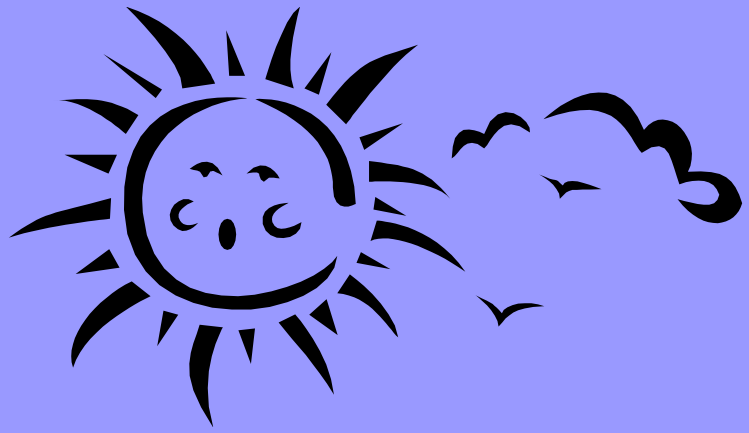


The Earth's Weather

Water Cycle

- Evaporation/Sublimation/Transpiration
- Condensation
- Precipitation
- Runoff (surface runoff)/collection (watershed)
- Percolation

Weather on Earth

- The primary driving force of all weather on the earth is caused by heat energy from the sun.

Heating the Earth

- **Weather** is the daily condition of the Earth's atmosphere.
- 3 main factors interact to cause weather on Earth

Winds are caused by differences in air pressure

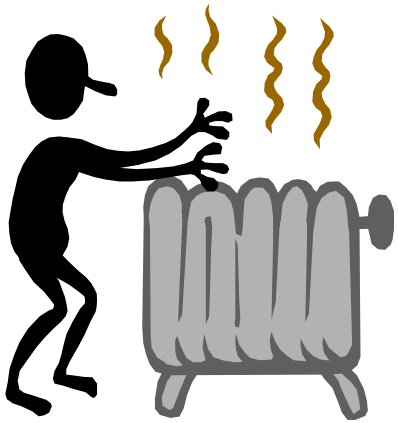
Heating the Earth

- People who study weather are called meteorologists.

You can expect some weather!

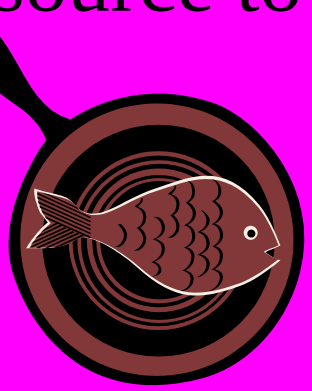
HEAT TRANSFER

- **Heat energy is transferred in 3 main ways:**
  - **Conduction**
  - **Convection**
  - **Radiation (radiant heat energy)**



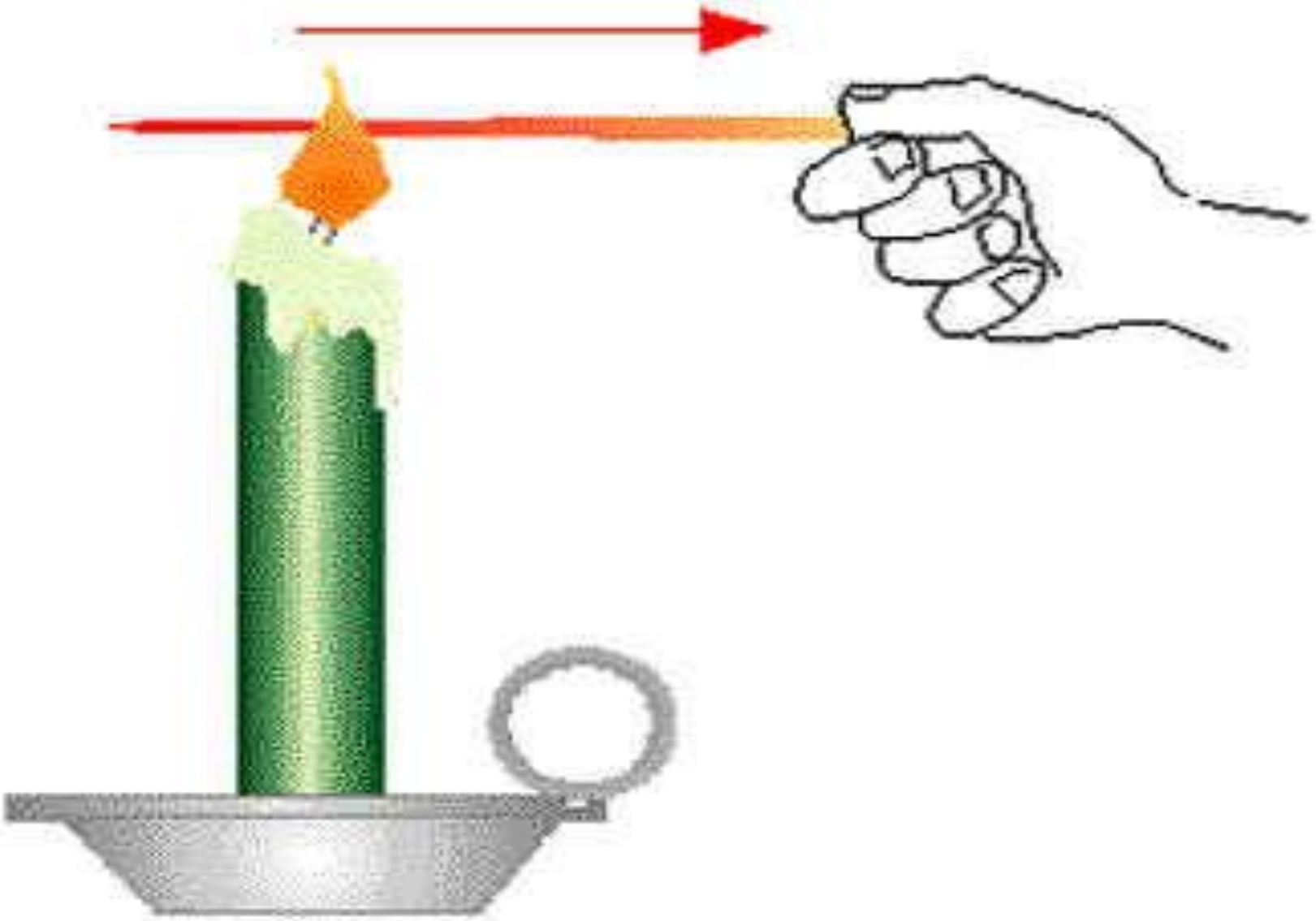
Conduction

- **Conduction** is the direct transfer of heat energy from one source to another through matter.



- Conduction occurs most readily in solid materials that transfer energy easily.

