Ice Cube Science Explanation handout (to be distributed after activity debrief)

Background for Ice Cube Activity

Ice melts faster in fresh water than in salt water.

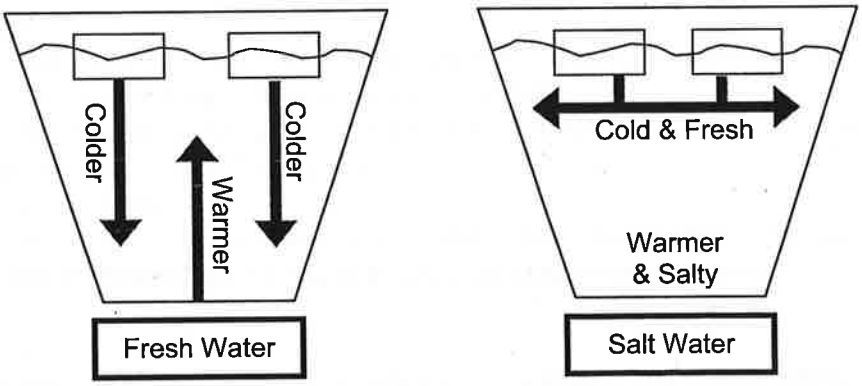
It's all about density!

1. What happens when ice melts in fresh water at room temperature?

- Water from melting ice is cold and fresh. It is more dense than fresh water at room temperature (REMEMBER: Liquid water density decreases as *temperature* increases.)
- The denser cold water from the melting ice sinks to the bottom of the cup. That's why you saw the food coloring sink to the bottom of the cup.
- When the dense cold water sinks to the bottom of the cup, it displaces water at the bottom of the cup. The room-temperature water at the bottom of the cup has to go somewhere when it is pushed out of the way by the sinking cold water. The displaced room-temperature water from the bottom of the cup moves up toward the surface. You saw that the food coloring was eventually mixed throughout the cup just by the movement of dense cold water sinking and room-temperature water being displaced.
- The result of this mixing process is that the ice is always being surrounded by new room-temperature water as the dense cold water sinks and less dense room-temperature water is pushed upward. Therefore, ice melts faster in fresh water.

2. What happens when ice melts in salt water at room temperature?

- Water from melting ice is cold and fresh. Fresh water is always less dense than salt water no matter what the water temperature is. (REMEMBER: Water density decreases as *salinity* decreases.)
- Since the cold water from the melting ice is less dense than the salt water, it floats on the top of the salt water. That's why you saw the food coloring form a layer at the top of the cup.
- The layer of cold water from the melting ice "insulates" the ice. In other words, the cold, fresh water from the melting ice helps keep the ice cold. Therefore, the ice melts more slowly in salt water.



Ice Cubes Explanations: Predictions and After the Results

From Group 1: I predict the ice will melt faster in salt water because:

1. Salt causes ice on roads to melt
2. Salt affects the freezing point of water
3. There are differences in the specific heat capacity of salt water and fresh water
4. The salt water has dissolved NaCl in it which causes the molecules to be in greater motion than the freshwater molecules, and that will cause the ice to melt (be eroded away)
5. D=M/V

From Group 2: I predict the ice will melt faster in fresh water because:

1. Adding salt makes things colder—that's why you use it when making ice cream and why you put it in coolers of beer
2. Salt affects the freezing point of water
3. The ice will be more buoyant in salt water than in fresh water, so the ice cube will have less surface area in contact with liquid in the saltwater cup.
4. Fresh water in the cup is the same as the fresh water melting off the ice cube, so it can melt more easily.

Ice Cubes Explanations—After the Results:

Examples of responses *after seeing the results* of the investigation:

1. Like dissolves like. Fresh water in the cup is the same as the fresh water melting off the ice cube, so it can melt more easily.
2. There are density differences between the freshwater ice cube and the cup of salt water; salt water is denser than fresh water, even really cold fresh water. This sets up two stratified layers: cold fresh water trapped on top of room-temperature salt water.
3. Because of density differences, the freshwater layer made up of a small volume of icy cold fresh water that melts off the ice cube is stuck on top of the larger volume of room-temperature salt water. There is less volume for the cold fresh water to spread out, so it keeps the ice cube enveloped in very cold, just-melted water. In the freshwater cup, the cold, just-melted fresh water sinks to the bottom and effectively displaces the room-temperature water in a continual circulatory effect (convection current); the remaining ice cube is surrounded by less cold water.
4. I was right. The ice will be more buoyant in salt water than in fresh water, so the ice cube will have less surface area in contact with liquid in the saltwater cup. That will make the ice cubes melt more slowly in the saltwater cup.

(Explanations #2 and #3 are correct.)