Name ____________________

Period ______________

Inquiry Lab #1

Background

Crystals are structures that are formed from a regular repeated pattern of connected atoms or molecules. Crystals grow by a process termed **nucleation**. During nucleation, the atoms or molecules of the **solute** are dissolved into their individual units by a **solvent**. The solute particles will begin to contact each other and connect with each other and begin to from crystal subunits. This subunit is larger than an individual particle of solute, so more particles will contact and connect with it. Eventually, this crystal nucleus becomes large enough that it falls out of **solution** (aka crystallizes). Other solute molecules will continue to attach to the surface of the crystal, causing it to grow until a balance or equilibrium is reached between the solute molecules in the crystal and those that remain in the solution.

1. What will be the purpose of this lab? ____

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2. What is a **solute**? ____

____

3. What is a **solvent**? ____

____

4. What is a **solution**? ____

____

5. What is **nucleation**? ____

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Procedures

In order to grow a crystal, you need to make a solution which maximizes the chances for the solute particles to come together and form a nucleus, which will grow into your crystal. This means you will want a **saturated solution** with as much solute as you can dissolve. Sometimes nucleation can occur simply through the interactions between the solute particles in the solution (called **unassisted nucleation**), but sometimes it's better to provided a sort of meeting place for solute particles to aggregate (**assisted nucleation**). A rough surface tends to be more attractive for nucleation than a smooth surface. As an example, a crystal is more likely to start forming on a rough piece of string than on the smooth side of a glass.

1. What is a **saturated solution**? ____________________

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2. Describe the difference between **assisted** and **unassisted nucleation**. ____________________

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3. Why can a rough surface be better for growing crystals than a smooth surface? ____________________

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Make a Saturated Solution

It's best to start your crystals with a saturated solution. A more dilute solution will become saturated as the air evaporates some liquid, but evaporation takes time (days, weeks). You will get your crystals more quickly if the solution is saturated to begin with. Also, there may come a time when you need to add more liquid to your crystal solution. If your solution is anything but saturated, then it will undo your work and actually dissolve your crystals! Make a saturated solution by adding your crystal **solute** to 300mL of your **solvent** (usually water, although some recipes may call for other solvents). Stirring the mix will help to dissolve the solute. You may want to apply heat to help the solute dissolve. You can use boiling water or heat the solution on the stove, over a burner, or in a microwave.

1. Write a step-by-step procedure for how you would make a saturated solution. Make sure to use the terms **solute**, **solvent**, and **solution.**

Growing a Crystal Garden or 'Geode'

If you just want to grow a mass of crystals or a crystal garden, you can pour your saturated solution over a substrate, and allow the liquid to slowly evaporate.

1. What kind of nucleation would be used in a crystal garden? Explain why.

2. What physical characteristics would a good substrate have?

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3. What kinds of objects would make good substrates for beginning a crystal garden?

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Growing a single large crystal

On the other hand, if you are trying to grow a larger single crystal, you will need to obtain a seed crystal. Mr. Sapin will provide the seed crystal for you. Pour your saturated solution into a **clean** container. Tie your seed crystal to a string and tie the string to a pencil, stirrer, or popsicle stick. Suspend your crystal seed in your saturated solution.

1. What physical characteristic would a good seed crystal have? ______________________

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Factors affecting crystal growth

The following factors are significant in determining how well your crystal will grow:

1. Number of nucleation sites

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2. Cleanliness of your saturated solution

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3. Physical/Mechanical Disturbance

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4. Rate of evaporation

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5. Rate of Cooling

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