Conduction

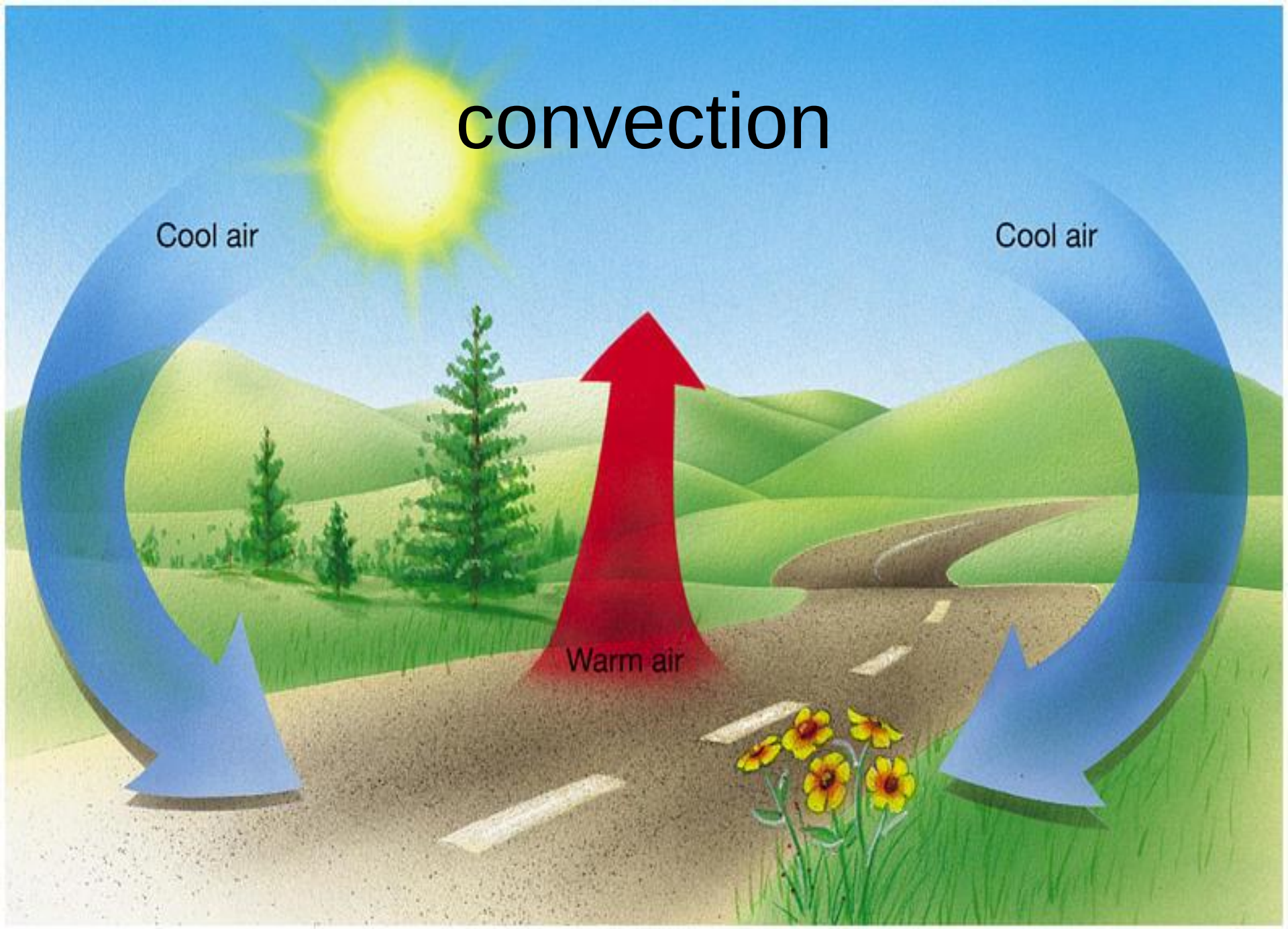


Convection

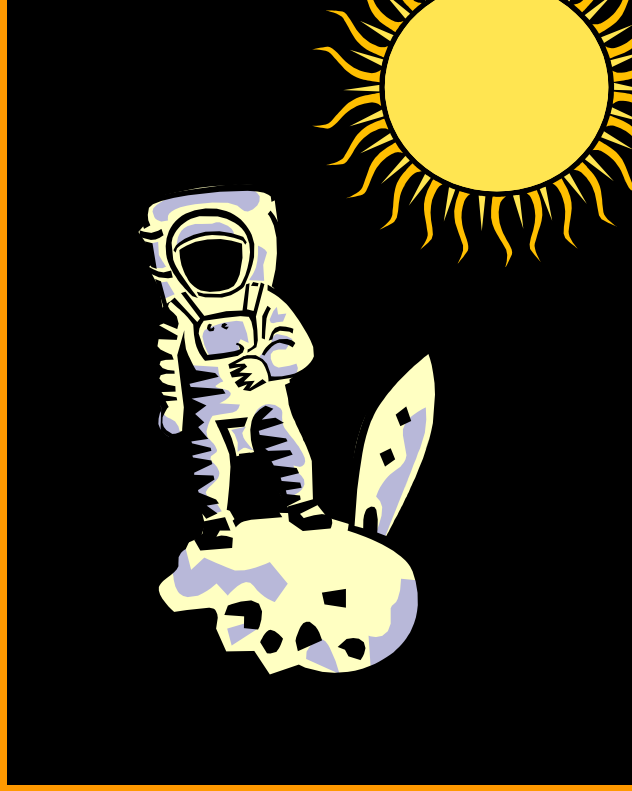
- **Convection** is the transfer of energy in a fluid (gas or liquid).

- Warm air or water rises because it is less dense than cool air or water. Cool air or water sinks because it has a greater density.

