Heat and Temperature

Chapter 14

Temperature

Section 14.1

Key Ideas

- What does temperature have to do with NRG?
- What 3 temperature scales are commonly used?
- What makes things feel hot or cold?

Temperature and NRG

- **Temperature** is the measure of how hot or cold something is
- It is also the measure of average kinetic NRG
- It is proportional to the average kinetic NRG
  - What does this mean?

As one goes up, the other goes up

Particles and Kinetic NRG

- Remember that all particles are moving so all particle have kinetic NRG
- Also, as particles more faster they take up more space
  - Why do they take up more space?

Thermometer

- A thermometer relies on the previously stated phenomenon
- A **thermometer** is an instrument that measures and indicates temperature
- As the temperature rises, the particles move faster and as the particle move faster they take up more space
- This causes the fluid in the thermometer to…

Temperature Scales

- There are 3 “commonly” used scales
- The Fahrenheit, Celsius, and Kelvin temperature scales are commonly used for different reasons
  - Different parts of the world
  - Scientific reasons

Temperature Scales

- Fahrenheit (^{o}F)
  - Water boils at 212 ^{o}F
  - Water freezes are 32^{o}F
- Celsius (^{o}C)
  - Water boils at 100 ^{o}C
  - Water freezes are 0^{o}C
- Kelvin(K)
  - Water boils at 373 K
  - Water freezes are 273 K

Temperature Scales

- Celsius is based on water freezing at 0^{o}C and water boiling at 100^{o}C
- Kelvin is based on absolute zero
  - **Absolute zero** is the temperature when molecular motion is at a minimum (stopped)

Conversions

Fahrenheit to Celsius

$$T_F = 1.8 * T_C + 32$$

Kelvin to Celsius

$$T_K = T_C + 273$$

Practice

- Get into groups of 2-3 and complete the following
- Page 477
- All

Relating Temperature to NRG Transfer

- Why does ice feel cold?
  - The particles in the ice are moving slower than the particles in your hand
  - The faster moving particles in your hand transfer some of their NRG to slower moving particles in the ice
    - This NRG transfer makes the ice feel cold (and makes the ice melt)

Average vs. Total Kinetic NRG

- As stated earlier, average kinetic NRG is related to temperature while total kinetic NRG is related to mass/amount
- The larger something is, the more particles it contains and the more particles it contains the more total kinetic NRG it has

1 minute…

Answer the following questions

1. Which has a higher average kinetic NRG, boiling cup of water or room temperature cup of water? Explain.
2. Which has a higher total kinetic NRG, boiling cup of water or room temperature cup of water? Explain.
3. Which has a higher total kinetic NRG, boiling cup of water or room temperature bathtub of water? Explain.

Relating Temperature to NRG Transfer

- When there is a temperature change, it indicates the transfer of NRG
- Heat is the NRG transferred between objects that are at different temperatures
- Heat always goes from higher temperature to lower temperature

Group Work

Indicate which way the heat is flowing in the following situations

1. You touch a hot burner on the stovetop
2. You open the front door in the middle of the winter
3. You grab a metal fence post on a 100 ^{o}F day
4. You open the refrigerator door

Assignment

- EOSQ (1-7)
- CR 14.1 (all)
- Math Skills – Temperature Conversions (1-15, 18)

NRG Transfer

Section 14.2

Key Ideas

- How does NRG transfer happen?
- What do conductors and insulators do?
- What makes something a good conductor of heat?

Methods of NRG Transfer

- There are 3 ways this can happen:
  - Conduction
  - Convection
  - Radiation

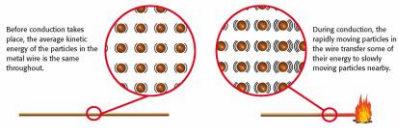
Conduction

- **Thermal conduction** happens through a material
  - i.e. the metal handle of a metal pot gets hot when it is placed on the burner
  - Think of another example
- This is caused when the faster moving particles run into the slower moving particles

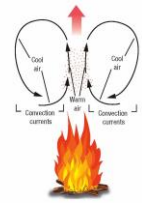
Convection

- **Convection** is the movement of matter due to the differences between densities that are caused my temperature differences.
  - This is the movement of matter
    - i.e. warm air moves into cooler air
- A **convection current** is movement of this matter
- Think of heating your house in the winter

Conduction



Convection



Radiation

- **Radiation** is the NRG that is transferred as electromagnetic waves
  - Visible light, microwaves, UV rays…
- Radiation does NOT require matter like the other 2 methods of heat transfer.
- This is the NRG we receive from the sun
  - What is another example of radiation?

Conductors and Insulators

- A **conductor** is a material in which NRG can transfer as heat
  - Ex. ?
- An **insulator** is a material in which NRG cannot transfer as heat
  - Ex. ?

Conductors and Insulators

- Heat energy is transferred through particle collisions.
  - Gases are very poor heat conductors because their particles are so far apart.
  - Denser materials usually conduct energy better than less dense materials do.
  - Metals tend to conduct energy very well.
  - Plastics conduct energy poorly

Specific Heat

- Specific heat is the amount of heat required to raise the temperature of 1 kg of a substance 1 K (or 1 ^{o}C)
  - What????
  - The higher the specific heat the more "heat" it takes to warm it up
- The specific heat helps determine if something is an insulator or a conductor

Specific Heat

Math Equation

NRG = Specific Heat * Mass * Change in Temp

$$E = cm\Delta T$$

Mass is in Kg

Temp is in **Kelvin**

Group Work

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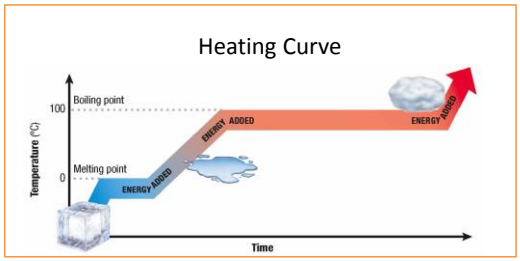
- 1-2

Specific Heat Values

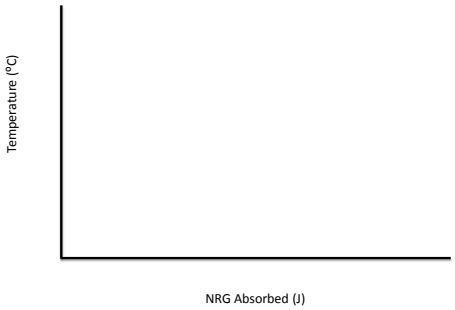
Substance	c (J/kg•K)	Substance	c (J/kg•K)
Water (liquid)	4,186	Copper	385
Ethanol (liquid)	2,440	Iron	449
Ammonia (gas)	2,060	Silver	234
Steam	1,870	Mercury	140
Aluminum	897	Gold	129
Carbon (graphite)	709	Lead	129

Specific Heat

- Heat raises an objects temperature OR changes the state of matter



Heating Curve



Assignment

- EOSQ (2, 5-7)
- CR 14.2 (not 4)
- MS – Specific Heat