Heat vs. Temperature

Temperature and Heat are **not** the same thing!

We have all noticed that when you heat something up, its temperature rises. Often we think that heat and temperature are the same thing. However, this is not the case. Heat and temperature are related to each other, but are different concepts.

Heat:

Consider a mug of steaming hot chocolate – it feels warm to your fingers. If you touch it, heat flows from the mug to your hand. That's the simple story: a hot thing warms up a cooler thing by the transfer of heat.

Heat itself isn't a "thing." It is impossible for an object to possess heat or heat energy. Heat is the transfer of thermal energy. Heat is energy in the process of being transferred from one object to another because of the temperature difference between them. Heat will not flow between two objects of the same temperature. Because heat is energy, it is measure in joules.

Heat energy is both kinetic energy and potential energy. Thermal energy exists when the atoms or molecules in a substance vibrate. These atoms have kinetic energy, which creates thermal energy. As something loses thermal energy, these vibrations slow down. As something gains thermal energy, these vibrations increase. Heat energy depends on the speed of the particles, the number of particles (the size or mass), and the type of particles in an object.

Heat transfer always occurs from the place where there is a higher temperature to the place where it is cooler. Heat (NOT cold) is transferred. For example, heat transfer in a bathtub occurs from the hot water to the cooler air and the cooler floor and the cooler tub sides, and the cooler person in the water. The process of heat transfer continues until everything is the same temperature. If I leave my mug of hot chocolate on the table while I go to check my email, heat will flow from the mug to the room until the hot chocolate is the same temperature as the room.

There are three main ways that you can get heat from something else: conduction, convection, and radiation.

Temperature:

Temperature is not energy. Temperature is a measure of the average kinetic energy that the particles in a substance have at a particular location. As heat energy increases, the temperature will increase. If molecules increase in vibration, rotation or forward motion and pass that energy to neighboring molecules, the measured temperature of the system will increase. Temperature is related to how fast the atoms within a substance are moving.

Temperature is a measure of hotness or coldness. If we take two objects which have the same temperature and bring them into contact, there will be no overall transfer of energy between them because the average energies of the particles in each object are the same. But if the temperature of one object is higher than that of the other object, there will be a transfer of energy from the hotter to the colder object until both objects reach the same temperature.

Temperature does not depend on the size or type of object. It is heat that will increase or decrease the temperature. If we add heat, the temperature will become higher. If we remove heat the temperature will become lower. Higher temperatures mean that the molecules are moving, vibrating and rotating with more energy.

For example, the temperature of a small cup of water might be the same as the temperature of a large tub of water, but the tub of water has more heat because it has more water and thus more total thermal energy.

Scales used to measure temperature are Kelvin, Celsius ^{o}C and Fahrenheit. In the Kelvin scale, 0 degrees Kelvin represents the absence of all kinetic energy or the absence of all molecular or atomic vibrations. Absolute zero is defined as the temperature at which the molecules have zero kinetic energy, which is why it is impossible for anything to be colder.