convection

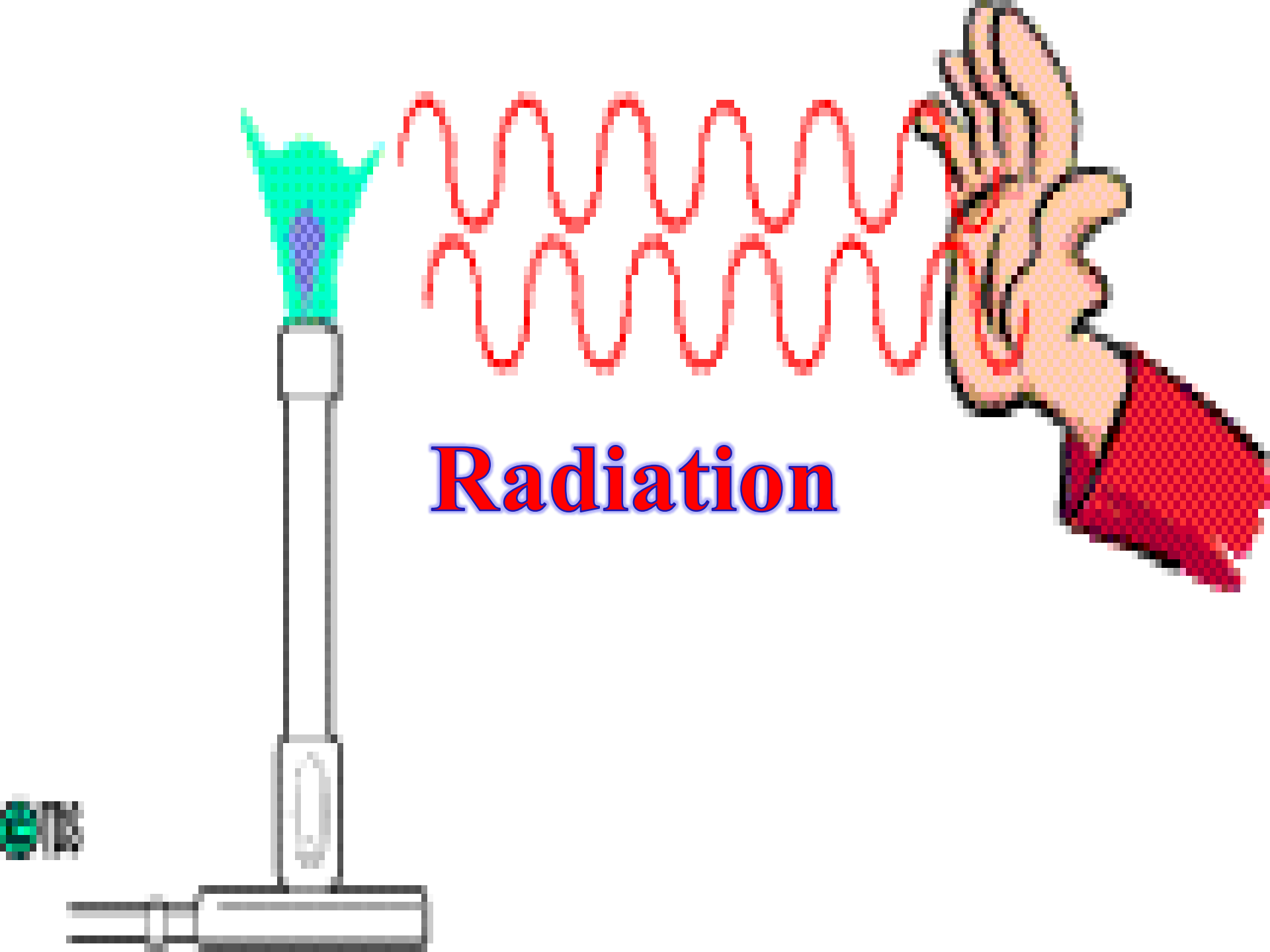


Radiation



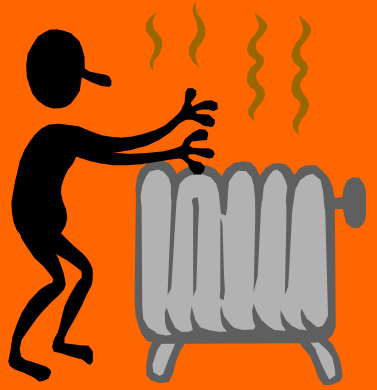
- **Radiation** is the transfer of energy through empty space.

- Radiation *does not need* the presence of a solid, liquid, or gas. It can travel through a vacuum. When radiant energy is absorbed, it changes into heat energy.

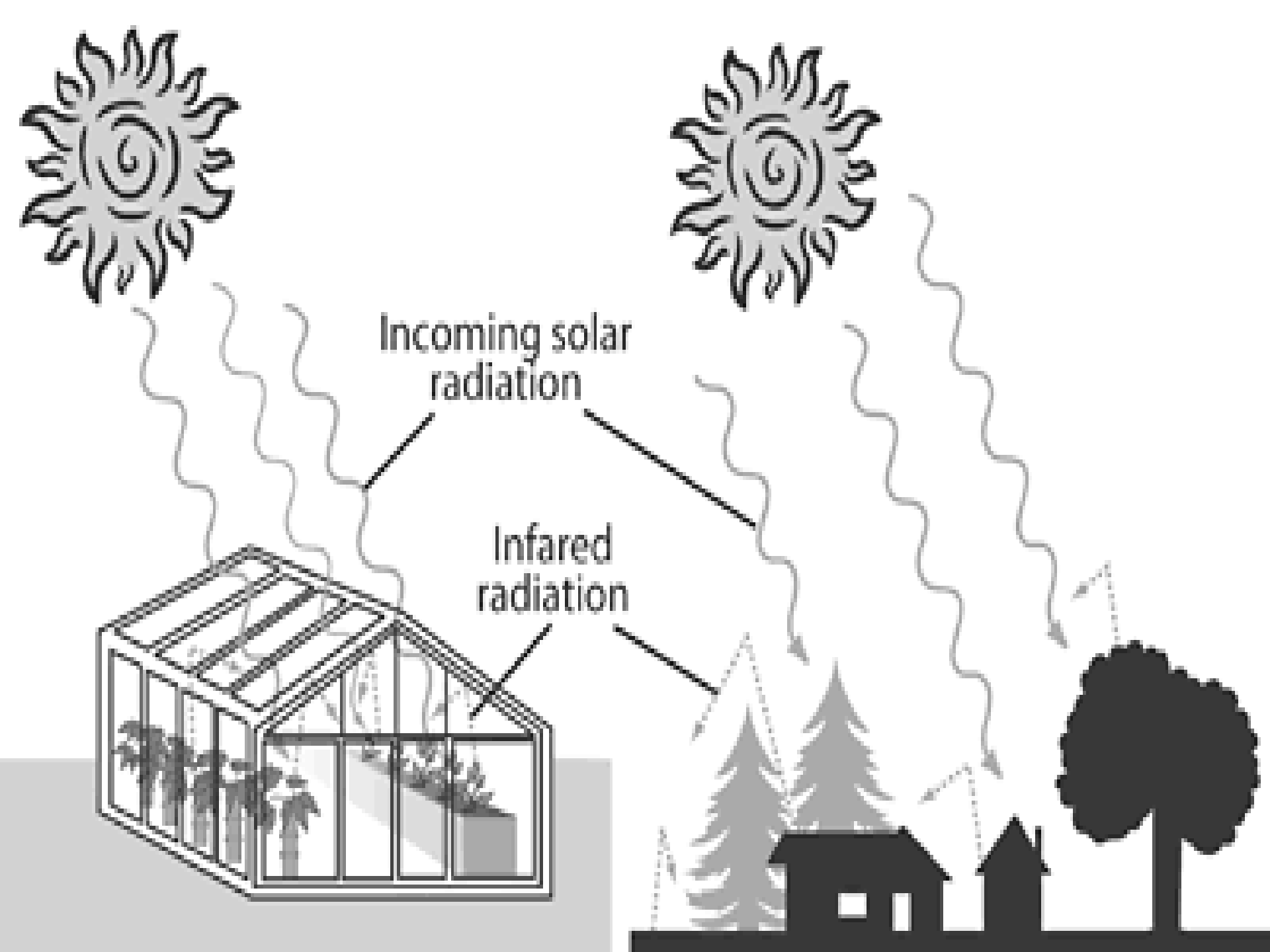

Radiation

Heat Energy and the Atmosphere

- The sun's energy comes to us as **radiant** energy.

