The Science of Snowflakes Student Laboratory Book

Junior Scientist: _____

Prof. Paulette Clancy, Cornell
Center for Materials Research

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Thinking about Snowflakes

Think about all of the attributes of snowflakes. Use the book Snow Crystals to help you think about how they look. Use your experience outside to think about how they feel and how they behave under different conditions. Use the space below to make a list of all the ideas you and your partner come up with.

Can you organize your ideas into the categories listed below? Do all of your ideas fit in the table? Can you add a new category to the table?

Shape	Texture	Properties	"New Category"

Description of a snow flake:

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The States of Matter

State	Shape	Volume	Mass	Picture of Molecules
Solid				
Liquid				
Gas				

What state is a snowflake in?

What happens to the state of a snowflake when heat is added?

Use what you have learned to complete the chart below:

Starting State	Heat is Removed or Added?	Ending State	Change in molecular structure
Solid		Liquid	
Liquid		Gas	
Gas		Solid	

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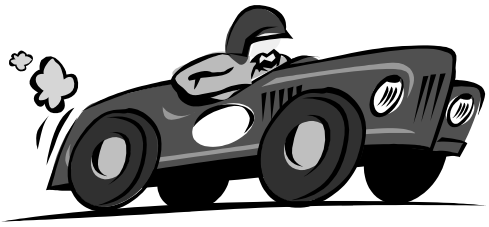
Temperature of substances at the 3 States of Matter

State	Water	Salt Water	Carbon Dioxide
Solid			
Liquid			
Gas			

Why do you think they put salt on the roads in the winter?



What are the characteristics of water in the 3 states?:

State	Why are the advantages of water in this state?	What are the disadvantages of water in this state?
Solid		
Liquid		
Gas		

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Lets Classify Snowflakes

Purpose: To observe the many shapes of snowflakes.

Equipment:

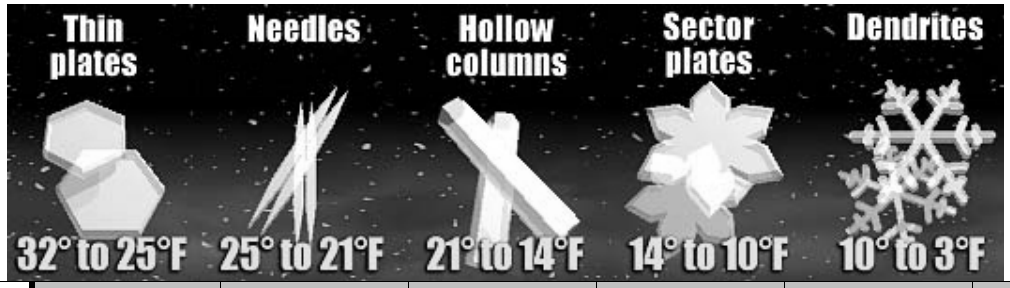
- box with a lid
- can of "Crystal Clear*" spray
- glass microscope slides
- microscope

Crystal Clear is a liquid plastic that can be sprayed on a surface and then hardens to form a thin transparent film. *Spray the Crystal Clear onto one of the glass slides and let some snowflakes fall on it. The liquid plastic will slowly creep up over the snowflakes and form a shell that replicates every detail of each snowflake. After the plastic dries you will have a permanent replica.*

Procedure:

1. Before you begin, it is important to leave the box with spray can and glass slides outdoors overnight so that everything is exactly the same temperature as the falling snow. If the spray or slides are just a little bit warm, the snowflakes will melt immediately when they land on the plate and be lost.
2. Now, spray on of the slides with the plastic, holding the slide out into the wind until you are ready to catch the snowflakes.
3. Hold the slide out and in just a few seconds you will have collected enough snowflakes. To keep the slide from getting too much snow, put it back into the box. Capture 5 slides of snowflakes following the same procedure.
4. Leave the wet slides in the box for several hours until the plastic hardens. Later, when you bring the slides inside, the snowflakes will melt but the plastic shell will remain, preserving the shape of the snowflakes forever!
5. Once the replicas are dry you can carefully examine the snowflakes under a microscope without worrying about melting them.
6. Try to classify the shape of the snowflakes in the chart below.

