LESSON DIRECTORY

SNOW IS A FORM OF ICE

PHOTO GALLERY

This activity develops precursor understanding about how ice forms in the atmosphere and falls as snow.

SCIENCE & LITERATURE

"Under the microscope, I found that snowflakes were miracles of beauty; and it seemed a shame that this beauty should not be seen and appreciated by others. Every crystal was a masterpiece of design and no one design was ever repeated. When a snowflake melted, that design was forever lost. Just that much beauty was gone, without leaving any record behind."

—Wilson "Snowflake" Bentley 1925

"Snow crystals are the hieroglyphs sent from the sky."

—Ukichiro Nakaya, 1954

CONCEPT OVERVIEW

This activity develops precursor understanding about how ice forms in the atmosphere and falls as snow.

Concepts:

- Condensation
- Snow
- Snowflakes

This activity provides concrete experiences of:

- Water vapor condensing
- Water vapor freezing
- Snow forming

PRE K–GRADE 2 CONCEPTS

- Water is in the air as water vapor.
- When the air is cool enough, water vapor changes into tiny water droplets.
- Clouds are made of tiny droplets of water.
- When it gets freezing cold in the clouds, the tiny droplets freeze into tiny ice crystals that can fall as snow.
- Snow forms in six-sided shapes.
- Snow will remain on the ground if the temperature is below freezing.

GRADE 3–5 CONCEPTS

- Water is in the air as water vapor.
- When the air is cool enough, water vapor changes into tiny droplets of water in a process called condensation.
- When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets of water.
- When it gets freezing cold in the clouds, the tiny droplets freeze into tiny ice crystals. Other water vapor molecules freeze directly to ice creating shapes we call snowflakes.
- Snow forms in six-sided shapes.
- Snow will remain on the ground if the temperature is below freezing.

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LESSON SUMMARY & OBJECTIVES

As we learn about water ice in the atmosphere on Earth, we also want to keep our minds open about how water ice and other ices may exist in other atmospheres in the Solar System.

Objective 1: Notice that water vapor in the atmosphere can condense to water.
We can collect evidence of the presence of water in the air in by observing the process of condensation.

Objective 2: Notice that that clouds are made of tiny droplets of water
Through the activity we can extend our understanding to consider that clouds are made of tiny droplets

Objective 3. Notice that snow forms in clouds.
Snow can form as temperatures become colder in the clouds. If the temperature at the surface is below freezing, snow remains on the ground.

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STANDARDS

BENCHMARKS:

4D The Physical Setting Structure of Material

GRADES K–2, PAGE 76

- Things can be done to materials to change some of their properties, but not all materials respond the same way to what is done to them.

GRADE 3–5 PAGE 77

- Heating and cooling cause changes in the properties of materials. Many kinds of changes occur faster under hotter conditions.

NSES:

Content Standard B Physical Science: Properties of objects and materials

GRADES K–4, PAGE 127

- Material can exist in different states—solid, liquid, and gas. Some common materials, such as water, can be changed from one state to another by heating or cooling.

ESSENTIAL QUESTION

How can water and ice exist in the atmosphere?

How do clouds form in the atmosphere? How does snow form in the clouds? What conditions are needed for snow to fall to the ground? What can we say, draw, write about snow that we look at, touch, and examine in class?

ACTIVITY QUESTION

How can we find out if there is water in the atmosphere?

What can we experience in class that can help us understand how water is in the atmosphere? How can we apply our science learning experience to an understanding about snow? What can we say, draw, write about water and ice in the atmosphere that we look at, touch, and examine in class?

BACKGROUND

Snowflakes in the History of Science

Johannes Kepler

Johannes Kepler wrote a 1611 treatise *On the Six-Cornered Snowflake*, which is likely to be the first scientific reference to snow crystals ever. Kepler thought deeply about the question of why snowflakes are so symmetrical. He did not have a way to answer the question with the tools available in his time.

