# Teacher Background
# Chapter 2, Lesson 4

***Why does salt make ice colder?***

There is a principle in chemistry that comes up in several different contexts. The simple version is that:

- **It takes energy to break bonds**
- **Energy is released when bonds are formed.**

These ideas can be used to help explain why the temperature decreases when salt is added to ice.

**Note:** In the context of melting and freezing of water, the use of the term "bond" refers to the interaction and close association *between* water molecules. It does not refer to the covalent bond which holds the oxygen atom and the hydrogen atoms together *within* the water molecule. The bond breaking and bond making involved in melting and freezing deal with the attractions and interactions *between* water molecules.

If an ice-and-water mixture is placed in a well-insulated container, some ice melts but some liquid water also freezes. During melting, the breaking of "bonds" between water molecules in the ice uses some energy, so the process of melting makes the ice/water mixture colder. But the making of "bonds" between water molecules to form ice is energy-releasing so the process of freezing makes the ice/water mixture warmer.

When these two processes happen at the same rate, the ice/water mixture stays at the same temperature. But when salt is added, it dissolves into the water and forms a saltwater solution. The salt water does not refreeze as fast as the rate at which the ice melts. The energy used to melt the ice is not balanced by an equal amount of energy released by freezing so the ice/saltwater solution gets colder.

This would actually work with any substance that dissolves well in cold water. Salt dissolves pretty well in cold water and is pretty inexpensive, so it is a popular choice.

 

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## Relative humidity

One condition that you often hear in the weather report is *relative humidity*. Relative humidity is reported as a percentage, but a percentage of what? As you know, humidity refers to the amount of water vapor in the air. Relative humidity is the amount of water vapor in the air compared to, or relative to, the maximum amount the air could "hold" at that temperature.

For example, assume the relative humidity is 50% at a temperature of 60 °F. This means that the concentration of water vapor in the air is 50% of the maximum it could hold at that temperature. Since water vapor condenses more readily at lower temperatures, it can hold more water at higher temperatures. This means that air with a relative humidity of 50% at 80 °F would have more water vapor in it than air with a relative humidity of 50% at 60 °F.

## Dew point

Another condition in the weather report is *dew point*. Dew point is like the opposite of relative humidity. It is the *temperature* that it would need to be for the amount of water vapor in the air to condense.

For example, if the air had a certain concentration of water vapor, it might condense at 40 °F. Then the dew point would be 40 degrees. But if the air contained more water vapor, it might condense at 45 degrees so this temperature would be the dew point.

## Conditions for frost

When the relative humidity is low, the temperature required to make the water vapor in the air condense (dew point) is low. When a surface is at or below the dew point and the dew point at or below the freezing point for water, frost can form on that surface.

 