

Ice on a Wire

A Phase Change Demonstration

Introduction

A weighted metal wire slices into an ice cube as the increased pressure melts the ice. The water quickly refreezes after the wire passes through.

Chemical Concepts

- Phase changes
- Pressure

Materials

Ice cube

Beaker, 500-mL or 1-L

Hook weights, 1-kg, 2

Metal wire, 18-, 20- or 22-gauge, 12 inches

Test tube basket, or similar-sized basket

Safety Precautions

Please follow all normal laboratory safety guidelines.

Procedure

1. Turn a 1-L beaker upside-down on a flat surface.
2. Hang a small basket, such as a test tube basket or a small produce basket, over the beaker. *Note:* The basket provides traction and lifts the ice cube off the beaker. As the ice melts, water runoff will be separated from the ice cube, therefore preventing it from slipping.
3. Securely wrap the metal wire several times around the hook of each weight and back up around the wire. Leave enough wire between the hooks so that it will span across the bottom of the basket with an inch or two of slack on each side of the beaker (but not enough slack so that the weights will touch the countertop). (See Figure 1.)
4. Place a large ice cube on the center of the basket.
5. Holding one weight in each hand, slowly and carefully place the wire over the center of the ice cube.
6. Release the weights slowly, making sure that the wire balances on the ice cube.
7. The wire will slowly slide into the ice cube, and the water will refreeze behind it.
8. The resulting “ice on a wire” may be displayed by removing the weights and the basket from the setup. Turn the beaker over so that it is right side up. Bend the wire so that it grips on to the sides of the beaker, allowing the ice cube to be suspended from the wire over the beaker.

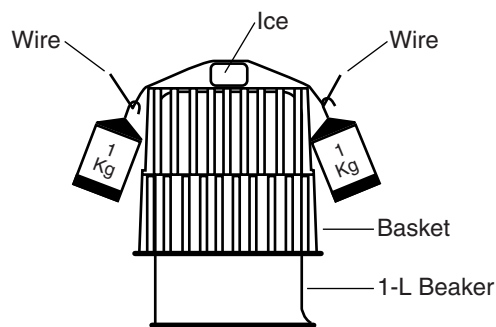


Figure 1.

Disposal

The metal wire, weights, and basket may be reused many times.

Tips

- Allow about 20–30 minutes for the wire to move approximately $\frac{1}{3}$ to $\frac{1}{2}$ of an inch into the ice cube.
- Small baskets from produce such as strawberries work well for this demonstration.

- It is best to position the ice cube so that the wire will rest on the smallest area possible.
- The weights are relatively heavy and may dent or nick a tabletop if they fall from the wire. Weights must be securely linked to the wire to prevent slipping. You may choose to set up the display on a demonstration tray to protect the tabletop and catch any water runoff.

Discussion

Increased pressure changes the melting point of ice. Pressure forces molecules to move at a faster rate, in turn increasing the internal energy of the ice. The higher internal energy causes the ice to melt even though the temperature remains the same. Once the wire has passed, pressure is reduced, and the water refreezes as the internal energy dissipates. This pressure/melting relationship also may be observed with ice skates. The thin metal blade melts the ice underneath it due to the force from the weight of the skater, and quickly refreezes when the source of pressure is removed.

The phase diagram of water is unique in that the freezing/melting point line is not vertical. The line slopes slightly because the freezing/melting point is at a lower temperature under increased pressure. Under pressure, water molecules at 0 °C will then fall into the liquid sector of the phase diagram. After the wire has passed, pressure returns to 1 atm, and the 0 °C water will freeze, returning to the solid region of the phase diagram. The greater the pressure on the ice, the faster it will melt. At pressures less than 2000 atm the melting point of ice changes approximately -0.01 °C for every 1 atm of pressure which is exerted on the ice (see Figure 2).

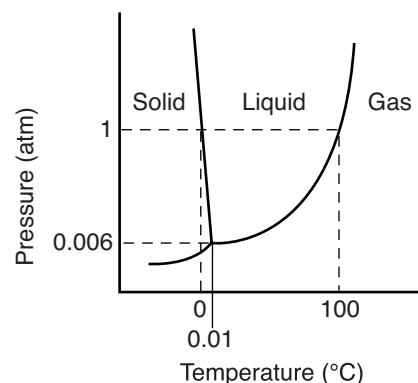


Figure 2.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Evidence, models, and explanation
Constancy, change, and measurement

Content Standards: Grades 5–8

Content Standard B: Physical Science, properties and changes of properties in matter, understanding of motions and forces, transfer of energy

Content Standards: Grades 9–12

Content Standard B: Structure and properties of matter, motions and forces, conservation of energy and increase in disorder, interactions of energy and matter

Acknowledgment

Special thanks to Penney Sconzo, Westminster School, Atlanta, GA, for sharing this activity with Flinn Scientific.

Materials for *Ice on a Wire* are available from Flinn Scientific, Inc.

| Catalog No. | Description |
|-------------|---------------------------------|
| AP5327 | Test Tube Basket |
| OB2066 | Hook Weight Set, Economy Choice |
| C0150 | Wire, Copper, 22 gauge, 4 oz |
| I0050 | Wire, Iron, 18 gauge, 25 g |

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.