



WILSON A. BENTLEY: SNOWFLAKE SHAPE ACTIVITY

Objectives: Students will learn about how snowflakes form and the types of shapes that snowflakes are composed of. They will practice observational and comparison skills. They will identify snowflake types based on their shape.

Time: 45 – 65 minutes (*Adjust Time As Needed*)

- introduction, (*suggested: 15- 20 minutes*)
- study snowflake shapes outside, (*suggested: 20 minutes*) – if snow is falling
- study snowflake shapes inside, (*suggested: 10 minutes*)
- examine snowflakes and classify them by their shapes, (*suggested: 10-15 minutes*)

Skills: Observation, Knowledge of basic shapes, Compare and contrast

Content Area: Science, Art

Materials:

To study real snowflakes out of doors:

- cardboard, 8 x 10, one for every four students
- sheet of black felt or velvet, 8 x 10, one for every four students
- glue
- magnifying glasses

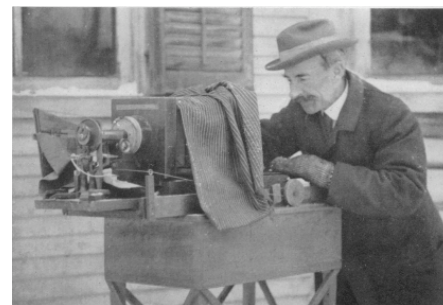
Classroom project: (contained below)

- snowflake type chart
- unidentified snowflake images answer sheet (2 sheets)

Grade Level: Grades 3-6

Historical Overview:

For over forty years, Wilson "Snowflake" Bentley (1865-1931) photographed thousands of individual snowflakes and perfected the innovative photomicrographic technique. His photographs and publications provide valuable scientific records of snow crystals and their many types. Five hundred of his snowflake photos now reside in the Smithsonian Institution Archives, donated by Bentley in 1903 to protect against "all possibility of loss and destruction, through fire or accident."



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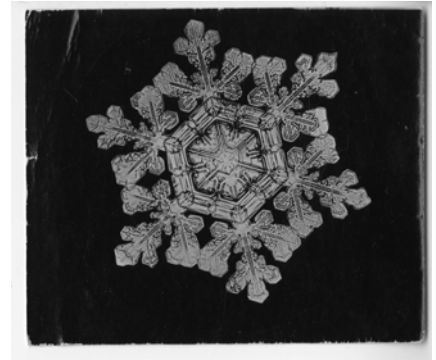
Wilson A. Bentley was born in 1865 in Jericho, Vermont. Taught by his mother, he lived and worked on the family farm. Growing up in the "snowbelt," where the annual snow fall is about 120 inches, Bentley developed an interest in snow crystals after he received a microscope for his fifteenth birthday. Four years later, in 1885, then equipped with both his microscope and a camera, Bentley made the first successful photograph of a snowflake.



Bentley pioneered "photomicrography," the photographing of very small objects, especially of snowflakes. Snowflakes or snow crystals are difficult to photograph because they melt so quickly, but Bentley developed the equipment and technique that allowed him to take thousands of photographs of individual snowflakes. He connected his camera to a microscope in order to create photos that showed intricate details of each snow crystal and stood in the winter cold for hours at a time. Patiently, he caught falling flakes and carefully handled them with a feather to place them under the lens. The apparatus was set up outside so that the delicate specimens would not melt, and a minute and a half exposure captured the snowflakes.



From that first photograph in 1885, Bentley photographed more than 5000 snow crystals until his death in 1931. Within his massive collection every single snowflake was unique, and in the year of his death he, along with William J. Humphreys, a physicist with the U.S. Weather Bureau, published *Snow Crystals*, a volume containing 2,300 of his photographs for all to study and enjoy. Throughout his life Bentley also published sixty articles in various scientific and popular journals. While most of his articles discussed snow crystals, he also photographed and wrote about frost, dew, and other atmospheric phenomena.



[Dendrite Star](#)



In 1903, he donated a collection of 500 of his snowflake photographs to the Smithsonian Institution to ensure their safety. In his correspondence with third Smithsonian Institution Secretary Samuel Pierpont Langley, Bentley offered positives and slides of his photos, writing that he was "deeply grateful for your [the Smithsonian's] kindly help in thus placing my collection of snow photographs





beyond all possibility of loss and destruction, through fire or accident." At that time he also sent a copy of a previous publication on the snow crystal photographs. Later, he sent a lecture he had given at the Brooklyn Institute of Arts and Sciences in 1905, intending that it would be edited and published by the Smithsonian, though it never was. His photographs remain in the Smithsonian Institution Archives, safeguarded from any misfortune. Bentley remained in Jericho, Vermont throughout his life. Ever dedicated to his work, he died there in 1931 after having caught pneumonia walking through a blizzard.



