

Lesson 3: Heat and Temperature – are they the same?

A Wrong Idea

Often the concepts of heat and temperature are thought to be the same, but they are not. Perhaps the reason the two are incorrectly thought to be the same is because as human beings on Earth everyday experience leads us to notice that when you heat something up, say like putting a pot of water on the stove, then the temperature of that something goes up. More heat, more temperature – they must be the same, right? Turns out, though, this is not true.

Initial Definitions

Temperature is a number that is related to the average kinetic energy of the molecules of a substance. If temperature is measured in Kelvin degrees, then this number is directly proportional to the average kinetic energy of the molecules.

Heat is a measurement of the total energy in a substance. That total energy is made up of not only of the kinetic energies of the molecules of the substance, but total energy is also made up of the potential energies of the molecules.

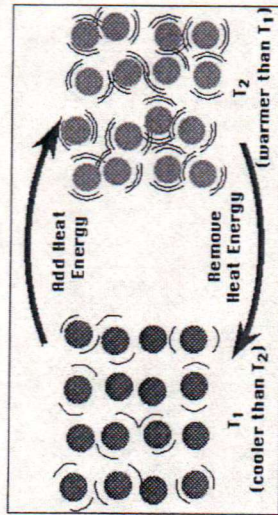
More About Temperature (unit: Kelvin) $K = ^\circ C + 273$

If Temperature is measured in Kelvin, then it is directly proportional to the average kinetic energy of the particles. Notice we did not say that temperature *is* the kinetic energy. We said it is a number, if in degrees Kelvin, proportional to the average kinetic energies of the molecules; that is, if you double the Kelvin temperature of a substance, you double the average kinetic energy of its molecules.

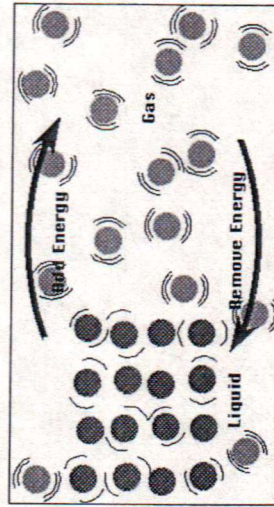
More About Heat (unit: Joules)

Heat is energy. Heat is the total amount of energy possessed by the molecules in a piece of matter. This energy is both kinetic energy and potential energy. When heat energy goes into a substance one of two things can happen:

1. The substance can experience a raise in temperature. That is, the heat can be used to speed up the molecules of the substance.



2. The substance can change state. Although heat is absorbed by this change of state, the absorbed energy is not used to speed up the molecules. The energy is used to change the bonding between the molecules. Heat comes in and there is an increase in the potential energy of the molecules. Their kinetic energy remains unchanged.



So, when heat comes into a substance, energy comes into a substance. That energy can be used to increase the kinetic energy of the molecules, which would cause an increase in temperature. Or that heat could be used to increase the potential energy of the molecules causing a change in state that is not accompanied by an increase in temperature.

Exercise: Using the ideas you have just learned, with a group, develop an argument to explain which has more energy – a swimming pool of cold water or a pot of boiling water. Produce a diagram/poster that enhances your explanation.