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ABSTRACT

This experimental edition provides a number of activities useful for investigating snow and ice with elementary school children. Commencing with games with ice cubes, the activities lead through studies of snowflakes, snowdrifts, effects of wind and obstacles on the shape and formation of drifts, to a study of animals living under snow. The emphasis is on involving children in discussions concerning the need for careful recording of observations to reach valid conclusions. Important ecological effects, such as the insulation afforded by snow, are stressed. Additional activities concerning temperature effects and suggestions for relating snow studies to other curricula areas are included. Necessary meteorological information is supplied for the teacher. This work was prepared under an ESEA Title III contract. (AL)

SNOW AND ICE

These activities were devised to fill a big gap in environmental science lessons for elementary school children. They are in first draft form and have yet to be tested in the classroom. Some activities are only general suggestions, others are explained in detail. They all suggest an investigative approach and active involvement for the student.

Please let us know how we should revise these activities so that they can be used more effectively.

ENVIRONMENTAL SCIENCE CENTER
5400 Glenwood Avenue
Golden Valley, Minnesota 55422

544-8971

SNOW AND ICE

These are activities in which children get "a feel for" many physical properties related to water and freezing.

If we verbally explained all of these properties to the children in terms of physics and chemistry, we would certainly make them sorry they had come to school. But it is not necessary for them to "know" about water in this way to understand how water will behave in different situations. And just being told is no fun anyhow!

Relationships between water and temperature were first discovered by experimenting. Experimenting for the first time is often called fooling around. Much of this fooling around done by kids is good experimenting, but one thing is often missing which would make their behavior much better experimenting. Remembering what caused the event to happen the way it did is often missing. Most people remember what happened but they are usually pretty hazy about what caused it to happen.

We hope the procedure outlined here will help students find ways of remembering "causing factors" and perhaps also to get "a feel" that these factors are as valuable to know as what happened. Because knowing what causes things to happen allows a person to predict what will happen next.

Relationships between water and temperature are important things to understand because they, in turn, are so intimately related with the world we have to live in. Without the special behavior of water, our world would be so different we wouldn't recognize it, even if we could be alive to see it. Our would would be more like the moon.

The emphasis of these activities are directed toward snow and ice. Other lesson units of the Environmental Science Center deal with rain, humidity, and erosion, which is the behavior of water that can be experimented with in warmer months.

Heat, or the lack of it, is what causes most of water's behavior. It is well not to make this proclamation to the children because this is what we think they will discover after fooling around (experimenting) with snow and ice. To steal their prize discovery from them by handing them the statement of it before they investigate would make the activity anticlimactic. That would be like telling someone "who done it" as you hand them your favorite murder mystery.

The way we think children will learn to remember what caused things to happen is by putting special emphasis on observing and measuring and especially on keeping records. We emphasize record keeping by trying to get the student to find that it is valuable to keep records so that he can gain the power of predicting or perhaps even causing things to happen himself. Observing and measuring automatically fall into place because they are what must be done in order to have something to record.

The importance of snow to living things in north-temperate America has been dramatically overlooked in curricula. Children grow up with the idea that snow is good for kids to play in or it is a nuisance and must be shoveled.

Very few people seem to be aware of the ecological importance of snow and ice. Somewhere in their schooling, children should become acquainted with such relationships as: many more animals and plants will survive a winter when there is deep snow; the soil does not freeze as deeply with a heavier snow cover; snow (frozen water) saves up a good proportion of a winter's water supply which is released in the spring; water freezes more rapidly in the wind than when it is sheltered in freezing weather; a lot of heat is involved in melting ice.

To be aware of these relationships through active manipulation of real snow and ice a student will be able to see his environment from some new, realistic points of view.

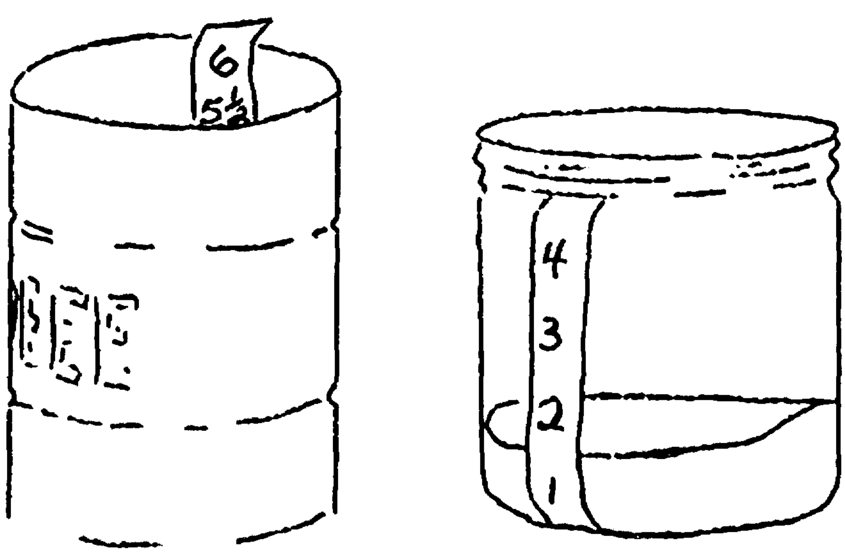
CONTENTS

MAKING A SNOW GAUGE

You can make a snow gauge from a large, wide mouthed jar or a tin can. Place a piece of masking tape on the outside of the jar 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. Check the amount of snow after each snow fall. Record and compare with the weather bureau's reports. Empty the jar each time so it is ready for the next snow fall.

