Snowflake Shapes

Snowflakes provide wonderful examples of symmetry. It is useful to engage students in examining the various forms of symmetry.

There are basically two types of symmetry:

- Rotational symmetry (also known as Radial symmetry)
- Reflection symmetry (also known as Bilateral, or Mirror symmetry)

What is the difference between these two types of symmetry?

- Rotational symmetry – You can cut the image in half in more than one direction, and the two halves will appear as mirror images of each other. The object has more than one line of symmetry. Examples: A triangle can be cut along three different axes. A circle can be cut along an infinite number of axes. The two photos below are examples of rotational symmetry. How many lines of symmetry are possible in each?

(Check: Five-pointed Star: 5 lines of symmetry. Stylized Snowflake: 6 lines of symmetry.)

- Reflection symmetry – You can cut the image in half in only one plane. In other words, there is only one direction in which you can draw a line that will result in two halves that are mirror images of each other. There is only one line of symmetry. For example, for the two pictures below, there is only one way you can fold each one that will result in the two halves being equal.

Activities for children:

1. A children's tutorial on symmetry can be viewed at http://www.linkslearning.org/Kids/1_Math/2_Illustrated_Lessons/4_Line_Symmetry/index.html

2. Have students examine a number of objects in the classroom, both two-dimensional and three-dimensional, to determine how many lines or planes of symmetry can be found in each.

3. Have students examine the symmetry of snowflakes by viewing photographs.
   - Wilson A. Bentley, nick-named "Snowflake Bentley," spent his life taking photographs of snowflakes. A collection of his snowflake photos can be found online at http://www.bentley.sciencebuff.org/collection.asp
   - Also view photo galleries on SnowCrystals.com at: http://www.its.caltech.edu/~atomic/snowcrystals/photos/photos.htm

4. The students should be able to figure out that, while most snowflakes have rotational symmetry, they do not all have the same number of lines of symmetry. Also, snowflakes sometimes have reflection symmetry (only 1 line of symmetry). And sometimes snowflakes are asymmetrical. Bentley's photographs include information about the weather conditions for each snowflake. Have the students study the weather conditions for various snowflakes to determine if weather conditions affect the number of lines of symmetry of snowflakes. Some answers can be found online at "A Guide to Snowflakes": http://www.its.caltech.edu/~atomic/snowcrystals/class/class.htm

5. Have students read the information that explains the Snow Morphology Diagram from the Snow Crystals primer at http://www.its.caltech.edu/~atomic/snowcrystals/primer/primer.htm
   On the diagram, "Supersaturation" refers to humidity. Low supersaturation numbers indicate low humidity. Have students obtain data (air temperature, humidity, and shapes of snowflakes) each time it snows throughout the winter. Have them use this data to create a graph similar to that found in the Morphology Diagram. Have the students see if their weather data enables them to predict the shapes/types of snowflakes. Download the Morphology Diagram at http://www.its.caltech.edu/~atomic/snowcrystals/primer/morphologydiagram.jpg

6. Take the students on a field trip in the schoolyard to look for patterns in other objects in nature. Have them draw simple pictures of objects they find in nature, and use those drawings to help examine the symmetry of the objects. Help the students begin to understand that the angle at which they make their drawing affects the presence of symmetry. Painters often alter the angle of three-dimensional symmetrical objects to make them appear asymmetrical in two-dimensional drawings, to add interest to the paintings.

7. For additional activities on snowflakes, see other activities at SnowCrystals.com. In particular, look at "Make your own" to see how to "Grow Your Own Snow Crystals." This lesson can also be found at http://www.teachersdomain.org/resource/lsps07.sci.phys.matter.lpsnowflakes/ under the title: "Why Do Snowflakes Come in So Many Shapes and Sizes?"