TAKE A CLOSER LOOK AT

THE STORY OF SNOW

TEACHER'S GUIDE

GRADES K-6

Dear Teacher,

The *Story of Snow* provides an excellent introduction to this favorite winter form of precipitation for the youngest students, and also serves as an in-depth nonfiction study of the science behind snow for older students. Illustrated with pen-and-ink drawings washed in soft blue tones and incorporating photographs of actual snow crystals, the text operates on several levels, which are coded using three font sizes. The largest font delivers a clear and simple text that the youngest, primary students will understand. A second level of text in a medium font adds scientific explanations for the principles presented in the large-font text. Finally, in the smallest font, concepts introduced in the illustrations are explained with more detailed, scientific information.

You can use this book as a springboard for a discussion of winter weather, the water cycle, crystal formation, and the three states of matter. With this Teacher's Guide, you also can use *The Story of Snow* to celebrate the magic of snow through science, math, language arts, music, and visual art activities.

SCIENCE

THE THREE STATES OF WATER

The first page of *The Story of Snow* introduces students to the three forms of water: liquid, solid, and gas. Begin by asking students to name examples of water in each of its three states.

- Liquid: lakes, rivers, ocean, tap water, puddles, etc.
- Solid: snow, frozen lakes and rivers, ice, frost, etc.
- Gas: steam, puffs of "smoke" we exhale on a cold day, humidity in the air on a hot day, etc.

Students will be more familiar with water in its liquid and solid forms. The concept of water as a gas, however, may be new to them. Conduct two demonstrations on the states of water.

- If the kitchen at your school has a large freezer, make a class visit. Open the door (or lid) and what escapes? (Water in a gaseous form.)
- Hand out several small mirrors to groups of students. Ask them to puff a breath onto the mirror. Explain that what they see is the gaseous water condensing on the mirror to become a liquid.