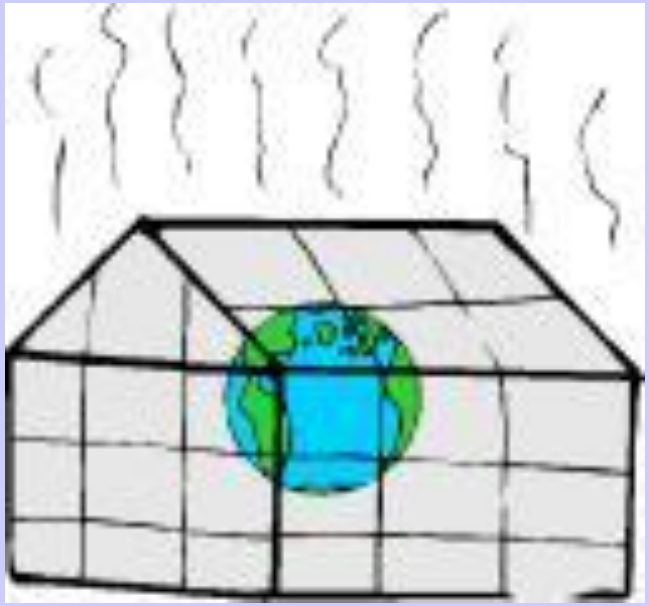


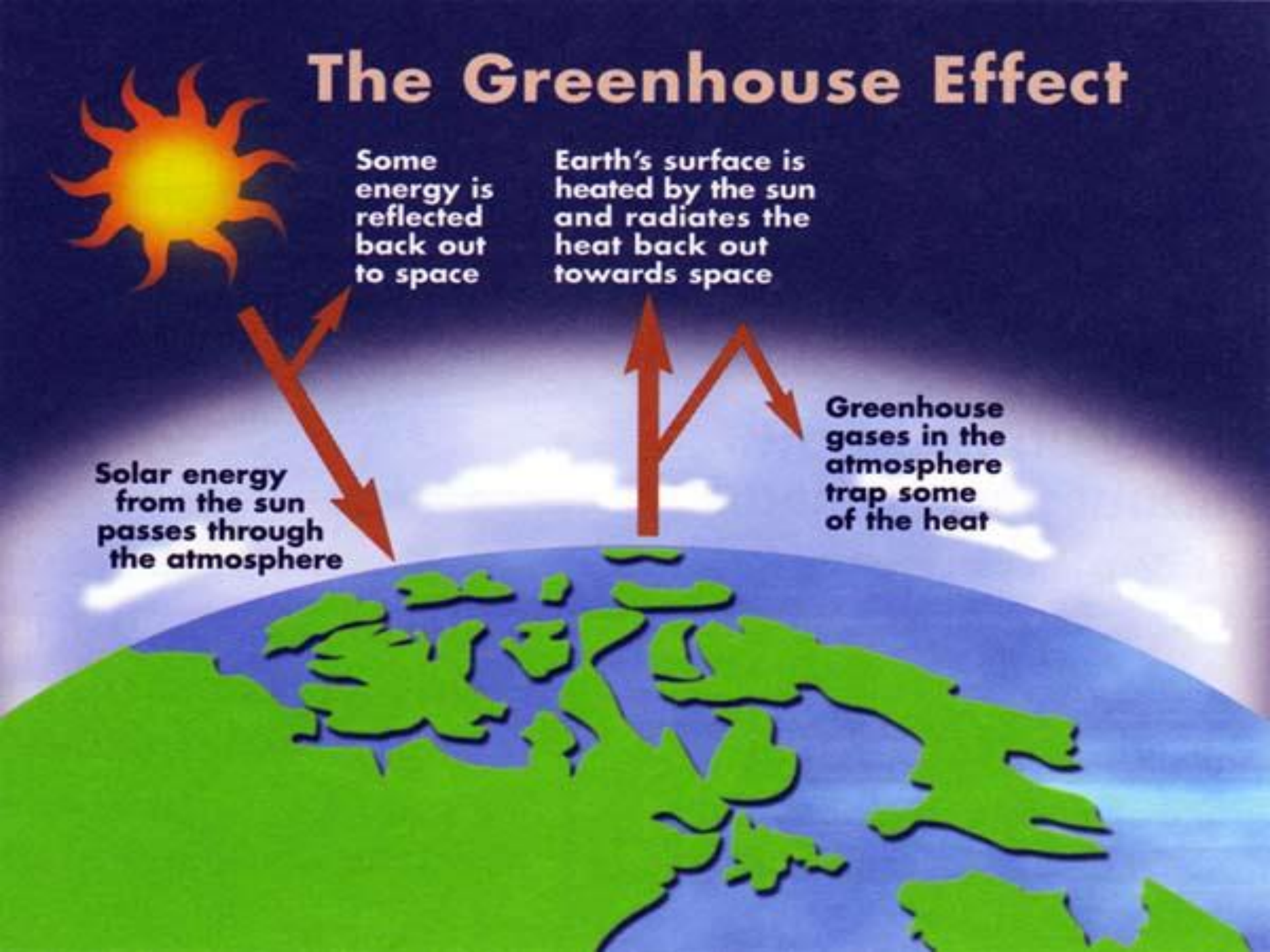
- The *atmosphere* absorbs, stores, and recycles the sun's radiant energy.


Incoming solar radiation
Infared radiation

The Greenhouse Effect

- Process in which carbon dioxide and other gases in the atmosphere absorb infrared radiation from the sun, forming a “heat blanket” around the Earth.




The Greenhouse Effect
Some energy is reflected back out to space
Earth's surface is heated by the sun and radiates the heat back out towards space
Greenhouse gases in the atmosphere trap some of the heat
Solar energy from the sun passes through the atmosphere

Direct and Indirect sunlight

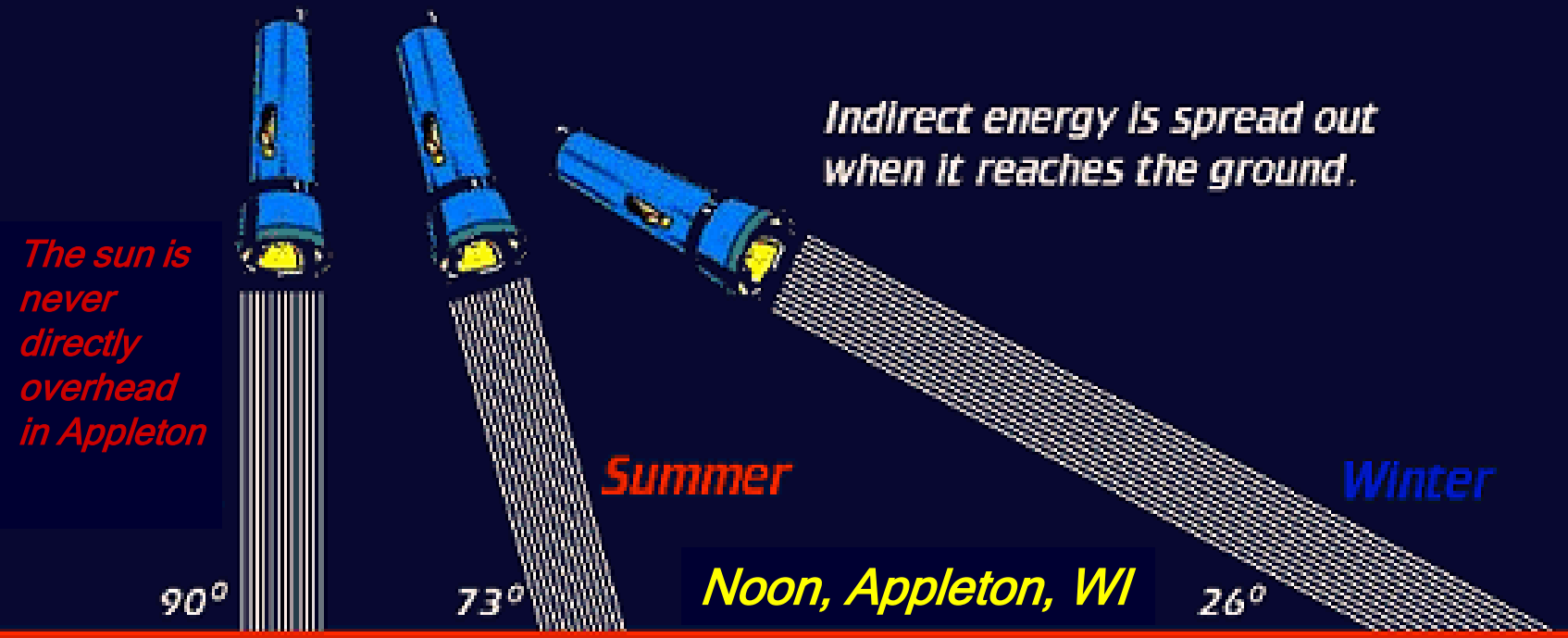
- Areas closest to the equator receive the most direct sunlight throughout the year.

- Farther north and south the light is indirect.
  - This is especially apparent during the winter months in which the sun is not as high in the sky.

Direct vs, Indirect Energy

Direct energy reaches the ground in a concentrated form.

Indirect energy is spread out when it reaches the ground.