René Descartes

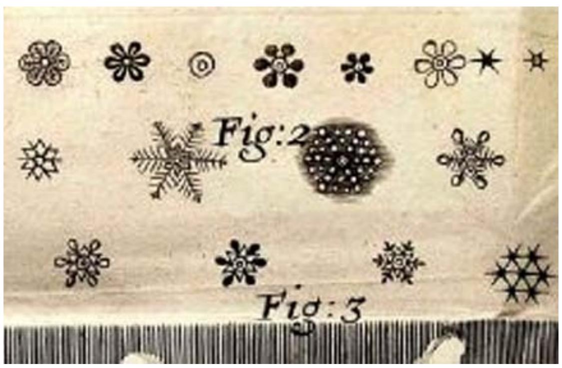
René Descartes, a mathematician and philosopher, was the first to give a fairly accurate description of the different forms of snow crystals. The year was 1635, and his observations were the best possible considering he only used his eyes as instruments. He made observations of unusual snow crystals. Descartes was amazed at how exact and symmetrical snowflakes were and he believed that no human could ever produce anything quite like a snowflake.

> These were little plates of ice, very flat, very polished, very transparent, about the thickness of a sheet of rather thick paper...but so perfectly formed in hexagons, and of which the six sides were so straight, and the six angles so equal, that it is impossible for men to make anything so exact.
>
> I only had difficulty to imagine what could have formed and made so exactly symmetrical these six teeth around each grain in the midst of free air and during the agitation of a very strong wind, until I finally considered that this wind had easily been able to carry some of these grains to the bottom or to the top of some cloud, and hold them there, because they were rather small; and that there they were obliged to arrange themselves in such a way that each was surrounded by six others in the same plane, following the ordinary order of nature.
>
> — René Descartes (1635)
> in F. C. Frank, "Descartes' Observations on the Amsterdam Snowfalls of 4, 5, 6 and 9 February 1634," J. Glaciology 13, 535 (1974).

Throughout history observations of snow crystals, or snowflakes, became more and more accurate, as in most areas of science. There were many different scientists who contributed to the knowledge we now have about crystals. Some of the more important ones will be discussed here.

Robert Hooke

Robert Hooke was one of the first scientists to look at snowflakes under a microscope. He made lots of drawings of snowflakes and published them in 1665 in a book called *Micrographia*. For the first time, drawings showed just how complex and precisely symmetric snowflakes are, for everyone to see.



Wilson A. Bentley

Wilson A. Bentley, who lived from 1865 to 1931, was a farmer and photomicrographer. He took photographs through a microscope. He is famous for his thousands of photographs of snow crystals, published in his 1931 book, *Snow Crystals*.

Ukichiro Nakaya

Ukichiro Nakaya trained as a nuclear physicist, but where he lived, there was no place to do nuclear research. So he led his curiosity to do the first real systematic study of snow crystals in 1954. He made a series of very detailed observations and identified and catalogued all the major snow crystal types. He also photographed many different snow crystals. He grew artificial snowflakes in a lab under specific conditions, and from his observations of these, he described how the crystals formed under different conditions. Most of his work was published in *Snow Crystals: Natural and Artificial* in 1954.

Source for the preceding section on the history of snowflake observation: Kenneth Libbrecht, CalTech, http://www.snowcrystals.com

The Cryosphere

Wherever the world is freezing cold, that is the cryosphere. It includes areas of northern hemisphere snow, mountain glaciers, frozen ground or permafrost, sea ice, ice shelves, the Arctic and Antarctic ice caps. Scientists monitor the conditions of the cryosphere to gain understanding about global warming and cooling trends.

The Snow Cycle

Today scientists are especially attentive to the snow cycle. The snow cycle is another way of thinking about the water cycle on a global scale. Satellites can now image and measure snow-cover around the world. Snow has a bright albedo that reflects sunlight, deflecting its solar radiation. New snow can reflect as much as 80% of the sunlight back into space. Snow-cover is also an indicator of large-scale weather patterns. NASA scientists monitor snow cover. Scientists create global climate change models that predict snow-cover. By fitting together all the clues about snow, we can compare models and build a better understanding of regional weather patterns and global climate patterns.

