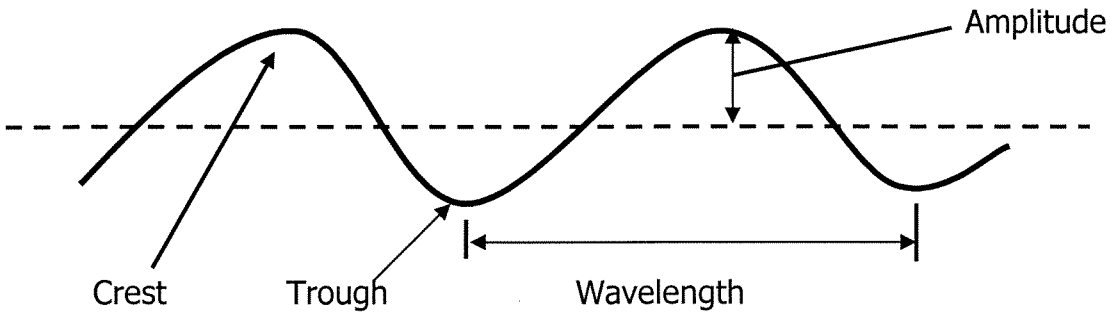
Name _____ Earth Science

Notes: Topic 2 – Energy and Weather Systems

A. Energy

1. Electromagnetic Energy – is energy that has the properties of a transverse wave. Electromagnetic energy travels through space at a speed of 3.0×10^8 meters per second (*Whoah.. that is really fast*).
    a. **Wavelength** – is defined as the distance between two successive troughs or crests. This distance is how electromagnetic energy is classified and identified. The entire range of electromagnetic wavelengths is called the **electromagnetic spectrum** and can be found on page 14 of your ESRT.



2. Solar Energy – is energy from the Sun and is produced in all the wavelengths of the **electromagnetic spectrum**. The Sun is the major energy source for Earth. Most of the Sun's energy is invisible like ultraviolet and infrared waves.
    a. **Visible light** – makes up only a small portion of the total energy that comes from the Sun. Visible light can be separated (by a prism) into the all the colors of the rainbow, each having a different wavelength.
    b. **Energy interactions with matter** - When electromagnetic energy comes in contact with matter it can do one of **three things**:

♦ The energy can be **refracted**, which means its bent as it passes through the material.

♦ The energy can be **reflected,** which means it "bounces" off the material and goes in a different direction.

♦ The energy can be **absorbed,** which means the material takes it in.

"Any material that is a good absorber of electromagnetic energy is a good radiator"

B. Phase Changes

Below are the four phase changes that you are responsible for and fortunately the information is on the front cover of the ESRT.

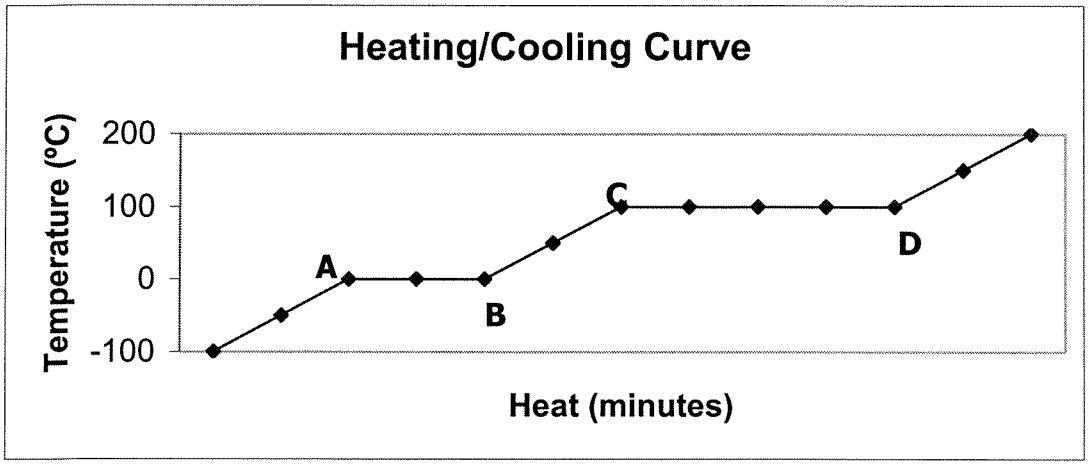
♦ Phase changes are energy transfers and there is **no change in temperature** during the phase change.