Overview: What are snowflakes?

Snowflakes start high in the atmosphere as ice crystals that freeze around small pieces of dust in the air. As they fall to the earth, the ice crystals join together to form snowflakes. The shape of each snowflake is determined by temperature, wind, the amount of time it takes to fall to the ground, and the amount of water vapor in the air. Snowflakes are six-sided because water molecules have six sides and tend to grow in six directions. Because conditions change as they form and fall to the ground, snowflake shapes may be very irregular, and one snowflake may have more than one type of form. No one has ever found two snowflakes that are exactly alike, but because they are crystals they do exhibit a regular structure.



What are the seven basic shapes of snow crystals?

There are many types of snow crystals – some scientists have described more than eighty – but here are the snowflake shapes that are best known (*see Snowflake Shape Chart for Visual*):



- Star Crystal
- Dendrite Star
- Columns
- Plates
- Capped Columns
- Needles
- Irregular Forms – which don't have a clearly defined shape





Instructions for Teachers:

Introduction: Introduce students to Snowflake Bentley and his work. Explain the basic ideas about snowflakes to your students. Relate these to the basic shapes in nature and in crystals.

Classroom exercise:

Hand out the chart of snowflakes types and have students study the seven most common snowflake shapes. Ask them to identify the basic shapes found in the various snowflake types such as a triangles or rectangles.



Outdoor exercise:

If you are in an area where snow falls, you can take the students outside to examine snowflakes as they fall. Paste a sheet of black felt or velvet onto a piece of 8 x 10 cardboard, one for every four students. Chill the boards in a freezer or a box out of doors. As the snow falls, go outside and have the students catch snowflakes on the cold boards and examine them with a magnifying glass. Have them quickly identify the shape and sketch each one. Have them count how many different shapes they were able to find outside.



Final Classroom Exercise:

Divide the students into groups. Give each group one of the two handouts with unidentified snowflakes, the chart of snowflake types, and have them fill in the snowflake type on the unidentified snowflakes sheet. Have them count how many sides each snowflake has and identify what basic shapes are in that snowflake. Have the groups come together and see if there are any differences in the way they identified the snowflakes.



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Instructions for Students:

Study the chart of basic snowflake shapes, looking at the basic forms that you can see in these shapes, such as triangles, needles, curves, and rectangles. How do they shapes fit together in a snowflake? How many sides are there on each snowflake? Are some more similar than others? Which is the most different? Which shape do you like the best?



Then use your observational skills!

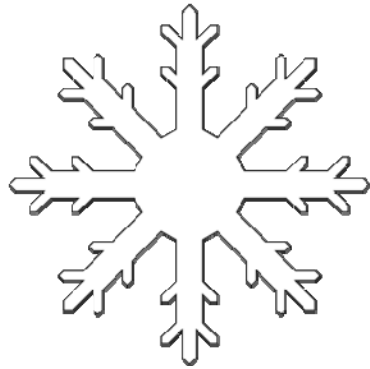
On the handout of unidentified snowflake photographs, see if you can name which type of snowflake each example has. What shapes are part of that snowflake? Is there more than one shape in this photograph?



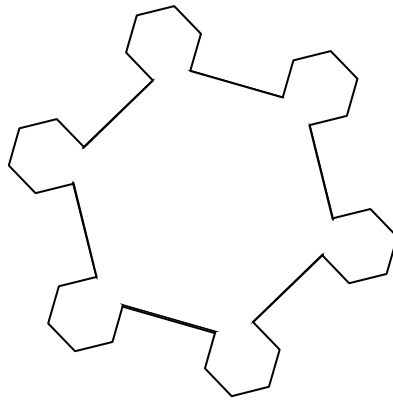
Write the number(s) of the snowflake type on the line below the photograph of the snowflake.