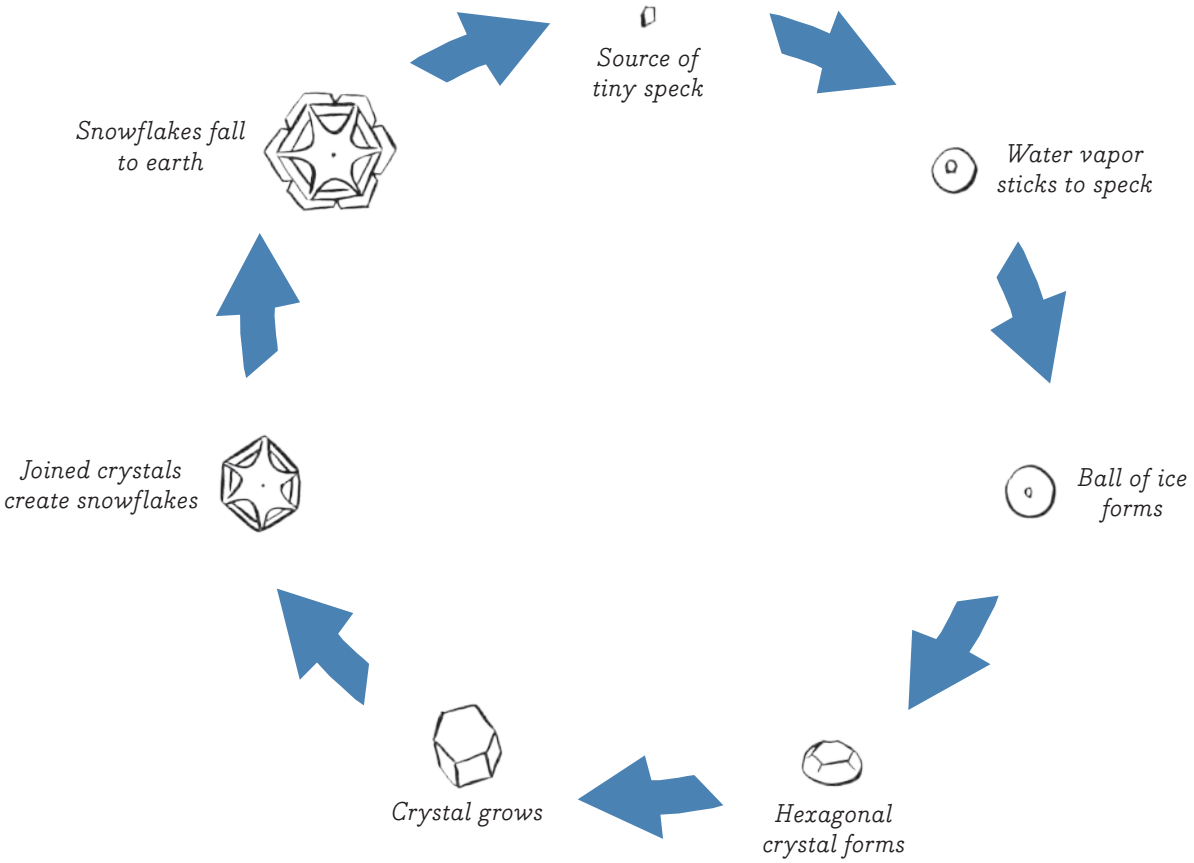
HOW CRYSTALS GROW

We often think of ice crystals in a star shape, and many of them are. After reading *The Story of Snow*, consider the concept of time-lapse photography with your students. You can explore this photography concept online (Try out Ducksters.com: www.ducksters.com/hobbies/photographyterms.php). Now share the videos of growing star-shaped ice crystals offered by Dr. Kenneth G. Libbrecht, professor of Physics at California Institute of Technology at www.its.caltech.edu/~atomic/snowcrystals/movies/movies.htm. While you are on the SnowCrystals.com Web site, take some time to share and discuss the other snow crystal photos.

FROM SPECK TO CRYSTAL

Crystals require a tiny speck of matter to grow around. As page 9 shows, the speck can be ash, salt, pollen, soil, or even bacteria. When that tiny speck gets cold enough, water vapor adheres to it and an ice crystal begins to grow. Invite students to create a circular graph that begins with their choice of a tiny speck, grows to a ball of ice, forms a hexagon, grows as a crystal, coalesces into a snowflake, and then falls to earth upon the source of the original tiny speck (see example).

Adaptations/Extensions: With primary-aged students, you may decide to make a single, large circular graph that traces the snow crystal journey.

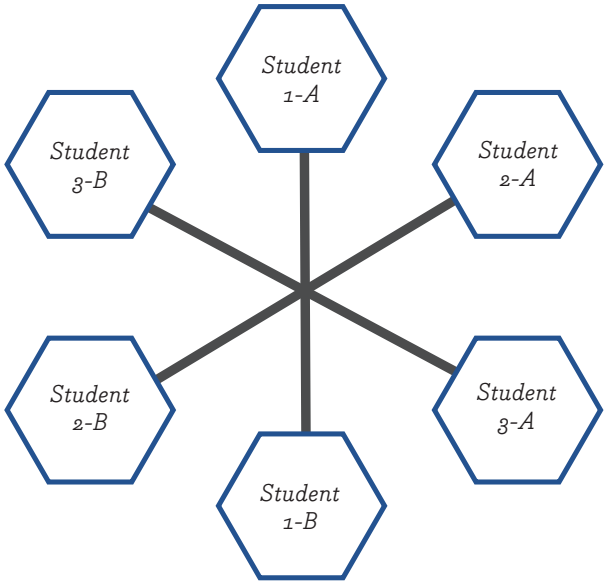


MANY FORMS OF SNOW

The Story of Snow tells us that snow crystals can come in many forms, including stars, plates, and columns. Divide the class into three groups, and assign each group to be either "stars," "plates," or "columns." Ask the groups to explore these forms further on the "Guide to Snowflakes" Web page designed by Dr. Kenneth G. Libbrecht, professor of Physics at California Institute of Technology: www.its.caltech.edu/~atomic/snowcrystals/class/class.htm. Once they have gathered enough information, ask each group to report back to the full class by sharing a slide show or poster of their findings.