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ACT OUT THE SCIENCE

Whole Group Mime Activity: *Movement*

Integration Mediating Experience

A Snow Story

Narrative	Movement	Concept
How does snow form? Let's all sit together. Imagine that we are a pool of water—not that we're in it but that we ARE the water itself.	Everyone gathers, seated in an open carpeted area, multipurpose area, open lawn or playground area.	An everyday experience of a pool of water.
Now, if we could look very closely at water, we could see that it's made up of small molecules of water, all moving around.	Engage students in such a way that they are sitting comfortably, Lead movements in a gentle jostling manner.	This touches on the notion that what we see as water is made up of smaller units.
You've probably heard of H_2O. Well, just for now, imagine that each one of us is a molecule of water, H_2O. The H_2 means two hydrogen atoms—like we have two arms. And the O means one oxygen atom, like we each have one head.	As the parts of the water molecule are related to the body (arms and head) lead a flowing movement of those body parts. (Be responsive to children adding their own thoughts about their knowledge of H_2O, etc.)	The idea is to set up an experiential playing out of how water works—using the terminology, aiming for precursor understanding.
So here we are—All our arms and heads as the molecules of water.	Here, lead movements together, flowing easily then stop the motion.	This reminds students of the H_2O structure.
So what does a pool of water do? Okay, it moves around. Maybe the wind creates a ripple. Maybe something splashes into the water.	Be the wind, setting up a ripple. Be something that falls into the water, setting up a splash. (Encourage a few student generated examples.)	This sets up the beginning of identifying the characteristics of water.
Another thing that happens is that water "evaporates." Sometimes, a water molecule floats up out of the puddle into the air.	Lead one or two at first (attempt in the telling to let the process occur gradually). Soon nearly everyone will be floating about.	The process of evaporation, a function of temperature and vapor pressure…
The water vapor, that is, the water molecules now in the air, float up higher and higher, buffeted about by the wind.	Let this happen gradually. Slowly floating up, and then moving about until everyone is (airborne).	The gradual, slow motion is to give the students the time to imagine floating higher and higher into the air.

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Narrative	Movement	Concept
As the water vapor gets higher, it reaches cooler air. In fact, it starts to get shivering, freezing cold.	Encourage students to show actions of feeling cold, shivering.	The Bergeron Process—water droplets form in clouds, but do not freeze until it reaches ~-10°C.
Now something VERY interesting happens. Some of the water vapor condenses—the molecules huddle together to form tiny droplets—clouds!	Encourage students to huddle together in small groups, "droplets" while still traveling together as a whole, as a "cloud."	Condensation is the opposite of evaporation—water vapor becomes liquid water.
As it gets below freezing cold the droplets are super-cooled until some of them FREEZE.	At the word FREEZE—stop the action momentarily.	An initial ice crystal that forms in a cloud is called an "ice nucleus."
It's almost as if the water gets frozen STIFF at an angle as if it were about to give someone a big hug—and froze in place.	Have students stretch out their arms at approximately an angle of 109º (a little greater than a right angle).	This angle corresponds to the molecular structure of H_2O and contributes to the shape of the crystals that form ice nuclei.
The molecules are just able to grab hands to form a six-sided crystal.	Help students form ONE example of a hexagon, and ice nucleus.	Once a crystal forms, it can be built upon by other water molecules.
The super-cooled water vapor then condenses and crystallizes around the hexagon, creating a unique shape—a snowflake.	Encourage other students to "condense" onto the newly formed ice crystal, building out from the initial structure.	A typical snowflake is composed of many ice crystals.
Soon many snowflakes are heavy enough to fall.	Slow motion falling of "snow" to the ground.	If the ground temperature is cold enough, it remains as snow; if it is warmer, it will rain.
And in the spring, when the snow melts, the snow becomes a pool of water.	As "snow" melts everyone is seated again, as at the beginning.	This completes an example of a snow cycle.

Small Group Mime Activity: *Movement Integration Mediating Experience*

Invite students to form small groups (about three to five students), look at pictures of snowflakes and create their own mime and narrated story about snowflakes. Encourage students to act out a sequence that results in the formation of unique snowflakes.

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MATERIALS

The activity enables students to collect evidence that water and ice is in the atmosphere.

For all activities, to record reflections, observations, calculations, etc.

- Science Notebooks: writing and drawing utensils.

Condensation Demonstration

- Ice cubes
- See-through drinking glass or enough clear plastic glasses for everyone
- Magnifying lenses or Proscope
- Dry ice

Snow Cycle Model

- Aquarium or Terrarium container and cover
- A small hand-held battery controlled fan
- Shallow container for water
- A sculpted "mountain," e.g. oatmeal box with construction paper
- Dry ice* (see safety guidelines)

Viewing Snow and Snowflakes

Gallery of pictures of snow and snowflakes (If in a wintry climate, snow itself)

- Black construction paper
- Microscope or Proscope

SAFETY ALERT

- Dry ice is frozen carbon dioxide; it is EXTREMELY COLD. Direct contact for more than a second or two can IMMEDIATELY damage living cells.
- ALWAYS supervise any activity that uses dry ice in the presence of children!
- Do not permit ANYONE to touch dry ice with their bare hands.
- *Model laboratory safety awareness: always use gloves and goggles when handling dry ice, due to its extremely cold temperature: -78.5° C, or -109.3° F.*

(Under highly supervised conditions, older students can also do these steps.)

