

# The kinetic theory of matter and thermodynamics



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The kinetic theory of matter is a collection of assumptions about the small particles of matter and the space around them that traces back to the fifth century B. C. when Democritus first wrote about it. This idea was later accepted by Galileo and Newton, however widespread acceptance of the theory did not occur until strong evidence was presented in the late 1700s and early 1800s (Tillery, 2009). The kinetic theory of matter states that matter is composed of a large number of tiny particles consisting of individual molecules that are in constant motion. A molecule is defined as the smallest particle of a compound or a gaseous element that can exist and still retain the characteristic properties of that substance (Bellis, 2011).

The kinetic theory of matter plays a large role in the study of heat because the temperature of matter affects the average kinetic energy of the particles. The Kinetic Theory of Matter describes heat transfer by conduction, where thermal energy appears to move through a material, warming up cooler areas. Heat is energy that is measured in Joules or other energy units; it is a measurement of some of the energy in a substance that moves between two objects of a different temperature. This process is called heat transfer or heat flow (Tillery, 2009). If you add heat to a substance, then this means you are adding energy to the substance. This added heat (energy) is usually expressed as an increase in the kinetic energies of the molecules of the substance. If the heat (energy) is used to change the state of the substance, say by melting it, then the added energy is used to break the bonds between the molecules rather than changing their kinetic energy. Temperature is related to heat because it is expressed as a number that relates to a type of energy, like heat, possessed by the molecules of a substance.

In this way, temperature directly relates to the kinetic energy of the molecules (Jones, 2011). Temperature can be measured in a variety of units. Most scientists measure temperature in degrees of Kelvin.

With this unit of measurement, the temperature value is directly proportional to the average kinetic energy of the molecules in the substance. That means if you double the Kelvin temperature of a substance, you double the average kinetic energy of its molecules. Temperature can also be measured in degrees Fahrenheit and Celsius. Fahrenheit is used mainly in the United States, and Celsius is used in Canada and other parts of the world.

Remember that temperature is not the kinetic energy, or heat, it is only the measurement of it. These measurements are taken on a device called a thermometer. The term heat capacity refers to the amount of heat required to raise the temperature of an object or substance one degree. Naturally, different objects will have varying heat capacity.

Materials with high heat capacities, such as water, require large amounts of energy to produce a small temperature change. Likewise, materials with low heat capacities, such as metals, do not require as much energy to produce a temperature change. The general rule governing heat capacity is that the larger and freer molecules are, the greater their heat capacity will be.

Metals often have very low heat capacities compared to nonmetals. For example, 1 kg of copper has a heat capacity of 394 Joules per Celsius, and 1 kg of marble has a heat capacity of 880. Therefore, stone can hold much more heat than metal (Kurtus, 2010). There are many different and varying sources of heat. Some heat is naturally occurring and these will be

discussed. The most readily available form of natural heat energy is from the sun, and this is known as solar energy. Nuclear reactions take place within the sun, where 3 atoms of hydrogen are joined together to form a large atom, helium.

In this process, called fusion, a small amount of the mass of the hydrogen atoms is converted into energy. This energy release is described by Albert Einsteins famous formula,  $E = mc^2$ . In the formula, E stands for energy in joules, m stands for mass in kilograms, and c stands for the speed of light in meters per second (Nelson, 1997) Another supplier of natural energy is geothermal power.

These are natural heat sources that occur within the earth. The most prominent are steam energy and other hot water sources. Geothermal power plants use steam energy or hot water and transform it into electricity. In the direct-use geothermal process, hot water is pumped from under the ground and sent directly to where the heat is needed through piping or other machinery. The system then sends the cooled water back underground or into storage ponds. Geothermal heating pumps disperse water through underground pipes to heat or cool buildings, depending on the season (Gibbs, 1999). This process takes advantage of the fact that the underground temperature stays stable. Geothermal heat energy is renewable and has negligible environmental repercussions.

The last source of natural heat that will be discussed is coal. Coal is the most used and least renewable source of natural heat energy. Half of the energy that is used in the United States comes from coal (Gibbs, 1999).

It is a carbon-based sedimentary rock that takes millions of years to form beneath the ground. When plants and animals died in archaic times, sediment formed in layers that are now several kilometers deep. The heat and pressure from those layers turns the carbon elements from those life forms into coal. Coal companies mine the rock, either at the surface if the coal is less than 200 feet below the surface or underground. The coal is then turned into many different types of products that will produce heat through combustion.

Unfortunately, there is a considerable amount of environmental concerns about the use of coal. Surface mining seriously deteriorates the surrounding environment and the processing and burning of coal is a major contributor to greenhouse gases. Due to these disadvantages, scientists are currently looking for comparable, efficient alternatives.

References  
Bellis, M (2011) The History of the Thermometer. Retrieved from <http://inventors.about.com/od/tstartinventions/a/History-Of-The-Thermometer.htm>  
Gibbs, D. (1999) Natural Sources of Heat Energy. Retrieved from [http://www.ehow.com/list\\_5948968\\_natural-sources-heat-energy.html](http://www.ehow.com/list_5948968_natural-sources-heat-energy.html)

Jones, A. Z. (2011) Introduction to Heat Transfer – How Does Heat Transfer. Retrieved from <http://physics.about.com/od/thermodynamics/f/heattransfer.htm>

Kurtus, R. (2010) Kinetic Theory of Matter. Retrieved from [http://www.school-for-champions.com/science/matter\\_kinetic\\_theory.htm](http://www.school-for-champions.com/science/matter_kinetic_theory.htm)

Nelson, ITP (1997) Sources of Heat. Retrieved from [http://resources.](http://resources.https://assignbuster.com/the-kinetic-theory-of-matter-and-thermodynamics/)

<https://assignbuster.com/the-kinetic-theory-of-matter-and-thermodynamics/>

yesican-science. ca/lpdd/g07/lp/nelson/nel13. html Tillery, Bill, et al (2009).

Integrated Science. Burr Ridge, IL: McGraw-Hill Learning Solution.