



Snowflake Types

LESSON

GRADE LEVEL:

K-3

CATEGORY:

Earth, Ecosystems, Ecology

TOPIC:

Snow, Ice crystals and snowflake formation

LENGTH:

- 10-minute warm-up repeated over several periods
- 10-minute prep the day before activity
- 10 - 20 minutes outside looking for snowflakes
- 10 - 20 minutes for creating paper snowflakes based on observations

SETTING:

Indoors and Outdoors

GROUP SIZE:

- Warm up: groups of 6
- Outdoor portion of activity: smaller groups

SUBJECT AREAS:

Science, Math, Art

KEYWORDS:

Water, ice, crystals, water vapour, snow, temperature, wind, snowflake, hexagon

Overview

Students consider factors that might influence snowflake formation such as temperature and wind.

Objectives

Students will be able to:

- Begin to understand how snowflakes form
- Examine the properties of water in its crystal frozen form
- Compare and contrast snowflakes and consider the importance of snow
- Consider factors in snowflake formation that make snowflakes unique

Materials

- Black construction paper or black fabric (black velvet) covered boards
- Magnifying lenses 5x or higher
- Small paint brushes for separating snowflakes
- Write in rain paper, if snowing, for sketching shapes outside
- Snowflake ID sheet
(available at www.snowcrystals.com/guide/guide.html) for reference
- Macro lens for IPAD (optional)

Making paper snowflakes:

- Square Paper (white is traditional)
- Scissors
- Markers
- Protractor for measuring folding angles 30 degrees for the final two folds

Making Connections

Snow plays an important role in Earth's climate. The prism structure of each ice crystal in snow reflects solar radiation back into space, helping to keep the Earth cool. This feature can be seen by the brightness that a snowfall creates as it reflects any available light, even during the night, street light is reflected by the snow crystals onto a dark street making it seem almost like daytime. The crystalline structure also plays an important part in ecosystems because its frozen structure makes it light enough to land on the ground and build up without soaking into the soil the way rain does.

Background

Snowflakes start forming high in the atmosphere when water vapour encounters small pieces of dust in the air to form a water droplet. If temperatures remain above freezing, eventually the water droplets combine and become heavy enough to fall as rain. However when atmospheric conditions dip below freezing, water vapour freezes directly from vapour to solid (a process known as deposition) into a single crystal. Because of the shape the snow crystals stick to one another as the snowflake continues to grow. As they get heavier and start to fall to earth, the growing snowflake may encounter different conditions such as time in clouds, temperature, wind, and differing amounts of water vapour. These variations and other factors create different shapes and patterns resulting in each snowflake being unique.

Snowflakes have a hexagonal (six-sided) shape because the three-dimensional structure of water molecules is six-sided and as crystals grow, they follow the molecular pattern. As the hexagonal ice crystals collide in snowflake formation, they stick onto one another along the edges of the hexagon structure. Picture a very tiny honey comb. Each of the six corners of the hexagon crystal has three sides exposed which makes these edges 'stickier' resulting in growth occurring at these six points. Although growth occurs at the same time, each of the six sides grows independently into the familiar six-sided snowflakes. All the variables involved mean that every snowflake is unique, but the final pattern exhibits a regular structure and a symmetry because they are all crystals of water.

When we see it snowing, what we are looking at might not be individual snowflakes, but a possibly a combination of irregular, partially melted, or many snowflakes lumped together because conditions may change while the individual snowflakes fall

to earth (melting or re-freezing) and blowing wind mixing different flakes together.

There is some debate on how many different snowflakes shapes exist, but for the purposes of this activity we can think of four basic shapes with variations:

- Stars - regular and dendrite (arms) including fern dendrite
- Columns - capped and un-capped
- Needles
- Plates

More information about the factors involved in snowflake formation is available here: www.snowcrystals.com please check copyright page for restrictions on use for educational purposes: www.snowcrystals.com/copyright/copyright.html

Procedure

The Warm-up:

Depending on your class you may wish to do only some of these ideas:

1. Begin with a discussion of hexagons (six-sided) shapes by looking at the structure of honey combs. Note that honeycomb hexagons sides are all equal in length.
2. Using materials that are six sided can students make the four basic shapes (stars, columns, needles, plates). To make the column and needle you will need 4 very short but equal length and 2 extra-long but equal length parts. On the star shape try to show each arm with very short arms of its own: a fern dendrite star.
3. Students may wish to draw the shapes to create a snowflake ID key to use outside, make this more complex for older grades by looking at a few variations of each main type, such as capped columns, fern dendrite stars using the information on www.snowcrystals.com
4. Perform simple experiments to determine conditions needed to be successful snowflake observers such as what causes snowflakes to melt (warm fabric, breathing, warm air temperatures).