1. **Evaporation** – liquid to gas
2. **Condensation** – gas to liquid
3. **Freezing** – liquid to solid
4. **Melting** – solid to liquid

C. Latent Heat

Definition: This is the energy absorbed or released by a substance during a phase change. This energy does not change the temperature of the system, but instead the energy is being stored as potential energy. Latent means hidden, so think of it as hidden heat in the molecules of the substance.

1. **Heat of vaporization** – the heat needed to change 1 gram of liquid water to water vapor (540 calories).
2. **Heat of fusion** - the heat needed to change 1gram of ice to liquid water to (80 calories).



Task to complete:

1. Name the phase changes on this curve (hint: their on the horizontal lines).
   A to B _____ **C to D** _____
   B to A _____ **D to C** _____
2. Label the phase of the water on each slanted line.

D. Three ways energy is transferred

1. **Conduction** – Conduction is the process of heat being transferred by molecular collisions. The heat energy makes the molecules bounce and vibrating into each other and each collision transfers heat to the next molecule. It is like the molecules are playing tag: the hot molecule is "IT" and when she tags the next molecule, he receives the heat energy and becomes "IT". With each successive tag the heat energy is transferred through the substance.

   ♦ **Conduction works best in solids** (although it can occur in liquids or gases).

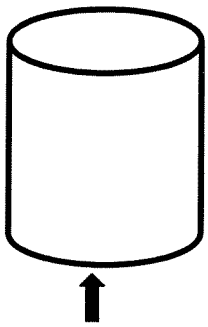
Example: Put a spoon in a cup of hot coffee. First the molecules in the "spoon" part will get hot and begin to vibrate more and transfer the energy to nearby molecules. Pretty soon the handle of the spoon gets hot too.

2. **Convection** – Convection is a process of heat being transferred due to **differences in density**. When a gas or a liquid is heated, it expands which causes it's density to decrease and then it will rise (remember less dense objects float).

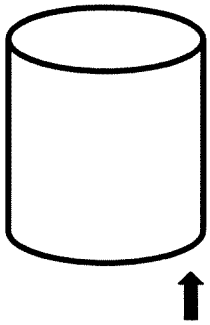
- This forms a current within the gas or liquid called a **convection current** or a **convection cell**.
- Convection does not occur in solids.

Example: This is what causes circulation of air in the atmosphere, water in the oceans and magma to move the tectonic plates.

☆ *Draw* how the circulation of water would look in these two beakers with the heat in two different places. These are convection currents or cells.



heat



heat

3. Radiation – Unlike the first two processes of transferring energy, this process transfers energy **without** having to go through **a medium or substance**. It transfers energy by **waves**.
   - Radiation can transfer heat energy through a vacuum.

Example: The Sun radiates electromagnetic energy to Earth through space.

REVIEW QUESTIONS:

1. During a phase change, what happens to the temperature of a substance?

2. What happens to light/energy when it hits a surface?

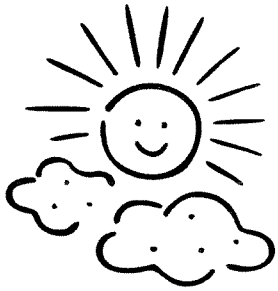
3. How is energy transfered through our atmosphere and our oceans?