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DEMONSTRATION

Seeing is not always believing. It is not obvious that water vapor is in the air. The appearance of condensation can seem magical to young children. It may seem mysterious that water droplets appear on the outside of a glass of ice-cold water. Young students may initially persist in the belief that that the water has moved through the glass from inside the glass to the outside. This demonstration aims at inferring that water vapor is in the air, as a basis for understanding the formation of snow in the clouds of the atmosphere.

PRE K–2

Water Vapor in the Air Can Condense When Cooled

Lead a brief discussion based on questions such as:

When have you experienced knowing that water is in the air?

- Rain
- Snow
- Drizzle
- Fog
- Seeing your breath on a cool morning

Scientists tell us that when something in the air gets cool enough, water vapor will condense, changing from vapor to liquid water.

How can we find this out for ourselves?

Note: This discussion lays the groundwork for understanding the purpose of a scientific experiment. A crucial experiment is one that predicts a result that persuades us that a particular explanation is most likely. In this case, prior to the experiment, it is important that young students have a sense of what results would tell us that water vapor is in the air. Otherwise, the appearance of water droplets might seem magical or misconceived as coming from inside the glass.

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Let's do an experiment: Notice that these three glasses are completely dry. No water. The temperature of each glass is the same as in the room—at room temperature. You can feel that they are neither cold nor wet.

We're going to leave one glass at room temperature.

We're going to put some water that is also at room temperature in the second glass. We're going to put some ice in some water to make it ice-cold, and then put that in the third glass.

What result would tell us that water is in the air around the outside of the glass?

Could we tell from the dry glass at room temperature? Could we tell from the glass with room temperature water in it? Could we tell from the glass that is cooled by ice?

In other words, if there is water vapor in the air, what should happen when we cool the third glass?

Okay, let's do it! Look very closely. We can use magnifying lenses or a Proscope to get a better look.

Notice that water droplets form on the outside of the glass.

Where did the water come from?

Even with the previous discussion, this question may lead to some interesting speculation that the water from inside the glass has appeared on the outside of the glass. The real reason for the water and ice inside the glass is to cool the glass so that water vapor in the air condenses onto it.

3–5

Water Vapor in the Air Can Condense When Cooled

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Provide the materials: three clear plastic glasses, water, and ice. Ask students to work in teams to devise a way to test for water vapor in the air. Lead a discussion about how these materials might help answer the question:

What result would tell us that water is in the air around the outside of the glass?

Let students consider possibilities. Circulate among students. Respond to questions with guiding questions, such as:

Could we tell from a dry glass at room temperature?

Could we tell from a glass with room temperature water in it?

Could we tell from a glass that is cooled by ice?

If there is water vapor in the air, what should happen on the surface of a cold object?

How can we test whether there is water in the air?

See if student teams arrive at something like this:

1. Draw and/or say what you think will happen if we put ice cubes in a glass of water.
2. Make sure the outside of the plastic glass is dry; put in a little bit of room temperature water. Observe.
3. Then put in a few ice cubes; watch what happens.

What do you notice? (fog, a film of water, condensation as water droplets)

Where did that wetness, moisture, fogginess, water come from?

Is this result consistent with the idea that there is water in the air?

Did the experiment demonstrate results consistent with this explanation? Based on the evidence of the dryness of the glass before, we would have to conclude that cooling the glass makes water vapor in the surrounding air condense on the outside of the glass.

Let's go one step further…Is it possible to see water freeze out of the air?

Teacher Demonstration

Set out a small block of dry ice (see safety guidelines). Show how cold it is by placing a few droplets of water and showing that the drops freeze.

Scrape the ice off so that the dry ice surface is completely clear.

If there is water vapor in the air, what result should we see occurring on the surface of the dry ice?

Notice the white powdery substance that forms on its surface. Scrape off that layer into a clear plastic glass or shallow plate. What does it look like? What is it? Where did it come from? Notice that it melts like snowy ice into water.