Observations:



	Thin Plates	Needles	Hollow Columns	Sector Plates	Dendrites	Other
Tally						

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Lets Classify Snowflakes ..continued

You may have had trouble filling in the chart …. Lets discuss why ...

As snow crystals form they take on a six-sided, or hexagonal shape, but with what seems like an infinite number of variations of being six sided. The temperature at which a crystal forms, and to less extent the humidity of the air, determine the basic shape. The many things that happen to snow crystals as they fall, such as collisions, partial melting and colliding with water drops that freeze to them, create even more shapes. This is why irregular crystals with no easily identifiable form are the most common.

Some times crystals are a combination of more than one form. For example, hollow columns that form in air colder than -8 Fahrenheit could grow thin plates on one or both ends as they fall through warmer air. While most people refer to shapes like those in the graphic above as snowflakes, flakes are really made of many snow crystals that have stuck together.
Snow crystals form hexagonal shapes because of the way the two hydrogen atoms that join with an oxygen atom to form a water molecule attach to the hydrogen atoms of other water molecules.

From the snowflakes you have collected, you will notice that the beautiful star shaped snowflakes are rather rare. Often you have needle or column shaped crystals or irregular crystals. The shape of each snowflake depends on the variations of temperature and humidity it experiences along its path as it forms within the cloud and falls to the ground. Each snowflake follows a unique path which is why all snowflakes are different from each other.

Conclusions:

Make three conclusions from the snowflakes you collected.

1.

2.

3.

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Properties of Crystals

Complete the Chart Below:

Structural Type of Crystal lattice	Size of Molecules	Space between Molecules	Bonds between Molecules	Other Characteristics	Example of such a crystal
Small Molecules					
Giant Molecules					
Ions					
Atoms					

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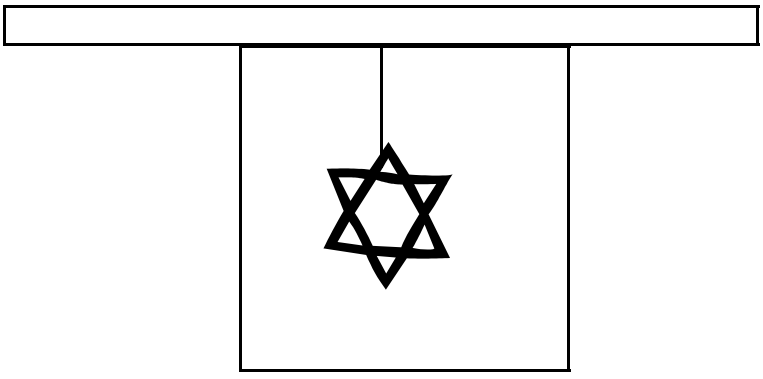
Lets Grow A Snowflake in a Jar

Purpose: To grow a crystal in a jar.

Equipment:
*string
* wide mouth jar
* white pipe cleaners
* blue food coloring (optional)
* boiling water (with adult help)
* borax (available at grocery stores in the laundry soap section)
* pencil

Procedure:
With a little kitchen science you can create long lasting snowflakes as sparkly as the real ones.

1. Cut a white pipe cleaner into 3 equal sections. Twist the sections together in the center so that you have a "six-sided" star shape.
2. If your points are not even, trim the pipe-cleaner sections to the same length. Now attach string along the outer edges to form a snowflake pattern.
3. Attach a piece of string to the top of one of the pipe cleaners and tie the other end to a pencil (this is to hang it from).
4. Fill a wide-mouth jar with boiling water.
5. Mix borax into the water one tablespoon at a time. Use 3 tablespoons of borax per cup of water. Stir until dissolved, (don't worry if there is powder settling on the bottom of the jar).
6. If you want you can add a little blue food coloring now to give the snowflake a bluish hue.
7. Insert your pipe cleaner snowflake into the jar so that the pencil is resting on the lip of the jar and the snowflake is freely suspended in the borax solution. Wait overnight and complete the experiment tomorrow.