"6 IS THE MAGIC NUMBER FOR SNOW CRYSTALS"

Begin this activity by gathering three meter sticks (or yard sticks). Invite a group of six students (three pairs) to stand in a circle. Ask each pair of students to face each other, standing one meter apart (or one yard apart). Now connect each pair of students by having them hold opposite ends of a meter stick and explain that most snow crystals have the very same six-armed star shape.



Extension/Adaptation: Conduct the beginning of the activity as above, but for older students, extend it by explaining that water molecules attach to each other in six-sided rings. Ask students to join hands and step backward until their hands are fully extended. Ask them to emphasize the angle that is formed where their hands join, in order to create a hexagon rather than a circle. Explain that this hexagonal shape is the shape of water molecules. Invite a second group of six to repeat the activity nearby. When you have two student-formed hexagons, ask the second group to align itself along one of the six straight sides of the first group. Review the diagram of joined water molecules on page 21 and note that snow crystals are formed by many hexagonal water molecules joining.

MATH

HEXAGONAL BUILDING BLOCKS

If you have plastic pattern blocks in your classroom, ask a group of student volunteers to separate out all of the hexagons for use in this activity. If you don't have pattern blocks, use your die-cut machine or ask a parent volunteer to cut 1-inch hexagonal shapes from oak tag or construction paper. Review the diagram of joined water molecules on page 21 and note that snow crystals are formed by many hexagonal water molecules joining. Invite students,

in pairs, to combine their hexagons to create six-armed snow crystals such as those pictured throughout *The Story of Snow*.

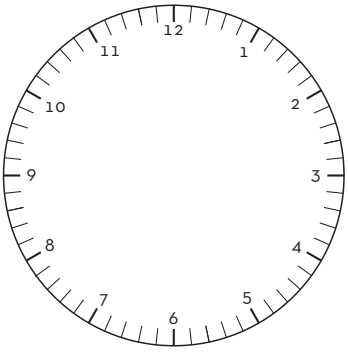
Adaptation/Extension: If you use an overhead projector, provide students with ½-inch hexagons cut from colored transparency acetate and invite teams to take turns creating and projecting snow crystals for the class. If you use a document camera, provide students with ¼-inch to ½-inch hexagon pattern blocks or paper hexagons and invite teams to create and project a snow crystal for the class.

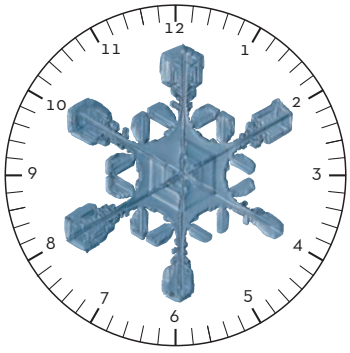
TELLING TIME WITH SNOW CRYSTALS

Materials needed:

- clock face outline
- enlarged circular ice crystal illustration (page 21)
- white paper "pie" shapes created by cutting a circle the size of the circular ice crystal illustration into six equal segments. (NOTE: students will use four "pie" shapes at a time.)

As noted on page 20, if a snow crystal is laid flat with its top and bottom arms vertical, the arms will point to 2, 4, 6, 8, 10, and 12 on the face of a clock. Provide primary grade students who are just learning to tell time with a clock face outline such as the one found at www.blackdog.net/games/clock/worksheets/singleclock.gif and a copy of the snowflake illustration on page 21, enlarged to be slightly smaller than the clock face outline, so that the arms reach to, but do not cover, the numbers on the clock.