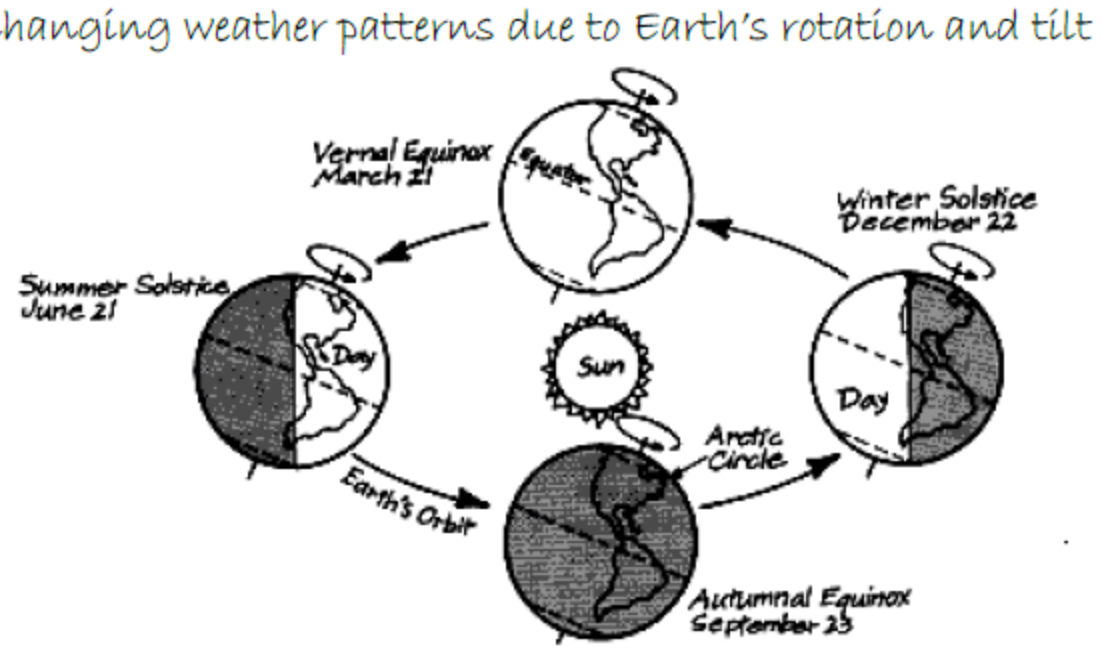
Energy Concentrated

Energy Spread Out

Gary A. Becker

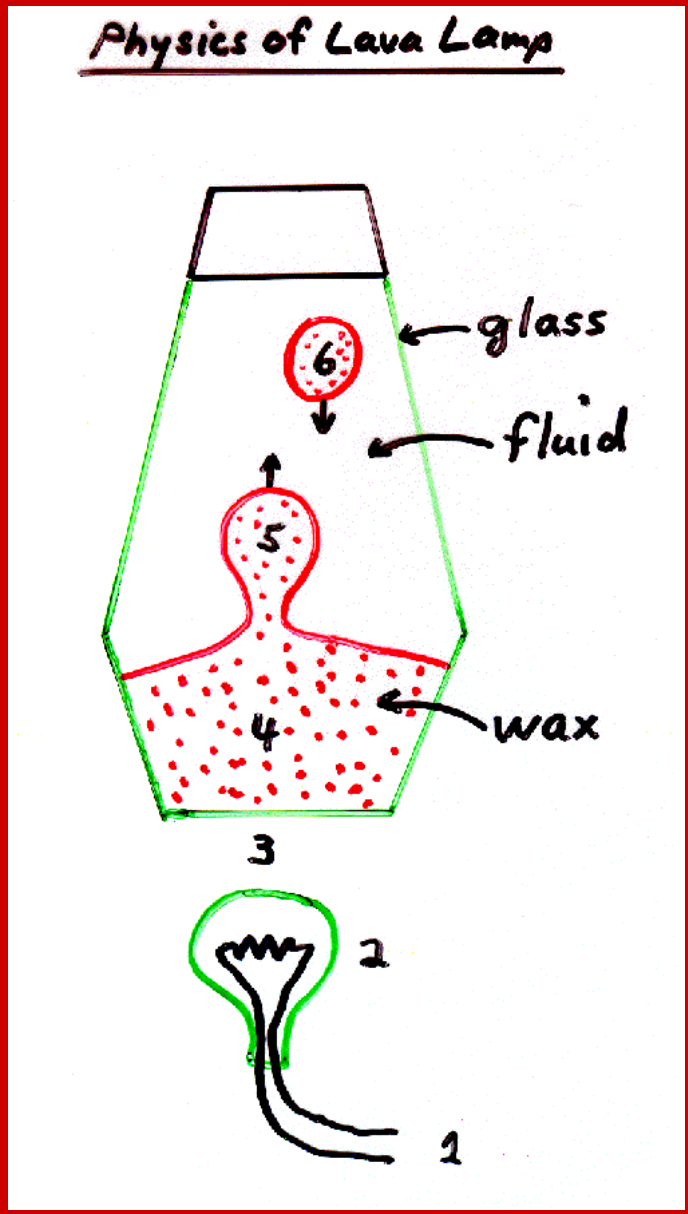
Seasons and the Tilt of the Earth

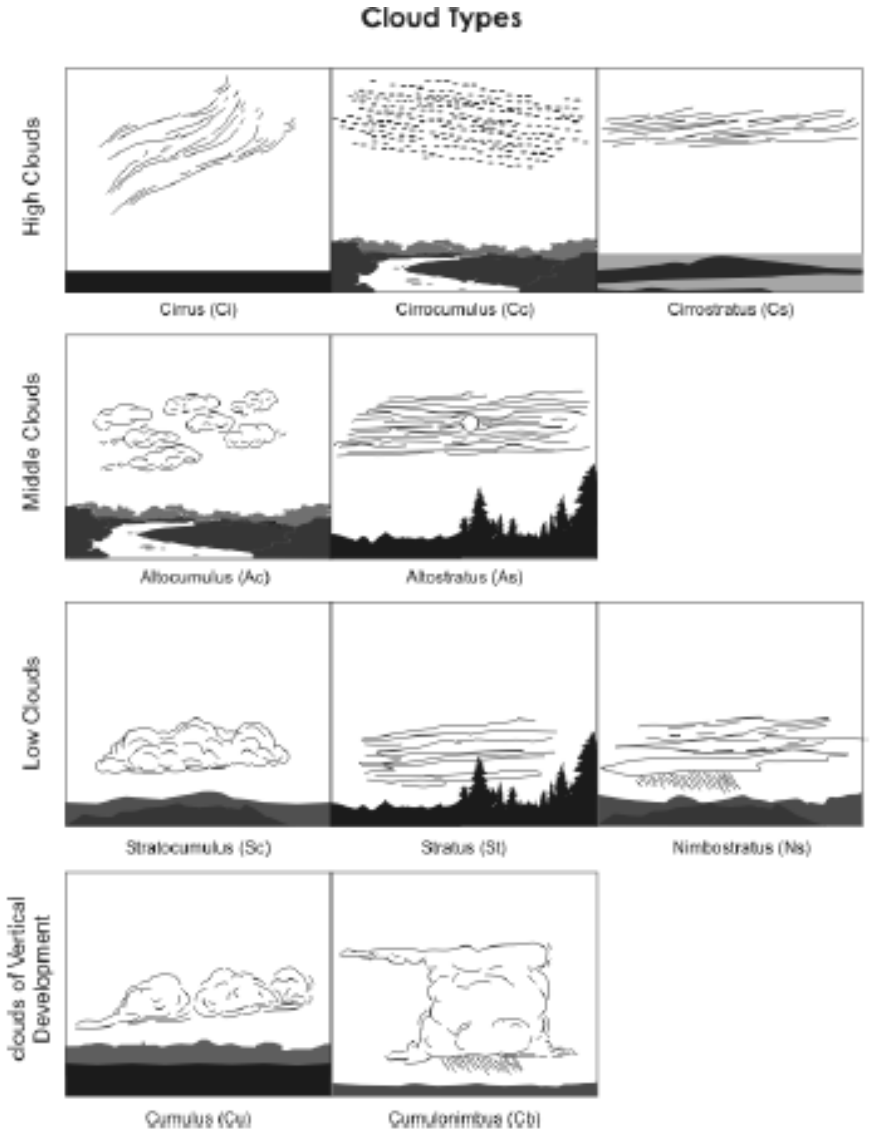
- The longest and shortest days of the year are called solstices
- Days that have equal lengths of sunlight in the northern and southern hemisphere are called equinoxes



Lava lamps

- Convection causes the "lava" in lava lamps to move up and back down.





If you study clouds carefully and observe how they change with the weather, you will see some very consistent patterns.

Before radio, television or newspaper forecasts were readily available, people whose livelihoods depended on the weather (like sailors or farmers) often used the clouds as a indicator of what might happen.