Prepare ten or more gauges to establish snow fall over a large area for use with the "Wind and Snow" activities.



ICE CUBE GAMES

Who can get an ice cube to melt fastest? Who can get an ice cube to last longest? (Any method within reason is permissible.)

These games (begging your pardon) break the ice on a series of activities about snow and ice. These are fun games. They are not original, but have proven effective for similar studies in the past.

The main point is to get children to feel a need to collect information. They also get the idea that the information collected is selected information — that it must be relevant to some objective to be useful. In this case the information must be relevant to rapid melting or to preserving the ice cube.

The student who has collected the most relevant information should be best able to win the games. His information may have been picked up through past experience or it may be picked up from the game. In either case it is important that the student becomes aware that he is basing his behavior on collected information and the more relevant this information the more capably he will solve his problem or attain his objective.

We would suggest that the teacher help collect data from all the students after the game has been played once or twice, and then have the students play it a few times on the basis of the newly compiled information. Relevant information will mostly fall under two general categories: conditions which are good for melting ice cubes, and conditions which don't melt ice cubes very well.

Maybe you will get information like this:

Good Conditions	Poor Conditions
radiator	desk top
mouth	in a box
pocket	blowing on it
crushing	cold room

Don't give the children any clues; let them find out for themselves. After they have collected a list of relevant information (and why not call it just that), they should be able to refine their procedures and further diminish the time for melting.

When trying to keep an ice cube from melting the smallest space and best insulation should win out.

Materials and Set-up:

1. Ice cubes, 2 or 3 per student. For best and quickest results the ice cubes should be small and uniform in size. Plastic trays can be purchased for freezing party ice cubes of only 1/2 inch on an edge. The flat discs, squares, or the hollow cylinders of ice made by some refrigerators, also work well.

2. Have aluminum foil available when the students want to make a container for their ice.

3. Clock for timing. Most students will neglect to check the time when they start. If you don't remind them to do this they will learn to do so more impressively when they find that they are unable to compare their results with other students.

4. Foam plastic cups, paper towels, and other insulating materials available around the room for students to discover when they want to preserve an ice cube.

5. Thermometers for refined information gathering.

6. A large sponge.

We suggest a schedule something like the following to be used with the ice cube games:

1. Pose the problem: Who can get an ice cube to melt the fastest?

2. Set rules (for your own sanity only).

3. Distribute ice cubes.

4. Play the game — maybe twice to take care of blunders.

5. Reward the winner.

6. Dialogue — that is, have the children share ideas about what the objective is and the best way of reaching the objective.

7. Collect some information and make a list.

8. Dialogue a little more.

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 (everybody will).

10. Reward the winner and particularly note the techniques of three or four of the fastest meltings.

11. Try the game again if students are still interested.

12. Or, students can predict how long it would take an ice cube to melt in some new location that hasn't been tried yet, like under the water from drinking fountain or under a light bulb. Then test out the predictions. You could establish (4-10) stations around the room which had not been used in the solutions. Predict the time necessary to melt an ice cube at each station after consulting data and recording any new data felt necessary.

13. Try the reverse game of preserving an ice cube as long as possible. Use same procedure as above.

SNOW TEMPERATURES

Background:

Snow is a good insulator. It prevents heat from moving through it because of both reflection from its shiny crystals and because of all the air spaces between the crystals. A blanket of snow is a warm blanket -- relatively. 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 school yard with a snow cover of about 18 inches. (Zero degrees Celsius is the freezing point of water.)

Snow Depth of 18 Inches

Air Temperature Above The Snow	Soil Temperature Number of Feet Away From the Building			
	2	5	10	25
1st Day -5° C.	$+3^{\circ}$	$+2^{\circ}$	-1°	-2°
2nd Day -21°	$+2^{\circ}$	0°	-2°	-4°

This data shows that the heat 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 is not likely without snow.

Also, the snow creates a 17 degree 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 degrees or 6 degrees C. (41 degrees to 43 degrees F.), then the snow would keep the soil cooler than the air. On warm thawing days in winter, temperature readings show a reversal of the temperature difference shown in the chart above.

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.

Materials:

Thermometers which register well below freezing

Posing a problem or question which considers snow affecting our behavior in the winter:

Some anecdotes:

____ Mr. Novak's car was snowed in completely during a big snow storm. But Mr. Novak was sick when this happened, and he 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 similar kind as the people's cars, but Mr. Novak's car started right away.

Does this story give 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 do you suppose she would do this?

___ It is -15° C. (or 5° F.) out today. That is pretty cold — way below freezing. There is snow covering the ground all over. But do you know that there is wet mud out there right in the school yard? Do you know where?

Do you know how that can 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 around here, where there are wild plants growing, there are also some kinds of spring flowers which will send up leaves or blossoms even before the snow is gone from the ground. If the snow is frozen, and if plants cannot grow when they are frozen, how can the spring flowers grow through the snow? (The soil is not frozen.)