Hmmmm. How do we explain this?

Engage students in a discussion of what they think happened.

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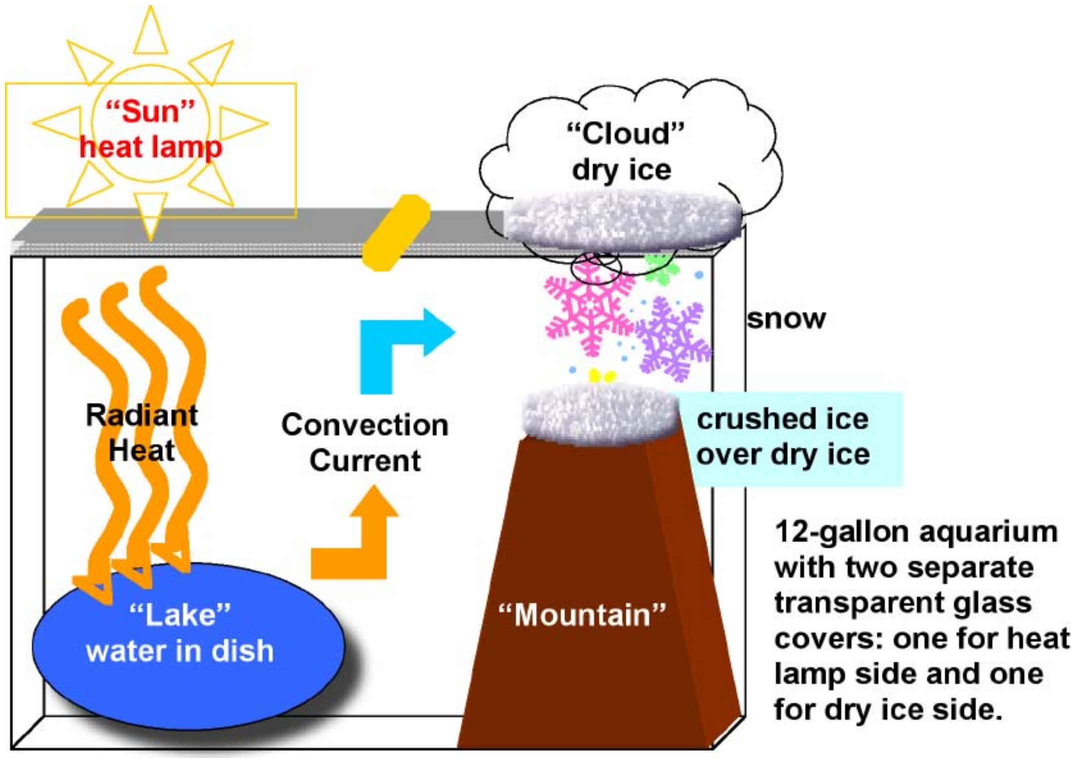
MAIN ACTIVITY

PREPARATION

Set up the snow cycle model. Essentially, this is a simplified model of how snow forms in nature.



Use an aquarium to set up a model of the snow cycle:

1. Place some water in a shallow container;
2. Place a heat lamp to simulate the Sun (to accelerate evaporation);
3. Sculpt a "mountain" (cardboard box and construction paper)
4. Place some crushed ice over dry ice on top of the mountain (to simulate a cryospheric location that is below freezing)
5. Place a two-part glass cover over the environment, one for the heat lamp side, one for the dry ice side;
6. Place a "cloud," a chunk of dry ice, on top of the glass above the mountain (to assure sub-freezing atmospheric temperatures for snow formation);
7. Watch as snow appears on the glass above the top of the mountain; tap lightly on the glass for the snow to fall.

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TEACHING TIPS

Explore

Snow is fascinating. In a wintry climate, on a snowy day, snowflakes can be directly experienced and observed. Snow-like ice crystals can also be obtained by scraping off the powdery condensate that appears on the surface of dry ice. Images of snowflakes can provide the basis for exploration in the classroom and to extend research. Explore the geometry of six-sided figures.

Diagnose

Listen to students' ideas about snow. How do students conceptualize what snow is, how it forms, and why it has its six-cornered structure? What implications do students draw from the behavior of snow?

Design

Devise a way to show the structure of snow. Have students create a variety of ways to show the structure of snow and snowflakes.

Discuss

Discuss snow and snowflakes. Discuss the nature of condensation around dust, bacteria, and ice in the atmosphere.