Begin by asking students to position the ice crystal so that its arms point to 2, 4, 6, 8, 10, and 12, noting that if one arm is pointing to 12, the others will be correctly placed. Next, give students four blank white "pie" shapes which are sized to cover the arms of the ice crystal but not the numbers on the clock. Challenge them to cover up arms of the ice crystal so that the remaining arms in view might read:

- 2:00
- 4:00
- 6:00
- 8:00
- 10:00

LANGUAGE ARTS

LETTER FROM THE SKY

The Story of Snow ends with a quote from Japanese scientist Ukichiro Nakaya: "A snow crystal is a letter from the sky." Once you have read the entire book and discussed it, ask students to brainstorm the factual messages from the sky that snow carries. List these ideas and the page references on chart paper. Next, invite students, individually or in pairs, to create a letter from the sky. The sky will address the students in the salutation. For example:

> Dear _____ ,
> (Student Name)
>
> Today I am not as wet as usual, even though I am a few degrees colder . . .
>
> (NOTE: these conditions result in "plate" crystals rather than star crystals.)
>
> Sincerely,
> The Sky

Adaptation/Extension 1: Ask primary grade students who are not yet writing full sentences to draw a picture of the sky sending letters to earth via snowflakes. Provide space for one or two lines of text and guide them in writing the message.

Adaptation/Extension 2: Rather than focus on the factual information about the sky that a snow crystal delivers, invite students to write a letter in the form of a poem that captures a more creative message from the sky delivered by one or more snow crystals.

A MAN WITH A PASSION

If your students are captivated by the study of snow introduced in *The Story of Snow*, you may want to read the picture book biography of one of the early American amateur studiers of snow entitled *Snowflake Bentley* by Jacqueline Briggs Martin, illustrated by Mary Azarian (Houghton Mifflin, 1998).

After reading both books to your students, engage them in a discussion of the things we know about snow crystals now (as evidenced in *The Story of Snow* and on such Web sites as SnowCrystals.com). Compare this list to the things people knew about snow crystals when Wilson (Snowflake) Bentley was conducting his studies.

Adaptation/Extension: List all of the facts we know about the different forms snow crystals take. Next to each fact gathered from *The Story of Snow* place a YES or NO related to whether Snowflake Bentley possessed that knowledge. To learn more about Snowflake Bentley and his work before this activity, visit www.snowflakebentley.com.

MUSIC

CATCH YOUR OWN SNOW CRYSTALS

After you read and discuss *The Story of Snow* with your students, engage them in the activity suggested on pages 32 and 33 ("How to Catch Your Own Snow Crystals"). Gather your materials—a piece of dark cardboard or foam core board and a magnifying glass—and then teach students the following song, sung to the tune of "Frère Jacques."

"I Can Catch a Snow Flake"

Snow is falling.
Snow is falling,
through the air,
all around.

I can catch a snow flake.
I can catch a snow flake
before it lands
on the ground.

After students have memorized the words, invite them to sing it as a round. Then, ask students to continue singing as they dress in their winter outerwear and head outdoors to catch snow crystals.

Adaptation/Extension: If you live in a warm climate or are teaching weather during a warm month, consider teaching students the song and then asking them to don hats and mittens and sing while they pretend to catch falling snowflakes in the gym or outside in the play yard.

ART

PAPER SNOWFLAKES

Most of us have memories of cutting paper snowflakes as students ourselves. *The Story of Snow* will inspire your students to make their own artistic paper creations. The patterns you choose will depend on the ages of the students you teach.

Source of patterns:

For young children who might be challenged by the necessary cutting, use this online snowflake creator:
www.math.rice.edu/~lanius/frac/koch/koch.html

Eight simple pattern choices suitable for grades two and up:
www.kinderart.com/seasons/dec7.shtml

Five pattern choices suitable for grades three and up:
www.noelnoelnoel.com/famfun/crafts/snowfl/snwflk.html

Ten complex pattern choices suitable for grades four and up:
www.marcels-kid-crafts.com/snowflake-pattern.html

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