___ Old Mr. Jasper waits for the bus every morning. On the corner where he waits, Mr. Simonton always shovels away the snow very carefully so that bus riders will have a place to stand. But old Mr. Jasper will never stand and wait in the shoveled place. He always goes and stands, up to the tops of his overshoes, in a pile of snow. Mr. Simonton thinks that Mr. Jasper is a rather strange old man. Why do you suppose that old Mr. Jasper stands in the snow pile to wait for the bus?

Activities:

Children can test the snow cover outside to see whether there is a difference in conditions above and below the snow.

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, thus drawing off skin heat by melting and making it seem colder than it is. It may seem damper, which it is, under 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. Children can take random measurements at first or perhaps have a game to see who can find the warmest or coldest spot. A discussion of what was discovered can lead to a desire for more organized collection of data so that some conclusion might be reached about snow temperature.

b. Preparation for thermometer —

1) Preselect a number of stations. Mark them with a stick or with dry tempra 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

   — under bushes

2) Put long, colored cords on thermometers so they won't be lost in the snow.

3) The children can work in pairs or in any combination. For fast work in cold weather, each pair of children can be responsible for only one reading.

c. Measurements with a thermometer —

1. Measure air temperature in at least three locations (shade the thermometers).
2. Measure temperature half way down in snow.
3. Measure temperature at soil surface.
4. Collect data on a big picture chart.
5. Can any conclusions be formed? Can any of the anecdote problems be solved?

SNOW AS INSULATOR

Materials:

- 2 to 7 medium sized cardboard boxes
- thermometers
- shovel
- yardstick

Purpose:

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

Problem A:

How much insulation does a blanket of snow provide?

Preparation:

1. Cut a small door on one side of two boxes. The doors should be only large enough to permit a hand and thermometer to enter. Cut these doors on three sides only so that it can be swung shut after each temperature reading. Place a 2 inch screw in each door to use as a handle.
2. Seal the box tops closed with masking tape.
3. Place one or two heavy stones in each box as weights against the wind.
4. Plan locations for the two boxes that are directly against the building and standing directly on soil. One box will be exposed to the wind and temperature so it would be wise to select a spot that does not tend to drift in. The second box will be kept under a foot of snow.
5. Put box directly on the soil.
6. Place the two boxes in their locations with the door section facing to the most convenient side for easy temperature reading.
7. Cover one with a foot or more of snow on all exposed sides — keep the snow a foot or more thick.
8. Keep the other free of snow.

Activities:

1. Check and record the temperature of the air near each box.
2. Check and record the temperature of the air inside of 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 time or two 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 box where the door is located to get the thermometer inside. Lay it down inside the box. Be sure to replace snow cover at proper depth.

3. Repeat this reading under varying conditions over a one or two week period.
4. Examine data.
5. Discuss findings, make predictions, invent other activities to go with the problem.

Problem B:

How much affect does the sun have on winter temperatures?

Preparation:

See Problem A. (1, 2, and 3)

4. Plan locations for the two boxes that will expose one to sunlight as much as possible and the other to sunlight as little as possible.

See Problem A. (5 and 6)

Activities:

1. Check and record the temperature inside each box during sunny periods and during cloudy periods.
2. Repeat the readings under varying conditions over several days.
3. Examine data.
4. Dialogue findings, other influences, invent tests for other influences.
5. Continue student suggested activities.

Problem C:

Does the depth of the snow cover make a difference in insulation provided?

Preparation:

See, or combine with Problem A. (1, 2, and 3)

4. Plan locations for the boxes that are directly against the building and standing directly on soil.

See Problem A. (5 and 6)

7. Cover one box with about four inches of snow on all exposed sides — keep covered to this depth as much as possible — check every morning with a yardstick.
8. Cover the second box with a foot or more snow on all exposed sides, keep covered at this depth, check every morning with a yardstick.

Activities:

1. Check and record the temperature of the air near the two boxes.
2. Check and record the temperature of the air inside each box.

See Problem A. (3, 4, and 5)

6. Continue student suggested activities, comparisons, and discussions.

EXAMINING 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 cirrus clouds occur and where there is a comparatively small amount of water vapor. The snow crystal begins to develop when water molecules form in a pattern of ice around a microscopic particle of salt or dust. (The salt comes from the sea spray and has been carried upward by the wind.) A beginning snow crystal is a plain hexagonal crystal of transparent ice.

As this flat, barely visible, crystal floats around, 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 degrees F. below zero.

The snow crystal falls to about 20,000 to 25,000 feet landing on the top layer of altostratus and altocumulus clouds. The temperature here is about -20 degrees F. The snow crystal falls through this cloud layer which becomes warmer and warmer, to about +14 degrees F. As the snow 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 becomes a larger plate with thickened edges and sharply pointed corners. The crystal churns about and slowly sinks into lower active stratocumulus clouds, about 12,000 feet above the earth. The temperature here is about 0 degrees F. The crystal continues drifting downward acquiring six broad plate-like extentions at each corner.

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

The crystal goes through nimbostratus clouds where the temperature is between 5 and 10 degrees above zero. Needle-like arms shoot out and at the same time branching crystals grow from them until they touch and join. 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 then hexagonal plates are formed at the end of each when it approaches about 3/16 of an inch in size. It is now heavy enough to leave the cloud and fall rapidly to earth.

Materials:

falling snow

dark background

hand lens

drawing paper

crayons, chalk, or pencil

Activities:

Examine falling snow or newly fallen snow.