4. How is energy transferred from one end of a metal rod to the opposite end?

5. According to the ESRT page 14, what has a longer wavelength: Radio waves or X rays?

6. According to the ESRT page 14, what has a longer wavelength: Blue or red light?

7. In scientific notation, what is the wavelength of ultraviolet light?



E. Weather Systems

1. **Station Models** - Station models are a way to organize weather data and display it on maps. There is a lot of great information on page 13 of your ESRT on station models and we will complete several activities that will be helpful in understanding and using station models.

Things to remember:

⇒ Station models never have any units recorded on them.

⇒ Air pressures are coded when recorded on a station model.

⇒ Only Fahrenheit temperatures are used (but no units are written).

2. **Air Masses**

- **(Definition)**

- **(How do air masses form?)**

a) **Types of Air masses**:

(For each type, write where it would form and what characteristics it would have. Characteristics mean warm or cold, moist or dry.)

- Continental Polar (abbreviated **cP**) -

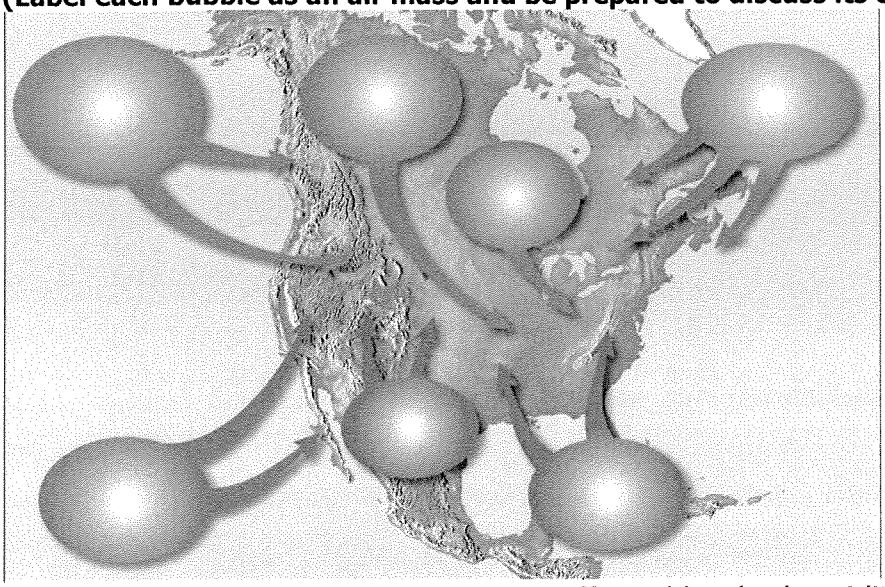
- Continental Tropical (abbreviated **cT**) -

- Maritime Polar (abbreviated **mP**) -

- Maritime Tropical (abbreviated **mT**) -

Notes: Topic 2 – Energy and Weather Systems

(Label each bubble as an air mass and be prepared to discuss its characteristics.)



3. **<u>Pressure Centers</u>** - Air pressure is affected by the humidity and temperature of the air, so high-pressure centers have different characteristics than low-pressure centers. Therefore, the weather associated with the two centers is drastically different and is critical to understand in order to make accurate weather predictions.

a) <u>High Pressure</u>

- *How do winds circulate around a high-pressure center?*

- *What type of weather conditions occur in a high-pressure center?*

(Draw how the winds circulate around a high with four arrows)

H

b) <u>Low Pressure</u>

- *How do winds circulate around a low-pressure center?*

- *What type of weather conditions occur in a low-pressure center?*

(Draw how the winds circulate around a LOW with four arrows)

L

Summary Question: What type of pressure system would be more likely to produce precipitation?