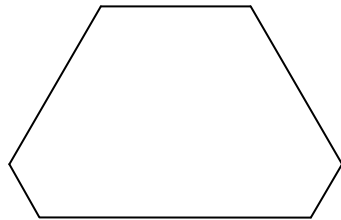
Snowflake Shape Chart:



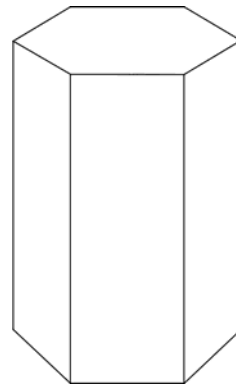
#1 Dendrite Star



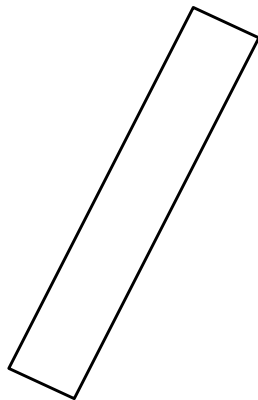
#2 Star Crystal



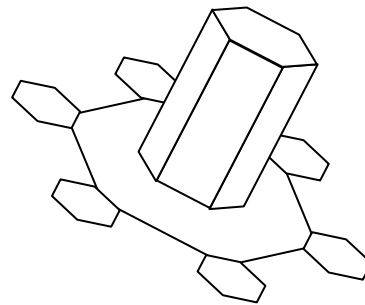
#3 Plate



#4 Column

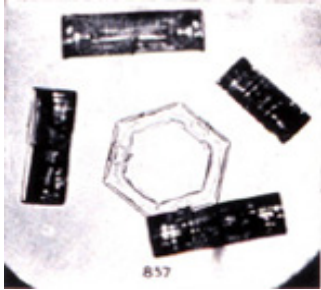


#5 Needle



#6 Capped Column

Bentley's Snowflake Images: #1





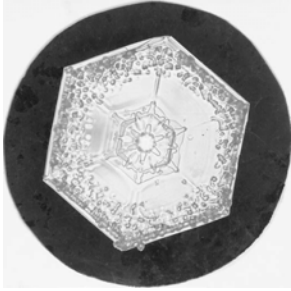


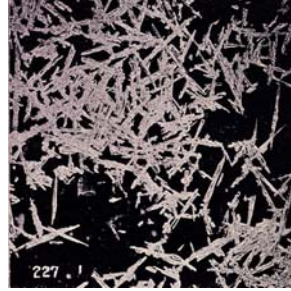






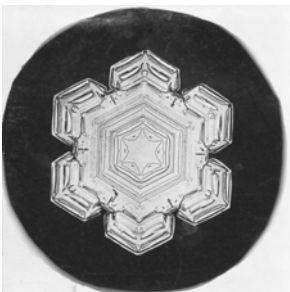
Bentley's Snowflake Images: #2

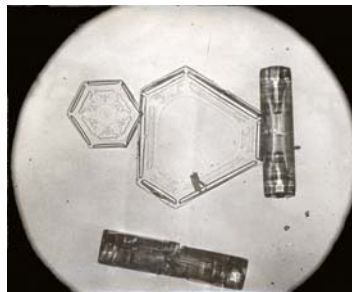














Additional Resources:

Texts:

Bentley, Wilson A. *Snowflakes in Photographs*. Reprint. Dover Publications, 2000.

LaCapelle, E. R. *Field Guide to Snow Crystals*. Seattle: University of Washington Press, 1969.



Libbrecht, Kenneth. *The Art of the Snowflake: A Photographic Album*. Voyageur Press, 2007.

Libbrecht, Kenneth. *The Secret Life of a Snowflake: An Up-Close Look at the Art and Science of Snowflakes*. Voyageur Press, 2010. (For elementary and middle school students)

Martin, Jacqueline Briggs, and Azarian, Mary, illustrator. *Snowflake Bentley*. Sandpiper, 2009.

Ukichiro, N. *Snow Crystals, Natural and Artificial*. Cambridge: Harvard University Press, 1954.



Reliable websites with documents online :

Smithsonian Scrapbook, Smithsonian Institution Archives,
<http://siarchives.si.edu/history/exhibits/documents/index.htm>

Smithsonian Institution Education site, <http://www.smithsonianeducation.org/educators/>

Jericho Historical Society Snowflake Bentley Site, <http://snowflakebentley.com/>



Snowflake Bentley Snow Crystal Collection of the Buffalo Museum of Science,
<http://bentley.sciencebuff.org/index.htm>

An online guide to snowflakes, snow crystals, and other ice phenomenon, created by Kenneth Libbrecht, Professor of Physics at Caltech (California Institute of Technology),
<http://www.its.caltech.edu/~atomic/snowcrystals/>

An online guide by James Provencio, Katie Ohsann, Stephen Barta, and Dave Gosselin, from the University of Arizona,
http://math.arizona.edu/~lega/195/Fall00/projects/Snow/Snow_Crystals.htm