Question: Is each crystal unique?
Are these basic types of snow crystals?
Can you find snow crystals with a distinctly different pattern?
Are any snow crystals broken?
What might break them?

Draw or sketch snow crystals from observation.

Dialogue about whether they have recorded the important characteristics of snow crystals in their drawings.

List the important characteristics of snow crystals.

Examine sides of preserved snow crystals (instructions attached). Examine the illustrations attached by copying them on a transparency projecting them.

Draw or sketch again including more information.

Notes:

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

PRESERVING THE SNOW CRYSTAL SHAPES

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

Materials:

- glass slides or pieces of glass
- clear plastic or lacquer spray
- cardboard
- magnifiers

Procedure:

Store slides and lacquer in the freezing compartment of your refrigerator. When it is snowing, quickly take the slides from the freezer outside so they will not warm up. Hold each slide on a small piece of cardboard or wood so the heat from your hand does not make the slide warm. Spray a thin coat of clear lacquer on the slide. Hold the slide out in the snow until several snowflakes have fallen on it. Allow the slide to remain outside in the cold, but protected from the snow for an hour for drying. You can now bring them in and examine with a microscope or hand lens.

OLD SNOW

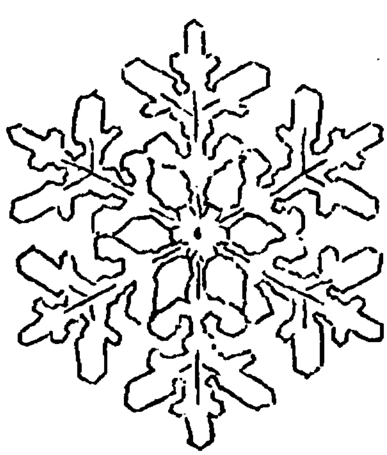
Background:

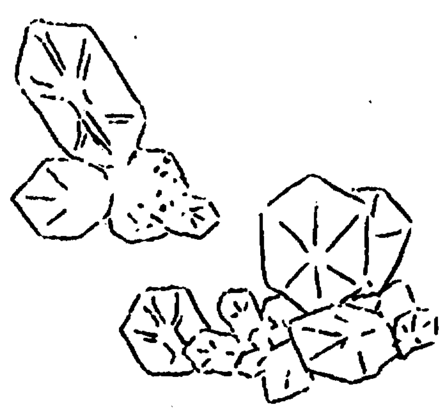
The original delicate crystals change their form to the granular crystals found within and at the bottom of a layer of snow. They change form through a process of evaporation from the many fine points and angles of delicate crystals. This makes the air around the crystals very moist (humid). This moisture recondenses (because of cold) onto the flatter, smoother surfaces of the crystals. This continuous evaporation from sharp points and condensation onto flat places transforms the crystals into little lumps of ice.

This kind of snow makes the best sliding and skiing because the small, more rounded crystals roll easily under the object traveling over them. New snow with sharp edges does not slide or roll easily and is harder to move across. Try this out with skis or a toboggan with or without someone on them.

Activity:

How can the freshly fallen snow crystal be distinguished from the old snow crystal that has been lying on the ground for a while? Collect a little of each and look at the crystal shapes with magnifiers. Now take samples all the way down to the ground from the collected snow and note any change in crystal form. Can we suppose that the snow which fell first, and is closest to the ground, fell as the crystal form we now observe?





CROSS SECTION OF A SNOW BANK

1. Locate undisturbed snow bank.
2. Using a snow shovel or similar object, slice straight down as far as possible making a clean cut to the soil level.
3. Examine the area exposed for levels of snow. You may locate:

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

4. Try to determine what condition created these layers.
5. Examine weather records to determine age of the snow at various layers.

DENSITY OF SNOW

Some Problems and Activities:

Which melts faster; an ice cube or a snowball, each of which weighs the same? How much water, at different temperatures, does it take to melt a cup of snow? (Water at 40 degrees F. will melt only 5.5% of its weight in snow; at 60 degrees F., 20%.)

How many cups of snow are needed to make one cup of water? Snow will be fluffy and least packed on the top of an accumulated layer on the ground. Fresh fallen snow has a lot of air between the crystals. Ten cups may be needed to make a cup of water. Snow found within the accumulated layer will be packed by both the weight of the snow above and by the recrystallization into more dense particles. It may take only three to five cups of the denser snow near the ground to melt to a cup of water.

Will a foot of new fallen snow be equal to a foot in depth one week later? Drifted snow will contain broken crystals of new fallen snow and although it is made up of very fine particles it may become very densely packed as these little fragments of crystals can fit tightly together. Test drifted snow for density by seeing how many cups of snow it takes to make a cup of water. When snow crystals become tightly packed together and then evaporate and recrystalize they can become frozen together where they touch each other. We can say that this snow is cemented together. It holds together well enough to be cut into blocks with a shovel or blade. Snow blocks are handy to use for building snow houses, forts, and windbreaks. Unfortunately, cemented snow is not always easy to find.

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

SNOW CAVE INVESTIGATION

Problems:

How warm is a snow cave?

Is it warmer in a large snow cave or a small one?

What are the factors that influence the warmth?

How much warmth will one candle generate in a snow cave?

What are the influencing factors here?

Materials:

thermometers

shovel

candles

matches

Notes:

Snow caves can best be dug out of snow banks at the edge of sidewalks where the snow has been built up from shoveling to a height of four feet or more and one edge of it is cleared as you would find along a sidewalk.