Use

Extend new knowledge about snow and snowflakes to deeper understanding of the formation and crystalline structure of ice.

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WARM-UP AND PRE-ASSESSMENT

Share Snow Vivencias*

Tell a brief snow experience story from your own life and/or select a story to read that has a vivid snow experience as part of the story. Consider telling the story in such a way that invites students to act it out along the way.

Refer to the story as "a snow experience" and "an experience of the *phenomenon* of snow."

Invite the students to share a snow experience from their own life or invent an imaginary snow story.

* *Vivencia* is a wonderful Spanish word used by poets to describe a vividly remembered experience in which the details are as fresh and as tangible as the living moments from which the memories arose.

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PROCEDURES

PART 1.

Model the Snow Cycle

This activity involves observing that water is in the atmosphere and extending that to understand that snow forms in clouds.

Open a discussion of how snow occurs in the natural world.

Ask guiding questions such as: *What happens if water vapor in the air bumps up against something as cold as ice floating in the air?*

Let students observe the snow cycle environment, initially without explanation. Then invite students to ask questions, propose explanations and discuss what they observe.

Let the fan blow on the water. If managed just right, it accelerates evaporation and produces a cloud above the dry ice.

- Note: With guidance, mature students can operate the fan. Under no circumstances should any student be allowed to touch the dry ice with bare hands.

Notice that snow appears on the surface of the dry ice. It is water vapor freezing directly out of the atmosphere to the surface of the dry ice. (Actual “snowing” may or may not be observable in this simulation.)

- This is not to say that there is dry ice on top of mountains on Earth. The purpose of the dry ice is to produce the cold temperature in the moist air to produce a cloud and to produce “snow” on its surface.
- Nevertheless it can be pointed out that on other planetary surfaces, such as Mars, it is cold enough for carbon dioxide to form dry ice. Ice caps on Mars are a mix of water ice (H_2O) and dry ice (CO_2).

In a natural cloud, when the air cools below freezing, ice crystallizes around dust particles and then builds up until it is large enough to fall. If the air is cold enough, it will reach the ground as snow. If it is warmer, it will melt as it falls and becomes rain. Sometimes it supercools and builds up rapidly, forming hail.

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PART 2.

Create a gallery of pictures and videos of snow and snowflakes.

Remind students of the process of snow formation: As water vapor rises, it condenses around particles of dust to form clouds. As the temperature falls, ice crystals form. Supercooled water vapor freezes to the dust and adds on the already-formed ice crystals, building up its crystalline structure. Eventually, it becomes heavy enough to fall through the atmosphere. If the air temperature remains cold enough, it falls as snow and remains on the ground.

Set up a series of exploratory zones that allow students to categorize, compare, and contrast the varied patterns of snowflakes. Select from the suggested materials. Invite students to create their own meaningful categories. Through discussion, encourage students to connect their own personal conceptions with the relevant science conceptions.

1. Examine pictures of snow and snowflakes
2. View videos about how clouds are made, about snow
3. Evoke snow experience stories from students

This table summarizes how snow forms.

Process	Result
• Ice forms in clouds, falls as snowflakes	• Snowflakes
• Snow falls, builds up in wintry places; forms glaciers where it is cold enough year-round	• Differences in snow cover

Catch a Snowflake

If it is snowing, take a piece of black construction paper that is already cold (by being kept in a place that is below freezing). Catch some snowflakes and examine them with a magnifying lens, a microscope, or Proscope.

Alternatively, you can take a closer look at the snow formed on the dry ice in the demonstration.

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DISCUSSION & REFLECTION

What is the difference between exploring and experimenting?

Scientists both explore and experiment. Exploring is open-ended observation and description that often leads to asking questions. Experimenting is a structured way of asking questions with several proposed explanations in mind. Scientists design a research experiment to test out which explanation most closely fits the results. Usually, it takes many experiements to develop a full answer. Sometimes a crucial experiment can be devised that is more definitive in eliminating or confirming a proposed explanation.

Guide students in a discussion of the difference and relationship between exploring and experimenting. They are likely to have a developing sense of the distinction and can express it in their own words.

CURRICULUM CONNECTIONS

Invite students to examine the literature and art as inspiration to create their own snow art. Snow and snowflakes have inspired many writers and artists. Share examples with students and invite them to create their own snow and snowflake art and writing.

