October 10, 2018

8th Grade Heat and Heat Transfer Review

***Vocab***

* ***Heat****: thermal energy*
	+ *The total of all energy within a substance*
	+ *Total energy of all molecular movement within a substance*
	+ *It can also be described as the transfer of thermal energy*
* **Kinetic energy**: the energy of motion
	+ Kinetic energy ALWAYS moves from areas of high energy to low energy
* **Temperature**: measure of the average kinetic energy of matter within a given substance
	+ Measure of average heat
	+ The higher the kinetic energy, the greater the rate of molecular motion, and the higher the temperature.
* **Heat transfer**: the transfer of thermal energy
	+ Heat transfer ALWAYS moves from areas of high temperature (high kinetic energy) to low temperature (low kinetic energy)
* **Freezing point**: the temperature at which a liquid becomes a solid
	+ At the freezing point, there are equal amounts of liquid and solid molecules
	+ Above the freezing point, there is more liquid matter
	+ Below the freezing point, there is more solid matter
* **Boiling point**: the temperature at which a liquid becomes a gas
	+ Above the boiling point, there is more gaseous matter
	+ Below the boiling point, there is more liquid matter
* **Equilibrium**: a stable situation in which opposing forces cancel each other out
	+ No net energy transfer
* **Law of Conservation of Energy:** energy can be converted from one form to another, but can neither be created nor destroyed.
* **Hydrogen bond**: weak interaction between the positively-charged hydrogen atom on one water molecule and the negatively-charged oxygen atom of another water molecule
	+ These weak bonds are the cause of surface tension, which allows water bugs to walk on water and dew drops to form as little beads of water
* **Freezing point depression**: the lowering of the freezing point of a liquid
	+ Adding a solute to a liquid decreases the freezing point
	+ The liquid freezes at a lower temperature
* **Boiling point elevation**: the raising of the boiling point of a liquid
	+ Adding a solute to a liquid increases the boiling point
	+ The liquid boils at a higher temperature.
* **Specific Heat Capacity**: the amount of heat (joules) that is required to raise the temperature of 1 gram of a substance by 1 degree Celsius
	+ Higher specific heat capacity = it takes more heat to raise a substance’s temperature
	+ Ex. it takes more heat to change the temperature of water than to

change the temperature of sand

* + Higher heat capacity 🡪 better insulator
* **Joules**: unit of energy

***Focus Questions***

**What is the relationship between heat, kinetic energy and temperature?**

* Heat is the transfer of thermal energy
* As heat increases, kinetic energy increases and temperature increases

**What changes in matter accompany changes in heat?**

* In general, matter expands when heated and contracts when cooled because of changes in the kinetic energy of molecules.
* As heat increases, substances change from solids to liquids to gases
* As heat decreases, substances change from gases to liquids to solids

**How do changes in thermal energy relate to freezing and boiling point of water?**

* Freezing point: when a solid becomes a liquid
	+ The lower kinetic energy in colder substances slows molecular movement and compacts the substances, forming a solid
	+ Tightly packed molecules
* Boiling point: when a liquid becomes a gas
	+ The higher kinetic energy in hotter substances increases molecular movement and breaks the bonds between liquid molecules, resulting in the liquid becoming a gas
	+ Molecules spread out

**How does addition of a solute change the freezing and boiling point of water?**

* Adding a solute to water decreases the freezing point of water and increases its boiling point
* Example: table salt, NaCl
	+ The positively-charged hydrogen atom pulls on the negatively-charged chlorine atom, while the negatively-charged oxygen atom pulls on the positively-charged sodium atom
	+ These interactions between all the atoms cause the table salt to dissolve into Na and Cl
	+ The Na and Cl get in the way of the water molecules and make it hard for the water to come back together and form a tightly-packed arrangement of molecules (ice)
	+ To get water to boil, extra heat is needed to break the bonds between the O and the Na as well as between the H and the Cl
* Salt must be removed before freezing or boiling water – extra energy is needed to do this

**How can the ability to absorb heat be measured as a physical property of matter?**

* Specific heat capacity is a measure of the amount of heat energy (joules) required to raise the temperature of 1 gram of a substance by 1 degree Celsius.



**How does a thermometer work?**

* As air temperature changes around a thermometer, the kinetic energy of the air molecules changes
* The change in the kinetic energy of the air molecules is transferred to the liquid molecules inside a thermometer
* As kinetic energy increases in the liquid, the molecules begin moving faster and the liquid expands, rising up the tube inside the thermometer
* Rising kinetic energy of air molecules 🡪 rising liquid = rising temperature