserving Frost Patterns



On a clear cold night set a pane of glass or a microscope slide on cardboard and place it where frost will collect on it. Heap snow around the cardboard. The warmth around the cardboard will cause some snow to melt slightly. The moisture which comes in contact with the glass will become cold again and re-freeze, forming frost crystals. Frost can also be collected on the underside of a glass, metal, or plastic plate placed on a tube which extends through the snow to the soil surface. The soil is moist and on a cold night it will be warmer than the air, especially when the ground is insulated by snow. Moisture will collect on the underside of the plate and become frost overnight.

Place the collecting appartus in the shade so that the sun does not melt the frost before you get to it. In the morning, spray the frosted surface with lacquer from a spray can which has been stored in a freezer. Leave the appartus outside until the lacquer hardens. Then you will have a permanent replica of the frost pattern for study.

III. Taking Samples of Snow

MATERIALS

can with top and bottom removed
can with bottom intact — *cardboard*

Have the children remove the top and bottom of a straight-sided can. Then have them push the can straight down into the snow until its upper rim is flush with the snow surface. They should now reach under the can and place one hand or a piece of cardboard under the bottom edge of the can. Have them remove the container of snow with hand or cardboard, and slide off any heaping snow on the top. The children should dump the snow from the cylinder into a can whose bottom is intact. Finally, have them melt the snow and test for water content, dirt, etc. Have them take samples of various kinds of snow.

IV. Melting Test

MATERIALS

heavy-duty aluminum foil — *scissors*
paint brush
black paint

Have the children cut four squares from heavy-duty aluminum foil. Have them leave one piece as it is, shiny on both sides. Two pieces should be painted black on one side only, and the fourth piece should be painted black on both sides. After the paint is dry, have the children gently lay them in a row on clean snow in a sunny area. One of the identical pieces should be placed with the black side down, and the other with the black side up. After two or three hours, have the children examine the pieces of foil. Ask which has melted farthest into the snow. Which has melted the least? Can the class explain this? They may want to repeat the experiment using paper painted with all different colors (a red square, a blue square, etc).

V. Cinders and Snow Banks

Often a snowplow will scrape up cinders and gravel and toss them to the side where they become part of the snow bank that lines the street. In time, the sun will warm the cinders and gravel, causing them to melt their way down into the snow, and leave protruding points behind them. Have the class examine these protrusions and see if there is any particular direction toward which they point.

BIBLIOGRAPHY

Bell, Thelma Harrington, *Snow*. New York: The Viking Press, 1954.

Webster, David, *Snow Stompers*. Garden City, N.Y.: Natural History Press, 1968.

THE ENVIRONMENTAL UNITS

Below is a list of the first titles in the Environmental Discovery Series. The ones with order numbers next to them are available as of August, 1972. The others are in preparation and will be available in the coming weeks. Also, ten additional units will be announced soon.

Next to the titles, we have suggested the grades for which each is most appropriate. We emphasize that these are suggested grade levels. The teacher is encouraged to adapt the activities to a wide range of grade levels, and subject areas depending upon the interests and abilities of the students.

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