For example, read about Snowflake Bentley.

Martin, Jacqueline Briggs (1998). *Snowflake Bentley*. New York: Houghton Mifflin Company.

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ASSESSMENT CRITERIA

Exemplary

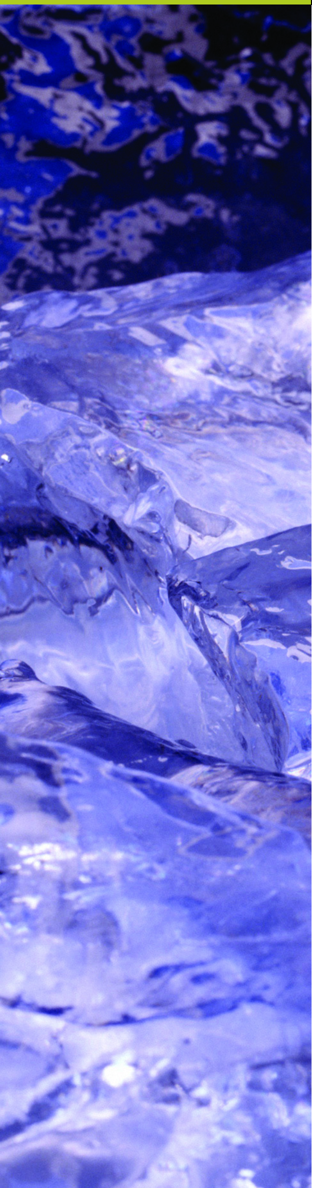
- Students write and illustrate a personal snow experience and share it dynamically with both a small group and the whole group.
- Students display drawings, constructions, and dynamic kinesthetic models drawn from their science notebooks and web-based research.
- Students identify and extend science questions drawn from direct observation and extended research about snow, snowflakes, and ice forming in the atmosphere.
- Students explore a rich range of information about snow and snowflakes and relate it to prior shared experiences.
- Students ask a rich and extensive range of questions about snow, snowflakes, and ice forming in the atmosphere.
- Students extend learning by considering implications of snow on other worlds.
- Students relate ideas to the whole context of exploring ice in the Solar System.

Emerging

- Students write and illustrate a description of how ice forms in the atmosphere and falls as snow, sharing it with both a small group and the whole group.
- Students pose basic science questions drawn from the concepts of snow and snowflakes.
- Students observe examples of representations of snow and snowflakes. Students display results using a variety of ways to represent snow and snowflakes.
- Students ask a rich range of questions about snow and snowflakes.
- Students make speculations about possible implications of ice forming in the atmosphere.

Formative

- Students recognize that water vapor is in the atmosphere.
- Students identify the basic principles of condensation and cloud formation.
- Students pose science questions drawn out of the context of exploring snow and snowflakes.
- Students observe snow and snowflakes through videos, photographs, and other visual representations.



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RESOURCES

http://snowcover.gsfc.nasa.gov
NASA's snow site: Observations of Snow Cover from the Ground and Space

http://visibleearth.nasa.gov
NASA's catalogue of images.
Cryosphere images:
http://visibleearth.nasa.gov/view_set.php?categoryID=509
Sea Ice:
http://visibleearth.nasa.gov/view_set.php?categoryID=510
Snow/Ice:
http://visibleearth.nasa.gov/view_set.php?categoryID=532

http://www-nsidc.colorado.edu/sotc
The site of the National Snow and Ice Data Center

http://snowcrystals.com
http://www.its.caltech.edu/~atomic/snowcrystals
Kenneth G. Libbrecht, Professor of Physics at Caltech, has created a website that tells everything you ever want to know about snowflakes. He has also written two marvelous books about snowflakes.

http://www.its.caltech.edu/~atomic/snowcrystals/icespikes/icespikes.htm
A great explanation and activity about ice spikes!

http://earth.rice.edu/mtpe/cryo/cryosphere/cryosphere_topics.html
http://dir.yahoo.com/Science/Earth_Sciences/Meteorology/Cryosphere
http://nsidc.org/snow/index.html
The Cryosphere and the Ice Ages

Images
Link to image gallery

For a fabulously easy way to preserve snowflakes for decades go to:
http://www.popsci.com/popsci/how20/e5fb1e4e0fca9010vgnvcm1000004eecbccdrcrd.html
Devised by Theodore Gray
www.theodoregray.com