- High clouds are associated with incoming or outgoing high pressure systems
  - A cirrostratus cloud is a milky white ice-crystal cloud that covers the sky (stratus = filling the sky)
  - Cirrus clouds are thin and whispy
- Middle clouds
  - Altostratus (cover the sky – the sun can still often be seen)
  - Altocumulus – puffy, middle level clouds
- Low clouds
  - Stratocumulus: puffy low clouds that cover most of the sky
  - Stratus (overcast)
  - Nimbostratus: a low level rain cloud
- Cumulonimbus are usually associated with strong storms and often bring thunder and lightning

Cloud Formation and Cycles

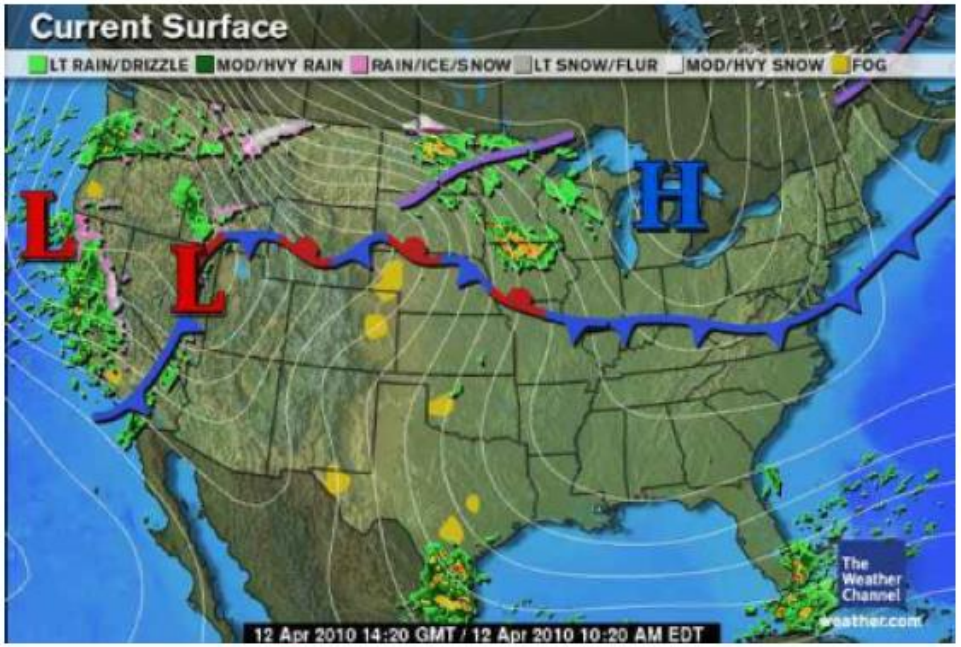
Clear skies, caused by high pressure weather systems) become filled with high clouds (cirrus) that often thicken to cirrostratus. Usually precipitation can be expected within the next day.

Middle level clouds move in and thicken from altostratus (puffy, middle level clouds) to nimbostratus (nimbus means rain). Sometimes a cumulonimbus, or storm cloud, also moves in.

Cumulus clouds (large, puffy-looking clouds that are often seen in a day mixed with sunshine and occasional clouds) often follow signifying clear weather; however, stratocumulus clouds may move in if there are strong, gusty winds and cold air.

After a day or so of fine weather and clear skies, the cycle will soon start to repeat.

