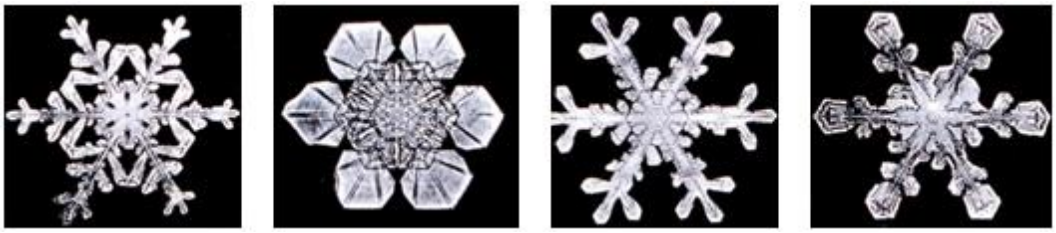
Name: _____ Date: _____

Student Exploration: Holiday Snowflake Designer

Vocabulary: axis of symmetry, edge, reflection, snowflake, symmetry, vertex

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)
Wilson "Snowflake" Bentley was a Vermont farmer fascinated by **snowflakes**. In 1885, he began to photograph snowflakes. Some of his images are shown below.



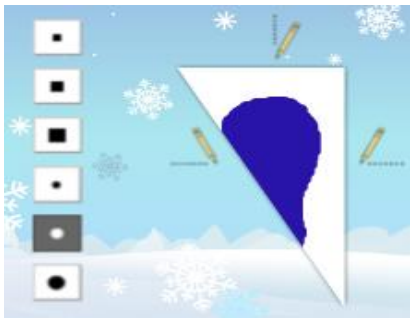
What are some of the similarities you see in these snowflakes? _____

_____

What are some differences? _____

_____

Gizmo Warm-up

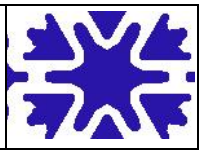


Although no two snowflakes are exactly alike, all snowflakes show **symmetry**, or the tendency of one part of an object to correspond exactly to another part. You can explore symmetry and invent your own snowflakes with the *Holiday Snowflake Designer* Gizmo.

To design a snowflake, do the following:

- Choose a **6 sided** or an **8 sided** paper fold.
- Choose a size and shape for your **Pencil** tool.
- Hold the mouse button down as you drag the pencil over the folded snowflake on the left side of the Gizmo. The completed snowflake appears on the right.
- Select the **Eraser mode** to erase lines that you have drawn.
- Select a background color and a foreground color from the selection at right. (Click the circles above or below the color squares to select a foreground or background color.)

When your snowflake design is finished, you can click on in the upper left corner by the snowflake to make a copy of the snowflake and then paste the image into a blank document.

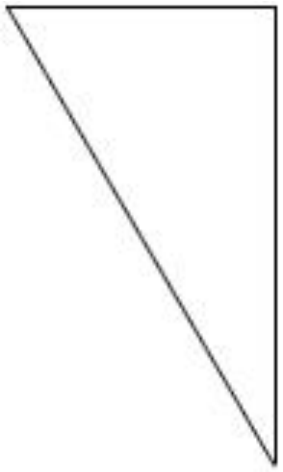
Activity: **Snowflake symmetry**	Get the Gizmo ready: • Click **Start a new snowflake**. • Choose a **6 sided** paper fold.	

Introduction: To make a snowflake, you fold paper several times so the original sheet of paper is now a smaller triangle with several layers. Each cut you make in the smaller triangle will be repeated several times when the triangle is unfolded.

Question: How does cutting paper translate to a completed snowflake?

1. Explore: Experiment with the Gizmo to find out which part of the snowflake corresponds to each **edge** (side) and **vertex** (corner) of the folded triangle. Label each part on the diagram at right with the appropriate letter.

   - Label the edge that corresponds to the outside border of the snowflake with "B" for "border."
   - Label the vertex that corresponds to the center of the snowflake with "C."
   - Label the vertex that corresponds to the vertices of the snowflake with "V."
   - One of the sides corresponds to the line segments that connect the center of the snowflake to each vertex. Label this side "CV."
   - The last side corresponds to the line segments that connect the center of the snowflake to the edges of the snowflake. Label this side "CS."



2. Observe: Click **Start a new snowflake**. Carefully draw the letter *b* into the center of the triangle, being careful not to touch the sides.

   A. How many *b*s appear on the snowflake? _____

   B. How many *d*s appear on the snowflake? _____

3. Analyze: Turn on **Show axes of symmetry**. An **axis of symmetry** is a line that separates mirror images, or **reflections**. Each axis of symmetry is a line that crosses the snowflake.

   A. How many axes of symmetry do you see? _____

   B. If you see a *b* on one side of an axis of symmetry, what do you see on the other side? Explain why this is so. _____

      _____

(Activity continued on next page)

Activity (continued from previous page)

4. Think and discuss: A snowflake has *six-fold symmetry* because it has six axes of symmetry. This occurs because of the structure of water molecules and the angles at which they bond together as an ice crystal forms.

    A. What would you see if you folded the snowflake on one of the axes of symmetry?

    _____

    B. What would you see if you rotated the snowflake 60 degrees, or 1/6 of the way around? _____

5. Predict: How many axes of symmetry would you predict for an eight-sided snowflake? _____

    Check your prediction using the Gizmo.

6. Make a rule: In general, how does the number of sides of a snowflake relate to the number of symmetry axes? _____

7. Explore: Design and print your own set of snowflakes using either six-sided or eight-sided designs. For inspiration, you can look at photographs of actual snowflakes on the Internet (do an image search on “snowflake”) or just use your imagination!

8. On your own: Based on your snowflake designs, create your own snowflakes using scissors and paper. Instructions for folding the paper for a six-sided or eight-sided paper snowflake can be found by clicking **How to fold the paper** at the bottom of the Gizmo.