E. Weather Systems (continued)

4. **Fronts** – The boundary between two different air masses is called a front.
   - ◇
   - ◇

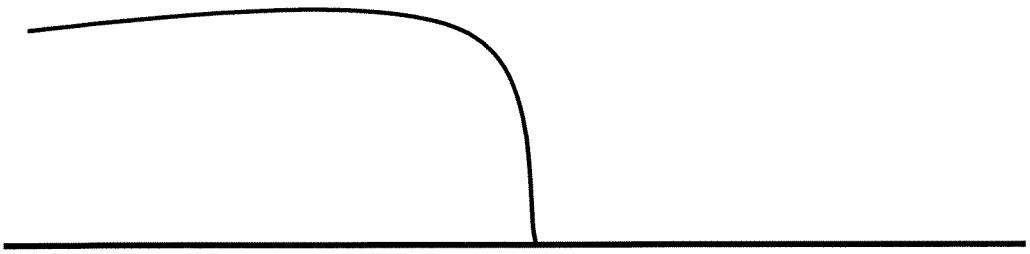
Types of fronts:

Draw symbol:

a) **Cold Front**

◇

◇ Due to the cold air being more dense than the warm air, the cold air is able to force the warm air up (and we know what happens when air rises).



Side view of air masses & front

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Summary Questions:

1. Where does the precipitation occur when a cold front moves through an area?

2. What is "cold front" precipitation like?

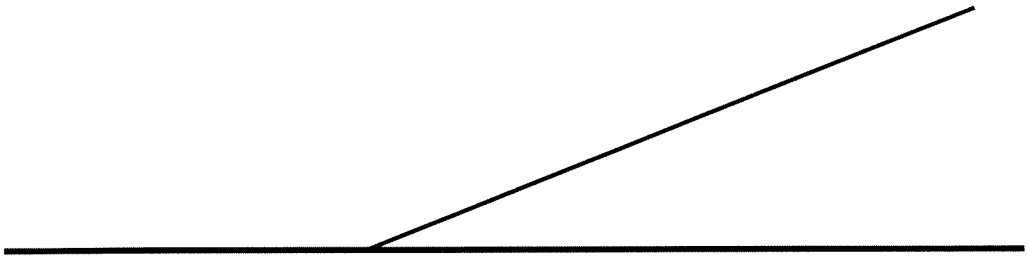
Types of fronts: continued

Draw symbol:

b) **Warm Front**

◇

◇ Due to the warm air being less dense than the cold air, the warm air is slowly "wedged" up (and you know what happens when air rises!!).



Side view of air masses & front

Summary Questions:

1. Where does the precipitation occur when a warm front moves through an area?

2. What is "warm front" precipitation like?

Two other types of fronts (that occur less frequently):

c) Occluded Front –

d) Stationary Front –

F. Climate

Compare and contrast climate and weather.

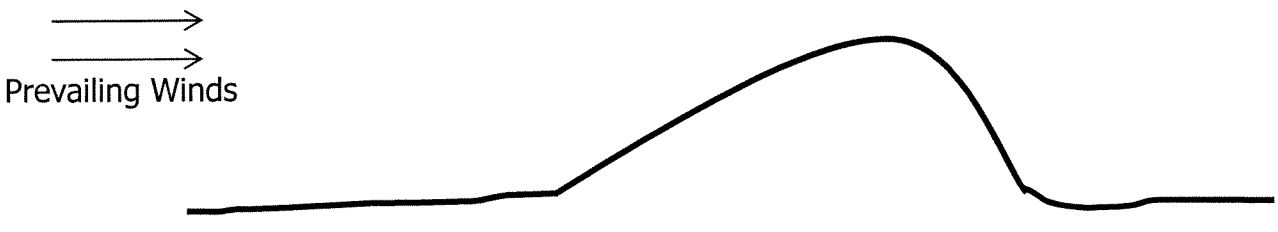
Fully Describe the two major aspects of Climate (moisture and temperature)

Explain how these factors affect Climate:

1. Latitude –

2. Altitude (elevation) –

3. Mountain Ranges – (use the drawing to help)



4. Large bodies of water (oceans) – (include a discussion of **Specific Heat**)

5. Oceans Currents –

6. Planetary Wind Belts –

a. Storm Tracks -

b. Monsoons –