Warm and Cold Fronts



Cold front

Area of cold/cool air that moves in and pushes under an area of warmer air

often bring Thunder Storms

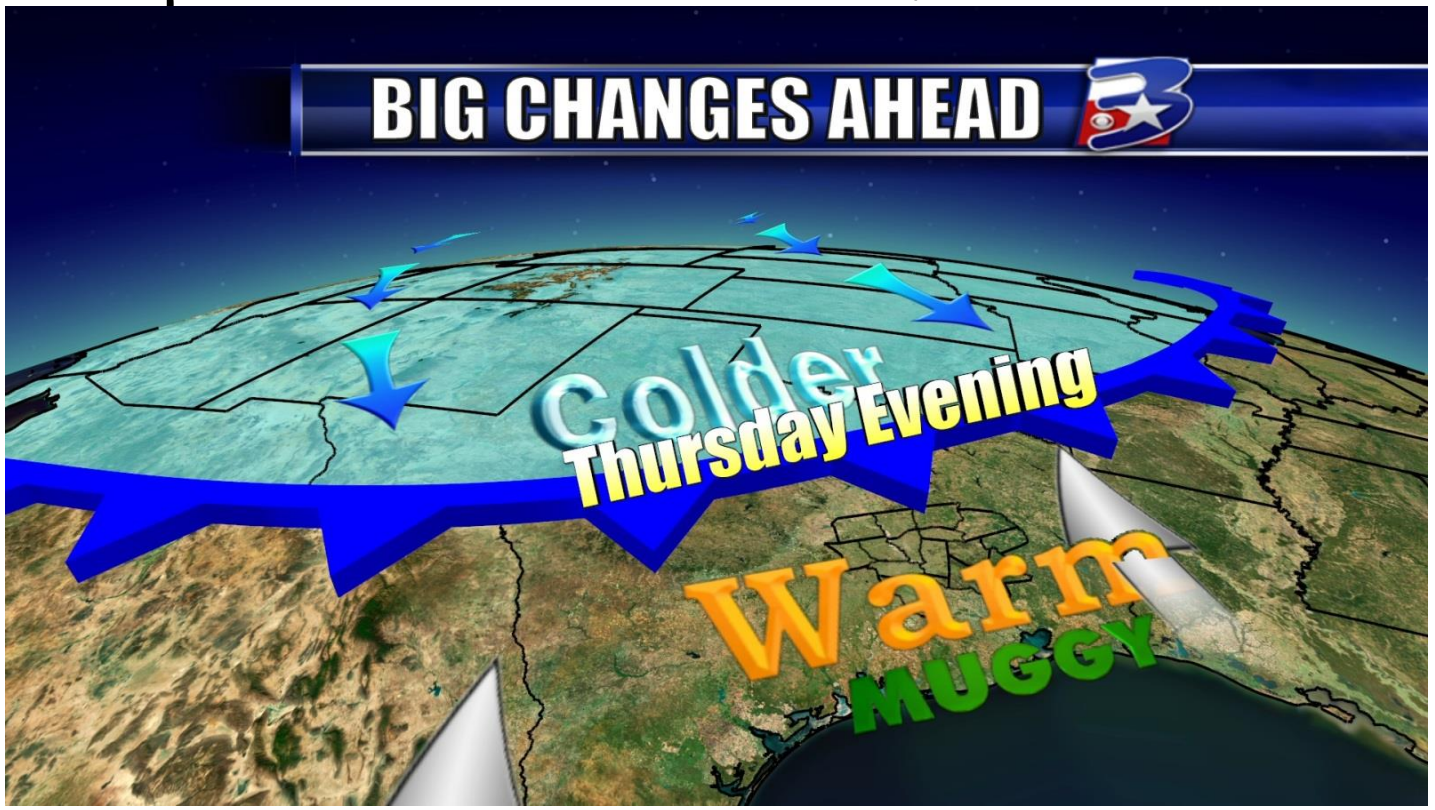
Warm Front

A warm air sys. "rides" up onto a cooler air mass

steady rain can occur

Air Masses

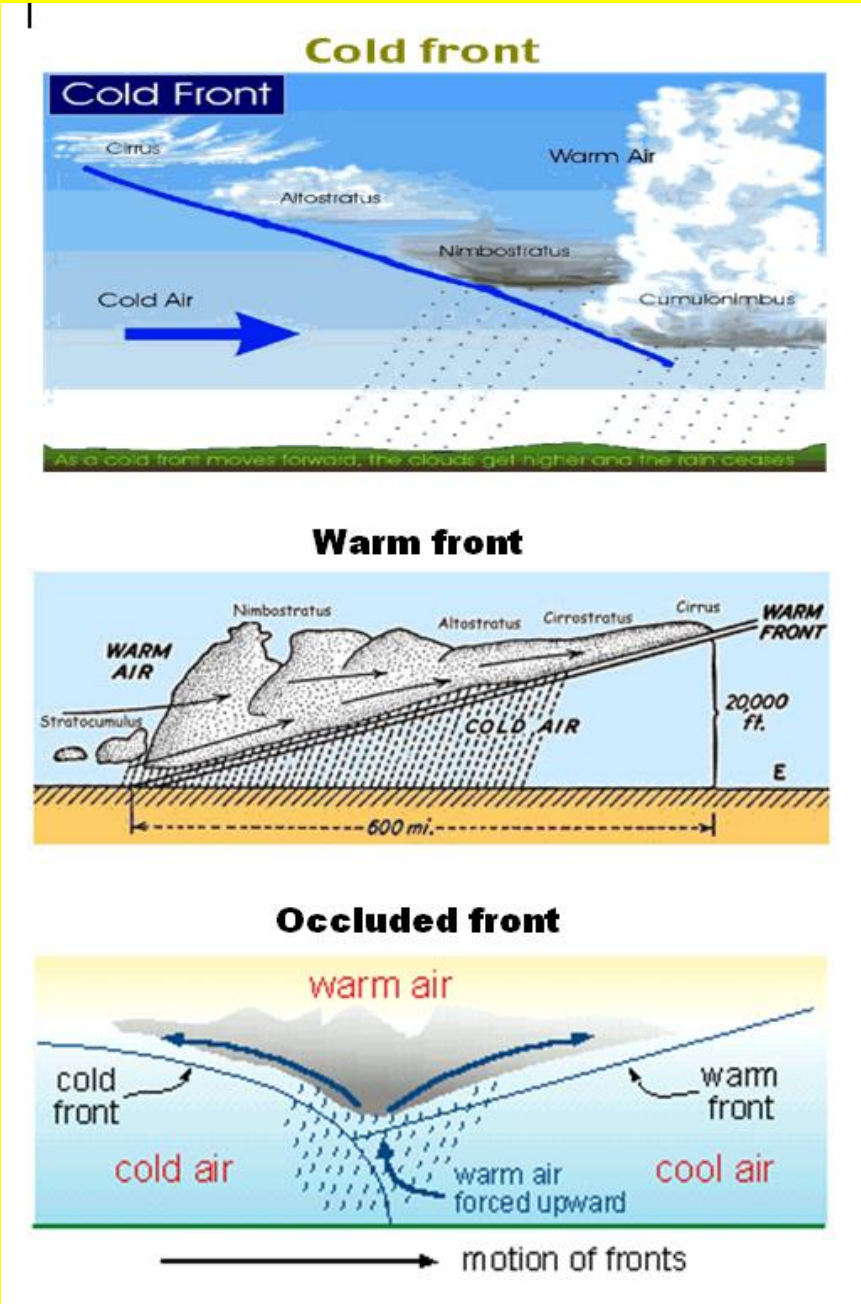
- An air mass is a large body of air in the atmosphere that is mostly uniform in temperature and moisture.



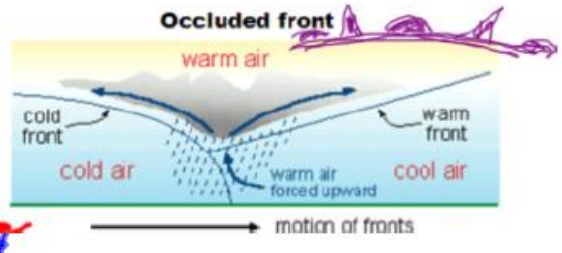
Cold fronts come into an area with greater force and push warmer air up and out of the way.

Warm fronts typically don't bring as much energy, but often bring rain because the warm, moist air "rides up and over" the cooler, dryer air

An Occluded Front occurs when warm, moist air is trapped between (and above) two air masses that are cooler.



Stationary and Occluded Fronts



Occluded Front

2 cold fronts meet and trap a warm front

Stationary

boundary of a warm and cold front that may not move for several days

Stationary 

Weather Instruments

- Meteorologists use a variety of tools for tracking and forecasting weather.
- Data is collected from electronic adaptations of the traditional (analog) instruments shown.
- Electronic monitoring equipment and computer models are used most frequently.

Weather Instruments

Barometer

Thermometer

Rain Gauge

Weather Vane

Anemometer

Ruler

Weather Instrument Descriptions

Barometer

There is air pressure around us all the time. The barometer measures the air pressure around us. Sometimes this air pressure changes because of changes in the atmosphere. When the air pressure changes there is usually a change in the weather. When there is a big change in the air pressure a storm is coming.

Thermometer

The thermometer measures the temperature of the air around us. The air temperature outside changes constantly. It changes because the sun changes its position in the sky, when the sun goes down at night, when the sun goes behind a cloud, or when warm or cold air moves into our area.

Anemometer

The anemometer measures how fast the air is moving around us. It may be blowing softly telling us that we will enjoy fair weather for a while, or it may be blowing hard telling us that a low pressure is near and a storm may be coming our way. The wind can be very pleasant or it can do a lot of damage.

