Heat and the Kinetic Theory of Matter

But the day of the Lord will come as a thief in the night, in which the heavens will pass away with a great noise, and the elements will melt with fervent heat" 2Peter 3:10

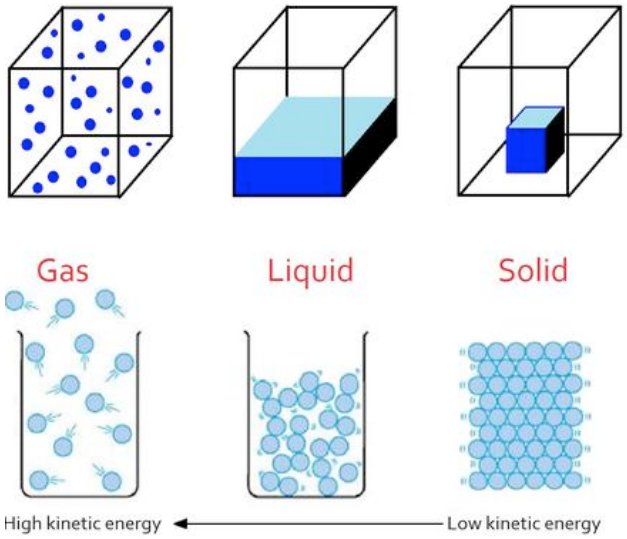
The Four Phases of Matter

- 1) solids 2)liquids 3) gases 4) plasma
- many substances can exist as more than one phase: water can exist as a solid (ice), a liquid (liquid water), and a gas (water vapor).
- the difference between these states is the amount of energy

  solids have the least amount of energy, which is part of why their particles hang so tightly together

  liquids have more energy than solids, which is why they will take on the shape of their container but only up to the surface

  gases have even more energy than liquids; their particles spread out to fill the entire space of their container; gas particles have so much energy that they just can't keep still; they fly around in all directions, putting as much distance as possible between themselves and the rest of the gas particles
- plasmas are ionized gases, and in their natural form are uncommon on Earth; examples include man-made things, like neon signs and fluorescent light bulbs; most stars are plasma, as are the northern lights you see around the Polar Regions; plasma only exists under certain conditions



Kinetic Theory of Matter

- The kinetic theory of matter states that all matter is made of small particles that are in random motion and that have space between them; this means that no matter what phase matter is in, it is made of separate, moving particles.
- the particles of a solid are actually moving, just not enough for you to see. This type of

vibrational movement is why a solid won't change shape no matter what kind of container you put it in.Not only do the particles of a solid not move very much, but they're also held very close to each other by strong attractive forces. These forces are what hold the particles in place and are what give a solid its fixed size and shape.

- the extra energy in the liquid state allows the particles to move around more freely, and they spread out more than those of a solid, putting more space between those particles. This is why a liquid will take the shape of its container up to its surface; like a gas, a liquid has no fixed shape but a liquid does have a fixed volume
- gases have even more energy than liquids so their particles are moving around a lot more; gas will expand to fill its entire container, not just to its surface like a liquid; the gas is the opposite of a solid and has neither a fixed size nor shape

Making Heat

- A phase change occurs when energy is added to or taken away from matter, usually in the form of heat
- heat is the thermal energy transported from one system to another because of a temperature difference; the transfer of that energy stops when the temperature balances out in the entire environment
- scientists use the unit of a calorie to measure heat: one calorie is measured as the amount of energy needed to raise the temperature of one gram of water by one degree Celsius. When you "burn" food (this happens VERY slowly in your body), you release energy.
- How do you make heat?

  1) chemical reactions - burning things; thermal energy is released; thermal energy is measured in calories

  2) friction - rubbing things together; much of that heat is the result of the friction and inefficiency: when you lift something and your muscle contracts, you are only 25% efficient because 75% of the energy is lost to heat

Temperature scales

- thermometers measure temperature
- Fahrenheit is the classic English system of measuring temperatures. Water freezes at 32 degrees Fahrenheit and boils at 212 degrees. The scale was created by Gabriel Daniel Fahrenheit in 1724

  to convert Fahrenheit to Celsius: (Fahrenheit-32) x 5/9=Celsius
- Celsius is the modern system of measuring temperature; freezing point of water 0 degrees Celsius and the boiling point 100 degrees Celsius
- Kelvin is an important scale used in most of science; absolute zero = 0 degrees Kelvin; scale that is based on energy content, rather than on arbitrary temperature values like the other two scale (based on water). Water freezes at the value 273.15 and boils at 373.15 Kelvin. The word "Kelvin" comes from Lord Kelvin, who did a lot of work with temperatures.