RAFT IDEAS

Topics: State Changes, Crystal Structure, Atoms, Molecules, Density, Volume

Materials List

- ✓ Small balls or objects in two sizes (such as clear 5-gallon bottle caps and the nipple sections of sport bottle tops)
- ✓ Hot glue
- ✓ Large box (such as from photocopy paper)
- ✓ Protractor
- ✓ Pencil and paper

This activity can be used to teach:
Next Generation Science Standards:

- Structure of matter (Grade 5, Physical Science 1-1; Middle School, Physical Science 1-1)
- Properties of materials (Grade 5, Physical Science 1-3)
- Changes of state (Middle School, Physical Science 1-4)

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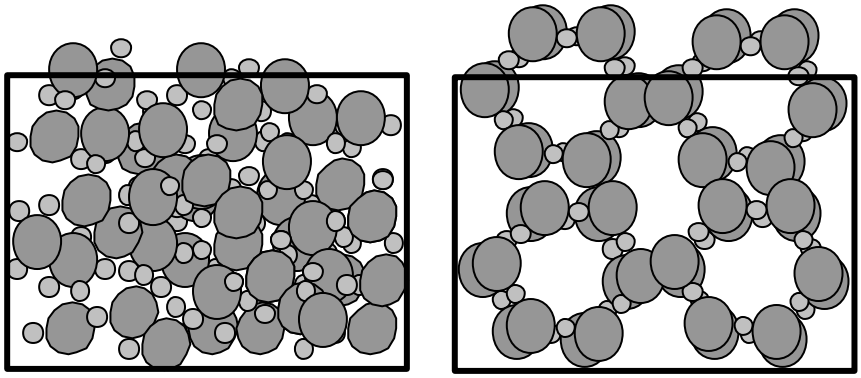
Water in an ICE Box

Modeling the Density of Their Molecular Structures



Liquid Water | Solid Water (Ice)

Water is the foundation of life on Earth, partly due to an unusual collection of properties that are not duplicated by any other substance. One of those properties is the fact that solid water, or ice, is less dense than cold liquid water. This property is what enables fish and other creatures to continue living in a lake or river that has frozen over. The ice floats on the surface of the liquid water, rather than choking the bottom of the lake or river.

This activity uses a simple version of a water molecule and a simplified version of an ice crystal to demonstrate why ice is less dense than water.

Assembly (Instructions for teachers or students)

1. Start by using the protractor to draw two lines that meet at an angle of 105°. You will use this as a template for gluing the water molecules together.
2. Hot glue together approximately 60 water molecules consisting of one larger ball (oxygen), and two smaller balls (hydrogen). To glue them with the correct angle, center the larger ball on the intersection of the lines on your template, and position the smaller balls on the lines next to the larger ball.
3. To make the simplified water molecules, glue 6 each, alternating, of the small and large balls together to form a hexagon (note that you will not have the 105° angle in these hexagons as you do in the individual water molecules).
4. Layer and glue pairs of hexagons together with 6 small balls between the hexagons. Glue six more small balls to the tops of the large balls of the top hexagon. These layered hexagons are your simplified ice molecules (notice that these follow the required 2:1 ratio of hydrogen to oxygen).

To Do and Notice

1. Have students loosely place the single water molecules into the box and note either how many it takes to fill the box or how full the box gets (depending on how many water molecules you have?
2. Now have students loosely place the ice molecules into the box and note either how many it takes to fill the box or how full the box gets (depending on how many water molecules you have).

Activity Instructions by Sara Woodhull and RAFT Education Department

3. Have the students notice that there are more water molecules in the box when they are separate (liquid) than when they join to form an ice crystal, and discuss why.

The Science Behind the Activity

Ice consists of an orderly array of hexagonal cells, where the angles between the hydrogen and oxygen atoms dictate that there is quite a bit of empty space between oxygen neighbors. Liquid water is less ordered, so water molecules can fit together more tightly. It is because of this tighter packing that liquid water is denser than ice.

Taking it Further

Try the water freezing experiment in the RAFT Idea Sheet ***Freezing Water into Ice***.

Web Resources (Visit www.raft.net/raft-idea?isid=452 for more resources!)

The USGS has a site written for teachers with detailed information about water, including its properties and its role in Earth Science. Visit this site at: http://ga.water.usgs.gov/edu/mwater.html