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

Dig the entrance and cave with a shovel and by hand (other tools could be garden trowels, jar covers, etc.)

The children will probably want to check the following temperatures:

unoccupied cave

occupied cave, one or more individual

insulated cave, inventive techniques

candle heated cave

little cave and big cave

It will become evident that records are needed. These may be created as the activities progress or may be predetermined depending on the degree of individualization appropriate to the class.

ICE THICKNESS

Problem:

How fast does ice develop?

What factors influence this development?

How thick does the ice in a container become?

What factor influences the thickness?

Does ice ever get thinner?

Materials:

containers — coffee cans of various sizes, milk cartons, etc.

thermometers

Notes:

You will want to pose the problem and plan time for contemplating the problem, suggesting tests to determine how fast ice develops, to bring equipment and to carry out the children's plans.

There are a number of factors you will want to encourage them to test.

- influence of air temperature
- influence of water temperature
- size of the container
- amount of water
- temperature of water under the ice
- thickness of the ice
- time needed to develop ice
- time's influence on thickness
- consider where ice forms — top, sides, or bottom of can
- what freezes last

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

Encourage the children to keep readable and useful records.

SNOW PAINTING

It's fun to use powdered tempera paint in a shaker container to create a picture in the snow.

The powdered paint can be placed 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 things is easiest. Tracks in the snow mess things up 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.

FROST DRAWINGS

When you have frost on your windows it can be fun to reproduce an area by having several children draw what they see in one square inch of the frosted window.

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 exposing a pattern in the one inch cut away area.

Have one child reproduce this in pencil crayon or chalk. Move the paper to expose another inch for another child to draw. The whole window can be done this way and displayed together or in sections and displayed separately by those who are interested.

WIND AND SNOW

Snow depth and drifts are of concern to many different 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 as 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 affect of wind on snow can be related to the affect of wind on soil. Wind erosion of the land takes place in the same way as the formation of snow drifts, but at a much slower rate. You may wish to relate the childrens' work with snow to the problem of soil erosion by wind.

I. Drifts around the school building

Materials:

yardsticks

clipboards or boards on which paper may be tacked

1/4" square graph paper

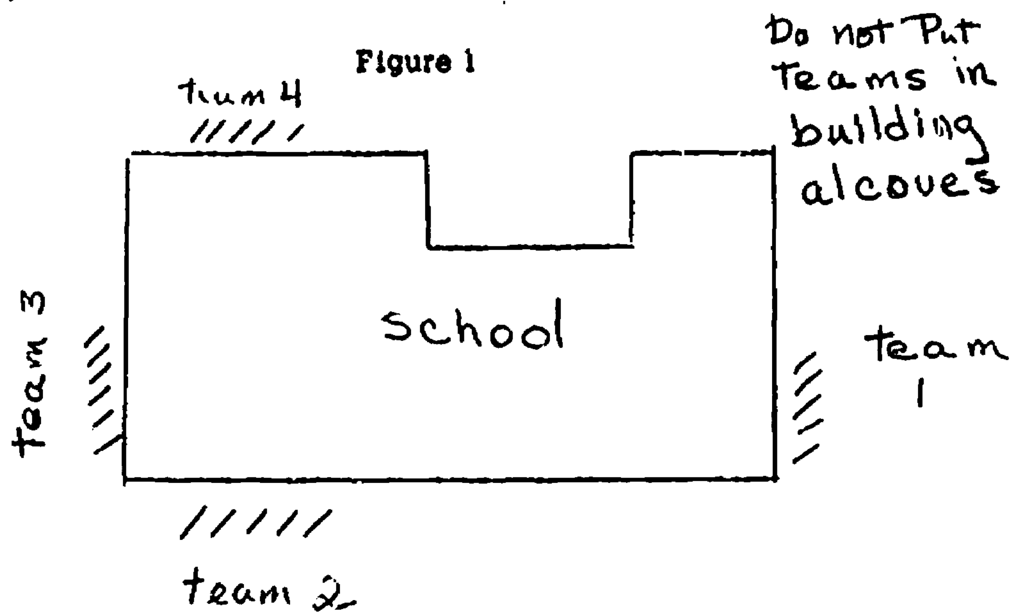
Purpose:

To raise a question in the student's mind as to why drifts occur and why they are of different shapes and depths.

Procedure:

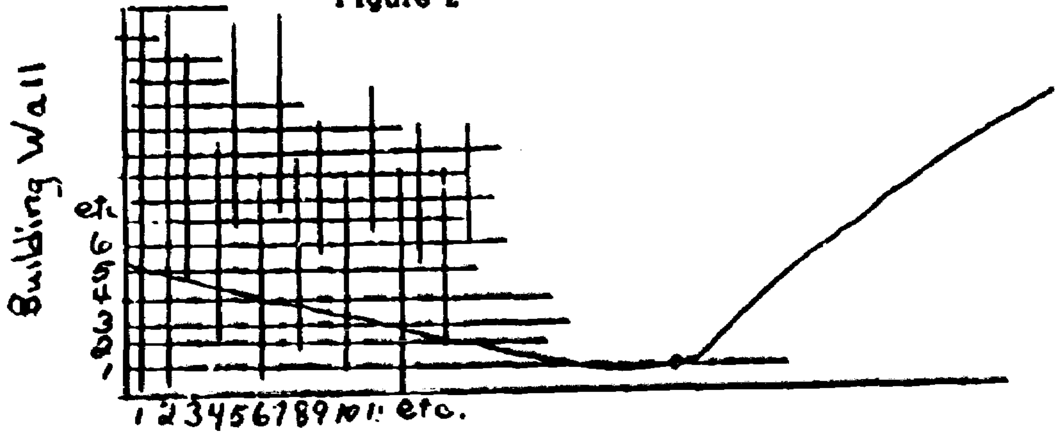
Investigate the shape of the snow drifts on opposing sides of a building in the following way:

