Ice Balloons

In this activity, you'll explore a frozen water balloon to learn how to ask investigable questions and how to use everyday objects to do experiments to answer those questions.

[This activity has been adapted from a more comprehensive professional development workshop. See: http://www.exploratorium.edu/IFI/docs/Raising_Questions.pdf]

What Do I Need?

- Cafeteria-style plastic tray
- 9" round balloons (made into ice balloons at least 2 days in advance)
- flashlight
- hand lens
- sticky notes
- pens
- wood & metal objects (like toothpicks & paper clips)
- salt
- food coloring
- plastic tub for water (big enough to hold a couple ice balloons and enough water to allow them to float)

How Do I Prepare?

1. Two days ahead of time, prepare ice balloons.
2. Using a faucet with slowly running water, fill balloons to about 5" around. Try not to run the water too quickly so that it doesn't create bubbles.
3. Squeeze out the excess air, then tie the balloons off.
4. Place the balloons in the freezer for two days, or until frozen solid.
5. Prior to doing the activity, fill plastic tub with enough water for the ice balloon to float. For tips on making ice balloons, see pg. 18 of the Raising Questions pdf (see link above).

What Do I Do?

1. When the ice balloons are completely frozen, you can begin experimenting.
2. Use scissors to cut the knot off the balloon, then peel the balloon off the ice.
3. Begin by noticing everything you can about the balloon, simply by looking.
4. Use a flashlight to illuminate the ice. Use a hand lens to see more details.
5. What do you notice about the ice? Do you notice "spikes," cracks, or frost? What questions does this make you think of? Write your questions on your sticky notes, one question per note. (Example: "Why does the ice have cracks?")
6. Use the paper clips and toothpicks to explore the surface of the ice.
7. What do you notice about how the wood and metal objects interact with the ice? What questions does this make you think of? Write your questions on your sticky notes.
8. Pour a small amount of salt on the ice. Watch what happens for a few moments.
9. What do you notice as you watch the salt on the ice? What questions does this make you think of? Write your questions on your sticky notes.
10. Rinse the salt off your ice balloon using the water. Place a few drops of food coloring on the ice.
11. What do you notice as the coloring spreads on the surface of the ice? What questions does this make you think of? Write your questions on your sticky notes.
12. Now try placing your ice balloon in the tub of water.
13. What do you notice as the ice floats in the water? What questions does this make you think of? Write your questions on your sticky notes.

How Do I Investigate My Questions?

1. You should now have quite a few questions about your ice balloon, with one question per sticky note. Look through your questions and see if you can group them by type of question. You can post your sticky notes on a wall or on your table, grouping them in the following ways:

2. Group questions that ask for an answer related to naming, knowing, or identifying, such as,

- "What are the white wormy things inside?"
- "What is the fuzzy white stuff on the outside?"
- "What is food coloring made of?"

These questions are good for research--you can look up the answer or ask someone.

3. Now group questions that begin with "Why...?", such as,

- "Why do some ice balloons have more spikes?"
- "Why does salt melt ice?"
- "Why is it harder on the outside and softer on the inside?"

4. Finally, group questions that you are able to answer by doing an experiment, such as,

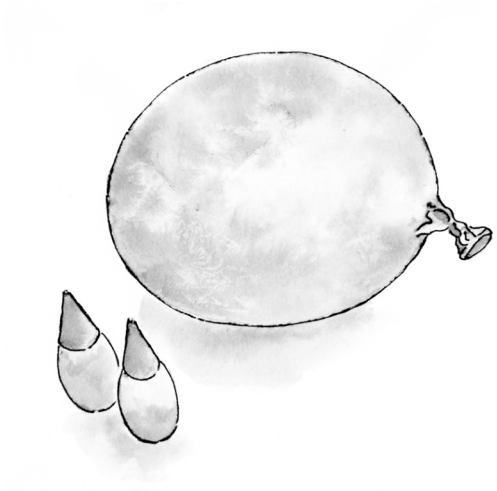
- "What if we put the balloon in hot water?"
- "Do different types of salt melt the ice?"
- "What melts it faster, salt or sugar?"

5. Go back to your "why" questions (from Step 3). You'll notice that these questions probably can't be answered with simple research, like the questions in Step 2. The "why" questions require complex answers and are not easy to figure out. But you can turn these questions into experiments by changing the "why" part into "Do all...?" or "What would happen if...?" For example,

- "Why does salt melt ice?" can be changed to "Does salt melt ice?" which is something you can investigate.
- "Why does ice melt so fast in water?" can be changed to "Does ice melt faster in water or milk?" which you can easily do as an experiment.

A more thorough description of a strategy for "turning questions" can be found on pages 36-38 of the Raising Questions pdf.

6. Now you have a whole pile of questions that you could investigate further. Choose a question from Step 4 or a reworded question from Step 5 that you would like to answer using your ice balloon and your materials. Do your investigation with your materials and see if you can answer your question! Part of the fun is to figure out yourself how you want to do the investigation. You decide what you want to do, and whether you'll take notes, draw your results, or just notice what happens.



What's Going On?

A fundamental part of exploring our physical and biological worlds in a scientific way is the process of raising and answering questions. Ice is an intriguing natural phenomenon explored in this activity, and it leads to question upon question. Questioning is an integral part of the inquiry process.

By questioning during your exploration of ice balloons, you begin to realize what you know and what you don't know. It is in the process of questioning that you become aware of things yet to be understood---areas that hold great curiosity, as well as areas that are not well understood. This questioning process is at the heart of the scientific process. By noticing, questioning, and experimenting, you are doing exactly what scientists around the world do.

Though seemingly basic, the science behind Ice Balloons is very complex and touches upon many ideas such as density, temperature, thermal conductivity, center of mass, freezing point depression, heat capacity, and the characteristics of the states of water, water vapor, and ice.[1] The use of food coloring, flashlights, and other items can also lead to a rich artistic experience. Both art and science can be explored as you raise questions.

In the instructions for this activity, however, we concentrate less on the science of ice balloons and more on strategies for observing, asking questions, and then choosing a question to investigate further. In this way, the inquiry techniques used here to explore the ice balloons can be adapted to help you explore any object or phenomenon.

If you'd like more information about the process of inquiry be sure to check out these other activity Facilitator's guides from the Exploratorium's Institute for Inquiry: http://www.exploratorium.edu/IFI/workshops/index.html.

1. For an overview, read the "Background Science for the Ice Balloons Activity", pgs. 19-21, http://www.exploratorium.edu/IFI/docs/Raising_Questions.pdf