The Activity

Prepare the black paper or black felt covered board and place all the materials you will be using outdoors in a deep freezer or leave them outside overnight if it is safe to do so.

1. Students should try to catch fallen snow on the cold black boards, they may wish to use the paint brushes to separate snowflakes. What happens if they try to capture snowflakes on their warm clothing? Experiment with how long it will take for their outdoor clothing to cool enough to see snowflakes without them melting.

You may use snow that has already fallen, but it may not yield good results due to compaction and melting and re-freezing; however, undisturbed freshly fallen snow may work, students may wish to try out predictions of where the best place would be and why.

If you are going out during a snowfall be aware that some snowfalls may not yield interesting snowflakes, if nothing interesting is found in 10 minutes, try again another day but gather ideas about why this was unsuccessful. On these unsuccessful days, note the weather conditions during the snowfall and try to predict what might happen next time.

2. Once an interesting snowflake is found students may wish to keep looking for other shapes. As they become better observers have students notice the differences and try to identify which shape they are seeing. Ideas include to draw/sketch the shape, photograph it or use the ID card to identify its shape and count the number of different shapes they find.

For younger students:

Bring snowflakes inside and find out what they turn into once they melt. Try to predict what they may find on another snowflake observation day.

For older students:

Have students predict what shapes they might see on another day and why. What factors might make different snowflakes (humidity, wind and temperature when the snowflakes are forming).

Part 2:

Make paper snowflakes using the drawings or observations.

1. Start by using square pieces of paper by folding 8.5x11 into a square. Bringing one corner up to the other parallel edge to make a triangle with the doubled-up paper. Trim the extra off.

2. Fold this again into another triangle. Keep the folds at the bottom which will become the center of the snowflake.
3. Use a protractor along the bottom folded point to measure off two more thirds. You will have two lines drawn that divide the triangle into three equal sections. Fold along those lines keeping the folds at the bottom.
4. Cut off the points on the top edge (farthest edge from the folded point at the bottom (the center of your snowflake). Open the paper to notice you have what looks like twelve points. Refold exactly as you had it and putting the point at the bottom. Draw along the top edge you had just cut and shape it from one side to the other. This shaping creates the stars points. Open it again and observe how the arms of the stars are starting to look like point. Refold.
5. On your folded paper, with the folded point at the bottom, draw first then cut a desired shape on the sides, reshape the top if you were not happy with it. Do not cut all the way through the paper horizontally or your snowflake will be cut in half. Cutting the folded bottom tip will put a hole in the center of your snowflake if you desire this.
6. Unfold very carefully to reveal your snowflake. Flatten under heavy books.

Assessment

1. Why are there different shapes of snowflakes?
2. What causes snowflakes to melt?
3. Can students find other places where the crystal structure of frozen water can be seen?
4. In groups of six, try to make as many snowflake shapes using their bodies by standing or laying down.
5. Use any form of written or oral expression to tell the story of a snowflake from when it was first formed in to when it falls on the ground.

Extensions

1. Look for, observe, and count the four basic shapes outdoors in the built environment and in the natural environment.
2. Investigate the hexagonal shapes of honeycombs that bees make in the summer.

Types of Snow Crystals

Adapted from snowcrystals.com

				
Simple Prisms	Solid Columns	Sheaths	Scrolls on Plates	Triangular Forms
				
Hexagonal Plates	Hollow Columns	Cups	Columns on Plates	12-branched Stars
				
Stellar Plates	Bullet Rosettes	Capped Columns	Split Plates & Stars	Radiating Plates
				
Sectoried Plates	Isolated Bullets	Multiply Capped Columns	Skeletal Forms	Radiating Dendrites
				
Simple Stars	Simple Needles	Capped Bullets	Twin Columns	Irregulars
				
Stellar Dendrites	Needle Clusters	Double Plates	Arrowhead Twins	Rimed
				
Fernlike Stellar Dendrites	Crossed Needles	Hollow Plates	Crossed Plates	Graupel