Figure 1



1. Start next to the building, and check the depth of the snow every two feet until you reach the building. To check snow depth, stick the yardstick straight down into the snow (Number 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 farther from the building. Children proceed in this fashion, recording each depth on the clipboard until they have taken 15 readings. When all data has 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. Using a 1/4 inch squared graph paper, have the children tape sheets together until they have enough paper on which to record their graph, one inch of snow drift equals one square 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 for 360 inches or about nine sheets taped end to end (see Figure 2).

Figure 2



5. Have each team construct a graph representing their drift's profile. Tape the graphs on the classroom wall. Group the graphs together 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 groups of graphs and try to account for differences between them. Each group should prepare a list of differences in the drifting pattern (depth, length, etc.) between their 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, etc.

7. Cautions

   a. If you have a choice, the best building for the drift study is a square one as it creates the most predictable wind eddies.

   b. The best grounds are flat, bare grounds, extending for a distance in all directions from the building. However, a slight slope will have little effect on the results.

   c. If the snow fall has been heavy, you may want the children to avoid areas containing snow cleared from walks and drives by the snow blowers.

II. Creating a snow drift

Materials:

scrap material brought from home or collected around school (bottles, pieces of wood, styrofoam meat trays, etc.)

Purpose:

To study the effect of the shape of an obstruction on the creation of drifts by the wind. To gain a feeling for what happens to the wind as it hits an obstruction.

Procedure:

In the following activities they will discover how obstructions to the wind cause wind eddies which in turn build and sculpture the snow drift.

1. Tell the children they will attempt to create some snow drifts such as 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 they 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 school yard. They might bring boxes or boards or other objects from home to work with. The only rules are 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 more 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 snow fall.

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 the longest drift? Why was his longer than anyone else's? (The length 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 I.) 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 the widest drift? Why was his wider than anyone else's? (See #1.)

   c. Did anyone cause the wind to dig a hole in the snow? Rounded objects will cause the wind to whip the snow out creating a hole.

   d. Who had the deepest 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 the tiniest 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 happened when the wind blew snow around a cube shaped object? Someone may have shoved the open end of a cardboard box into the snow and observed the drifts that develop around it.

You might want to select judges and have contests to find:

   a. Who can create the longest drift?

   b. Who can create the widest drift?

   c. Who can cause the wind to dig the deepest hole in the snow?

   d. Who can create the deepest drift?

e. Who can create the tiniest minidrift?

f. Who can create the greatest number of different kinds of drifts using one shape and size object? (You might use shoe boxes for this one.)

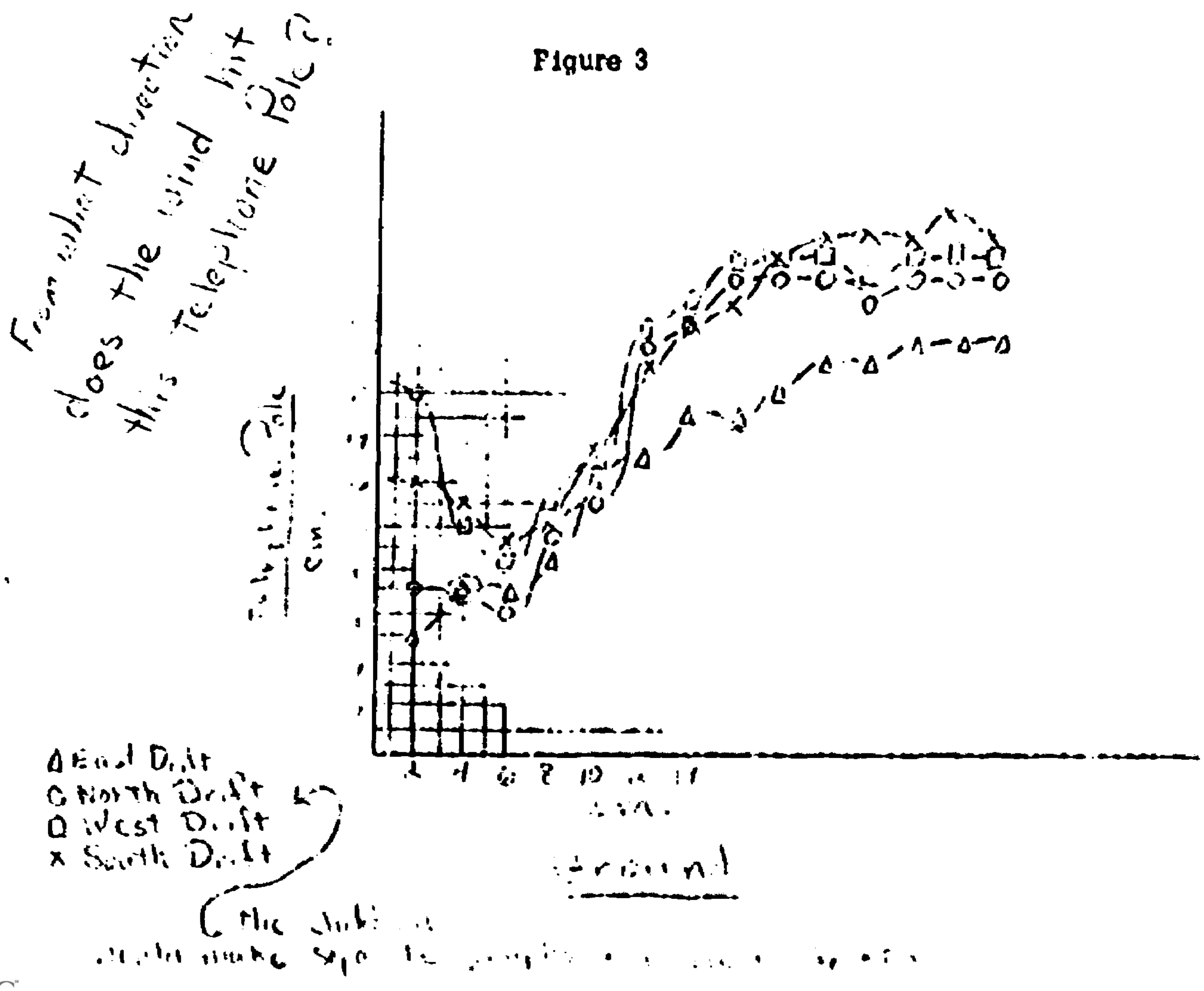
g. Who can create the oddest shaped drift? A very asymetrical object such as a toy doll might be suitable.