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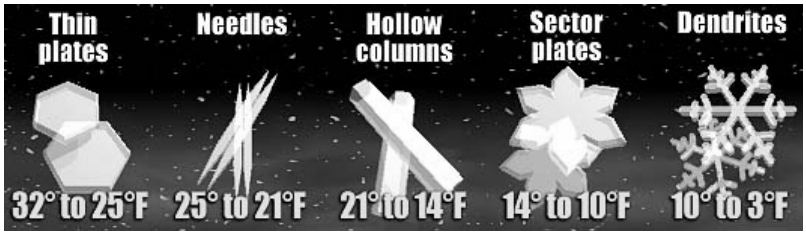
Lets Grow A Snowflake in a Jar

...Continue the experiment.

Observations:

8. Remove the crystal from the jar. Carefully hold the crystal and examine it using a handheld lens. What do you notice about the shapes of the crystals?

9. Can you classify them under one of the shapes of a snowflake: Thin Plates, Needles, Hollow Columns, Sector Plates, Dendrites. If so, which shape is most prevalent?



Conclusion:

10. How is the growth of the snowflake crystal in the jar similar to the growth of a snowflake in the sky?

11. How is the growth of the snowflake crystal in the jar different to the growth of a snowflake in the sky?

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Experiment Template

Up to this point you have done some great scientific work, following the procedure of the experiments carefully, recording your observations, and making conclusions. Your good work has caught the eye of a fellow scientist. She is particularly interested in how the growth of your crystal in the jar would change if it was grown under different conditions.

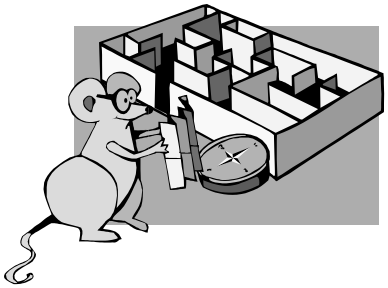
Your task is now to design an experiment to test this: Design an experiment that will show if the growth of the crystal changes if grown under different conditions. Use the Experiment Template to help with your design.

Purpose: What is the intent for performing the experiment? What are you trying to find out?

Equipment: What equipment do you need to complete the experiment?

Procedure: List the steps to follow out the experiment. Be very specific.

Observations: You may collect information in a chart, draw a diagram, or write down what you see at different stages of the experiment.



Conclusion: Return to the purpose of the experiment. Can you answer, or give insight into the question you set out to answer? After performing the experiment, what can you conclude? Can you give recommendations to future scientists about how to modify the experiment to make it more effective?

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Design a Mini-Hut

The same scientists who challenged you to look at how different conditions affect the growth of a crystal in a jar, now has an other challenge for you. She wants to know how to maintain and alter the crystal structure of ice. Here is the challenge:

1. Can you design a "mini-hut" that would keep the crystal structure of an ice cube in tact (can you keep the ice in a solid state) for a maximum amount of time?

2. Can you design a "mini-sauna" that would quickly change the crystal structure of an ice cube (can you change its state to a liquid) in a minimal amount of time?

You may not use electricity to help in either of the designs above. However, you may use any other materials you have at home or in the classroom. Discuss these problems in your group, brainstorm for possible ideas to test for solutions, make a list of supplies you will need to carry out the experiment, and write out a procedure. Use the Experiment template to help you focus your design.

You will have two classes to workout your design, then the competition will begin. All groups will enter a "mini-hut" and a "mini-sauna" into the competition. The "mini-hut" that keeps the ice cube from turning into a liquid the longest, wins. The "mini-sauna" that changes the ice cube from a solid to a liquid first, wins. Good luck!

Design Evaluation				
Group	**Mini-Hut Design Strengths**	**Mini-Hut Design Weak-nesses**	**Min-Sauna Design Strengths**	**Min-Sauna Design Weak-nesses**

Complete the Design Evaluation below for Three different Groups.

Comments:

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Experiment Template

Purpose: What is the intent for performing the experiment? What are you trying to find out?

Equipment: What equipment do you need to complete the experiment?

Procedure: List the steps to follow out the experiment. Be very specific.

Observations: You may collect information in a chart, draw a diagram, or write down what you see at different stages of the experiment. Make sure that the information you are collecting here will give you insight to the purpose of the experiment.

Conclusion: Return to the purpose of the experiment. Can you answer, or give insight into the question you set out to answer? After performing the experiment, what can you conclude? Can you give recommendations to future scientists about how to modify the experiment to make it more effective?

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