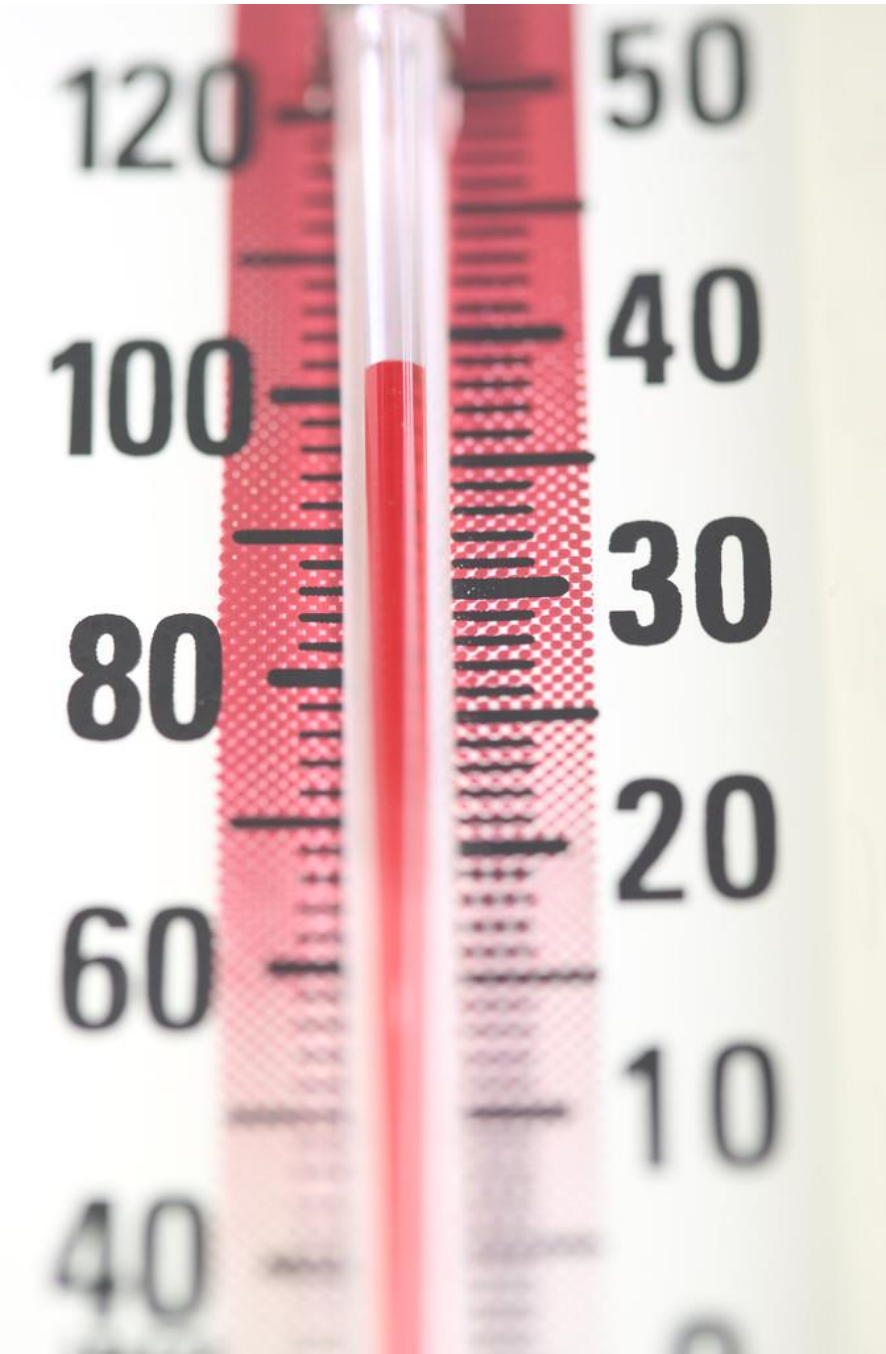
Weather Vane

The weather vane tells us from which direction the wind is coming from. It is set up so the arrow points in that direction. The wind hits the back tail and turns it so the arrow will point in the direction the wind is coming from. Sometimes we can tell if a storm is coming by knowing which direction the wind is coming from.

Weather Instrument (continued)

Rain Gauge	Ruler
The rain gauge measures how much rain we got during a rainstorm. After the rainfall is measured, meteorologists will look at the other weather instruments to see what the conditions were like right before it rained. They will record this data. When they see the other instruments all measuring the same again before another rainstorm, they can predict how much rain we will get with the storm coming in.	The ruler measures the depth of the snow after a snowstorm. After the snow depth is measured, meteorologists will look at the other weather instruments to see what the conditions were like right before it snowed. They will record this data. When they see the other instruments all measuring the same again before another snowstorm, they can predict how much snow we will get with the storm coming in.

- Thermometers record in degrees
  - Fahrenheit (U.S.)
  - Celsius (metric)



Measuring TEMPERATURE

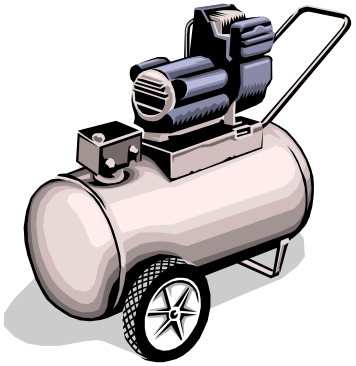
- When a liquid is heated, it expands. Likewise, when a liquid is cooled, it contracts (or takes up *less* space).

•Thermometers measure the changes in the expansion of a liquid in units called *degrees*.

•On the *Celsius* scale, 0° degrees is freezing, 100° is boiling, and 37° is normal body temperature for humans.

To estimate Fahrenheit to Celsius (or vise versa):
(F – 32) x 5/9 = C
C x 9/5 + 32 = F

Air Pressure



- Atmospheric pressure – or **air pressure** is the measure of the force of air pressing down on the Earth's surface.
- Air pressure is affected by:
  - Temperature (lower temperatures *increase* air pressure)
  - Water vapor (dry air exerts more pressure than moist air)
    - More moisture in the air = *lower* air pressure
  - Elevation (elevations high above sea level have lower air pressure than places at or below sea level, which have a higher air pressure)
- Air pressure is measured with a barometer

Air Pressure and Barometers

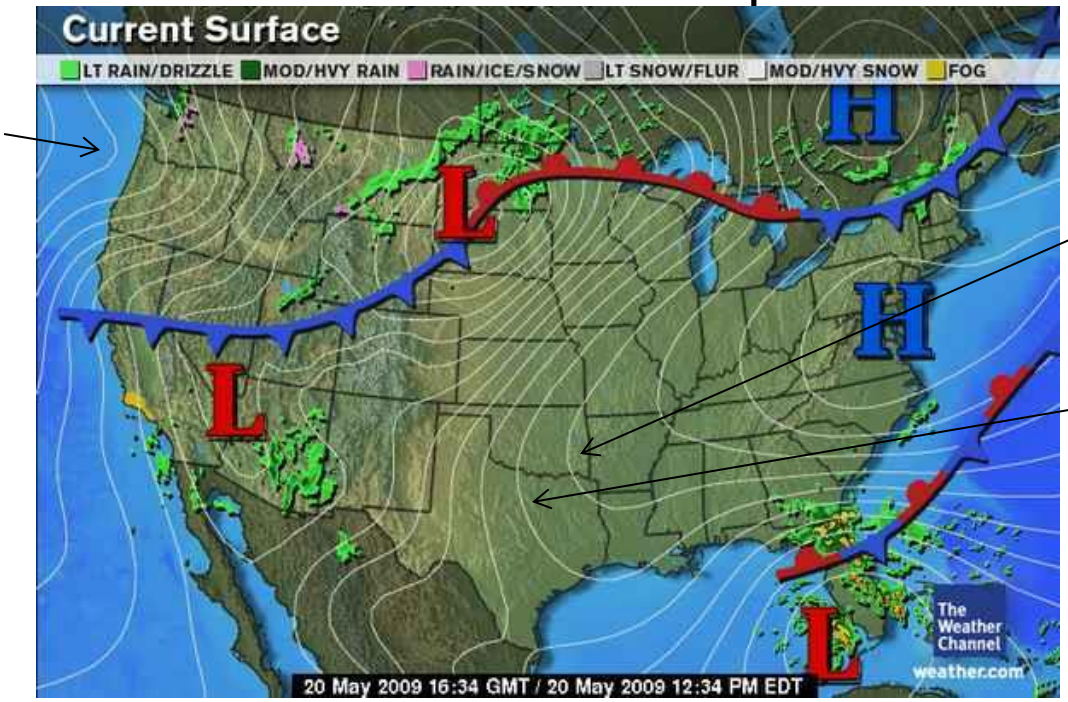
- Air pressure is measured with a barometer

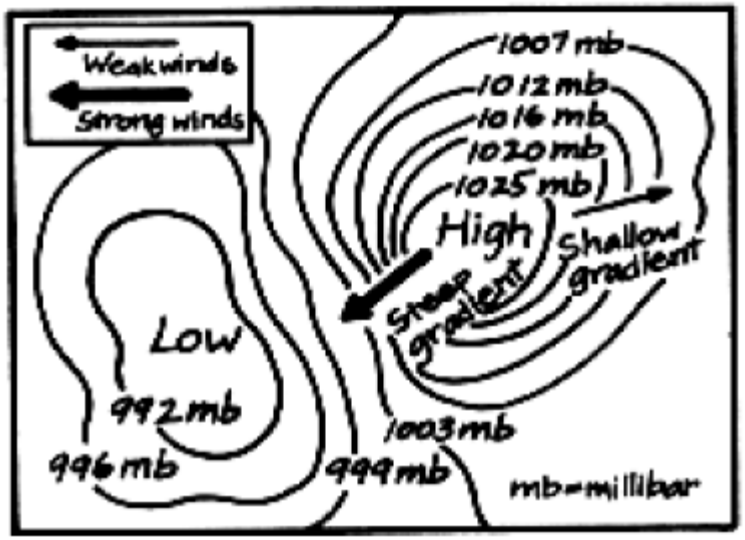
- The U.S. uses *inches of mercury* to measure air pressure. The metric system uses *hectopascals*.

- Barometers work by measuring how much force the air pushes down with (weight of the air)

Isobar

- A line on a weather map connecting points of equal atmospheric pressure.
- You can use high and low pressure areas to determine wind direction.
- Strong winds are present when isobar lines are closer together. When lines are more spread out winds are weaker.





Pressure Gradient

- Winds are strong along a steep pressure gradient.
- Winds are weak along a shallow gradient.

Happy Forecasting!

- Greetings, I’m meteorologist Raynee Dai with today’s forecast…