III. Natural drift patterns

Each team 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 (see Figure 3), etc. More than one profile should be taken for each drift studied.

They should always attempt to answer the question, "From which direction is the wind blowing?", by studying their graphs.

Figure 3



IV. Does a drift change?

Have each team select a fairly large drift for study. You may want to assign several teams to a drift. The best time to begin this study is following a fresh snow fall. Over a period of a week have them examine their drift 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? Mostly the change will be caused by compaction of the snow. If no team presents this idea as a reason for change in depth they might repeat the activity calling for examination of the shape of snow crystals at different depths in the drift (see that lesson). Other ideas the teams might offer are melting and new snow fall.

B. Change in surface appearance

These changes are unpredictable. New patterns might appear as the condition of the snow changes and the wind. The class might make sketches of any surface patterns. Another change which may take place is the development of a crust.

C. Change in compactness

1. As the drift settles and changes take place in the lower layers, the drift becomes more compact. This can be tested simply by the following method. Provide each team with a glass or cup having the same diameter bottom, and marbles.
2. Have the children mark the glass about a half inch up the side.
3. Each team sets the cup on the drift and places marbles in it until it sinks to the mark on the side. The measure of compactness equals the number of marbles added. If the cup sinks to the mark without adding marbles the measure of compactness is zero.

OUTLINE OF ACTIVITIES FOR "CLUES TO LIFE IN THE SNOW"

I. Tracks of animals such as birds, squirrels, and mice

II. Home of the meadow mouse

A. locating the study area

B. starting to identify the animal

C. food investigation

D. a close examination of his pathways

Materials:

clipboards

garden trowels (optional)

stakes (four per team)

plastic bags

grease pencil

CLUES TO LIFE IN THE SNOW

I. Tracks

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

If your school grounds include an open field of weeds and tall grasses, mice, shrews, and moles may be present. If the grounds border on a woody section, birds and squirrels will be added to the list of possible animals. If you are fortunate enough to have access to a low, swampy area, you will find mice, shrews, and moles particularly prevalent.

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 degrees for a few days. These animals come out of their burrows more often during warm weather. Have them bring paper and pencils and a ruler along. Examine the area closely for tracks on the snow. The children may find tracks of birds or squirrels, possibly rabbit tracks, and likely the small, delicate markings of mouse tracks. Ask them to look closely at a group of footprints and carefully draw four of them. Someone may measure the size of the tracks and include this with the drawing. When they return to their room, ask the children to write a story about their animal. It may be pure imagination or it may contain some of the factual information they gained on their field trip.

Refer to an animal tracks handbook from the library for identification sketches of tracks. (A Field Guide to Animal Tracks, Murie, 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 and in tunnels under the snow. On warm days the meadow mouse will come out of his tunnels and scurry across the surface of the snow. You may have found his tracks during the preceding study. An area which contains a meadow mouse population will be honey combed with surface runways tunneled beneath the snow and at ground level. The best conditions for the study of these tunnels is found in early spring when the snow has begun to melt. 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, during the summer, is low and moist with grasses and vegetation which have been allowed to grow. 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. The perifery of baseball fields, the railroad right-of-ways, and ditches are a few possibilities.

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

B. Who is it?

1. When you have located the above area divide your class into groups of four students each.
2. Tell them you will be going outside to investigate an animal that lives under the snow.
3. Ask them to make up a list of things which may be clues to how this animal lives.
4. The class should discuss the lists and make up one list of things which everyone will look for.
5. Take the class 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 these creatures are? 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 based on their observations of the tunnel? For example, maybe some members on the list are too large to fit in the tunnel.

C. Eating habits

1. Have the class 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 add a few more things of this type. A good list of test foods might include the following: cereals that are ready to eat and cereals that require cooking, fruits, vegetables, meats that are cooked and meats that are raw, eggs, candy, paper, marshmallows, coffee, tobacco, toothpaste, etc. Ask the children to volunteer these items and bring them from home. Each team may be made responsible for collecting and investigating one or two of the food items.

2. Each team locates a tunnel entrance (trying not to trample the area).

3. Each team places one of their assigned foods into the tunnel entrance. They should place a stick or some 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 on, if it has been moved, or if it is disturbed. List the items and describe what happened or did not happen to them. Based on this one test, what kinds of food does he seem to prefer?

D. A close examination of the pathways

1. Equipment: A small garden trowel works well for lifting the roofs off the runways. Clipboards or paper tacked to a wooden board to keep paper off the damp ground. Pencils for recording. Small plastic boxes for enclosing items found along the runway. Grease pencil for writing on the plastic boxes.

2. Limit the area that each team is to examine. Have each team measure an area approximately 12 feet on a side and place a stick at each of the four corners. Tramp a line in the snow between the stakes so the entire area is enclosed in a square. These are their boundaries.

3. Careful and systematic procedures must be followed.

   a. Each member of the team should select only part of the area for examination.

   b. The tunnels should be uncovered carefully by lifting off the roofs with the trowel. Tunnels which branch off should be followed also.

   c. To avoid trampling tunnels, the children should start at the edge of their enclosed area, sit down, and completely examine an area within their reach before moving to another spot.

   d. Look carefully for anything the runways contain such as droppings and nests. These items should be collected and placed in plastic boxes or bags. (A mouse nest is a large, globular mass of grass and fibers, about six to eight inches in diameter. The children might find old summer nests above ground. Winter nests are built in pockets connected with the underground burrows. Their nests are made of dry grass and sedges from the surrounding area.)

   e. Note any entrances to underground tunnels found along these surface runways.

4. Recording is an important part of any scientific study. The teams shoulc make a map of the tunnels on the paper. Large, squared graph paper aid in the drawing of these maps. The location of items found along the run way should be recorded on the map also. For example, a pile of droppings might be drawn on the map as a group of small circles. The children might give the pile a number. This number is also written on the plastic bags that contain the droppings. The box of droppings and the map can later be correlated in the following studies.

5. Comparison of maps and items collected. Combine teams in the classroom. Ask them to list differences between their maps and collections. Can they find reasons why these differences exist? This may require a return visit to the study area.

6. Re-examine the list of possible animals. If the children cannot narrow it down to the mouse, tell them that it is the mouse.

7. Provide the children with pictures of the meadow mouse from science books.

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SNOW — EXTENDED ACTIVITIES

There are many ways to look at snow other than the scientific point of view.

When we look at snow as a part of our environment most everyone sees beauty — beauty, however, modified by our point of view.

The scientist may see the perfection of the white hexagonal shaped crystal, the artist may see the glistening cover, the poet may see "feathery icelets in the air," a sceptic may see it as a whitewash of the world. This list can go on and on — the child can see snow as his new playmate or a father see it as something cold to get out of the way.

As the children in your class involve themselves in these snow activities it would enrich the experience to discuss how people look at snow from their points of view and then have the children imagine themselves to be that other individual.

1. Draw a picture as an artist would see snow.
2. Write one or more poems as a poet might express his feelings for snow.
3. Draw or write about childrens' fun with snow.
4. Collect newspaper and magazine pictures and articles about people dealing with, enjoying, or working with snow.
5. Collect ideas or pictures of how man needs snow.
6. Read poems and stories involving snow and ice.

PRESERVING FROST PATTERNS

On a clear cold night set a pane of glass or a microscope slide on a cardboard where frost will collect on it. In the morning spray the frosted surface with plastic in a spray can that has been stored in the freezer. Leave it outside until the plastic hardens. Then you will have a permanent replica of the frost pattern for study.

It is also possible to collect frost on the underside of a glass, metal or plastic plate placed over a tube which extends through the snow to the soil surface. A cardboard box, open at both ends, can serve as a tube.

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 as frost over night on the underside of the plate.

Heap snow around the box. Place the box in the shade so that the sun does not melt the frost before you get to it.

TAKING SAMPLES OF SNOW

Remove the top and bottom of a straight sided can. Push the can straight down into the snow until its rim is flush with the snow surface. Reach under the can and, by hand or with a piece of cardboard, cut the snow even with the bottom edge of the can. Remove the cylinder of snow with your hand or cardboard and slide off any heaping snow on the top. Dump this snow into a can whose bottom is in tact. Take sample of different types of snow. Melt and test for water content, dirt, etc.

MELTING TEST

Cut squares from heavy-duty aluminum foil. Leave one shiny piece on both sides. Paint two of them black on one side only, and a fourth one black on both sides. After the paint is dry, gently lay them in a row on clean snow when the day is sunny. Place one of the identical plates, black side down, and the other black side up. After two or three hours examine the plates. Which has melted farther into the snow? Which has melted the least? Can you explain this?

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 snowbank that lines the street. In time, the sun warms the cinders and gravel and they melt their way down into the snow to leave protruding points. Examine these and see if there is any particular direction that they point.

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