Weather!

Mr. P’s Class

Meigs Magnet School

Room 213

What is Weather?

- **Weather** is the condition of the Earth's atmosphere at a given time.
- It can change drastically in a 24 hour period.

What causes Weather?

- All elements of weather are the direct result of energy from the sun.
- The sun’s rays hit earth and the land absorbs the heat unevenly.
- This uneven heating causes changes in weather.

What does weather include?

- Air temperature
- Cloud cover
- Amount of sunlight
- Relative humidity
- Precipitation
- Pressure
- Wind speed + direction

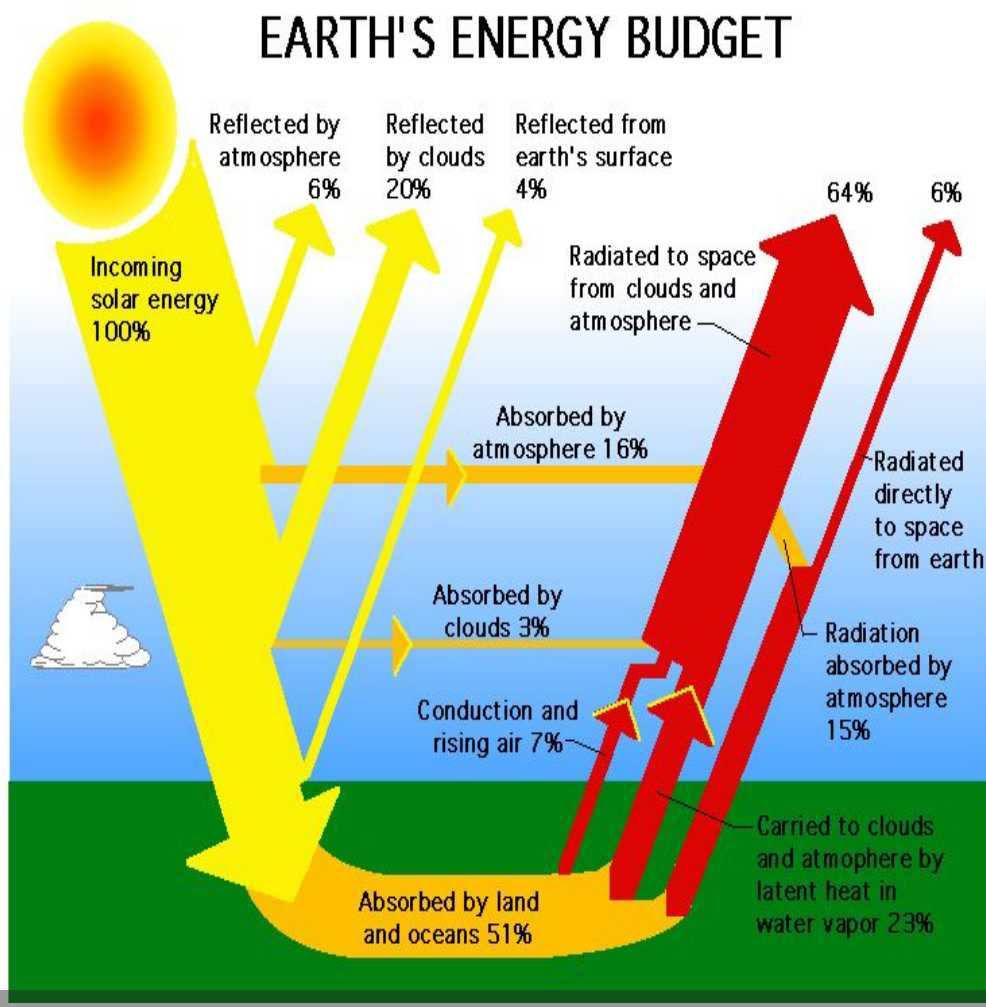
Temperature

- **Temperature** is amount of heat in a substance. Expressed in degrees Fahrenheit or Centigrade (Celsius)

- Temperature is measure by an instrument called a **thermometer**.

The Earth’s Atmosphere

- It is a layer of air that surrounds the earth.
- It is made up of many gases. Mostly Nitrogen, Carbon Dioxide and Oxygen.



Students, draw anywhere on this slide!

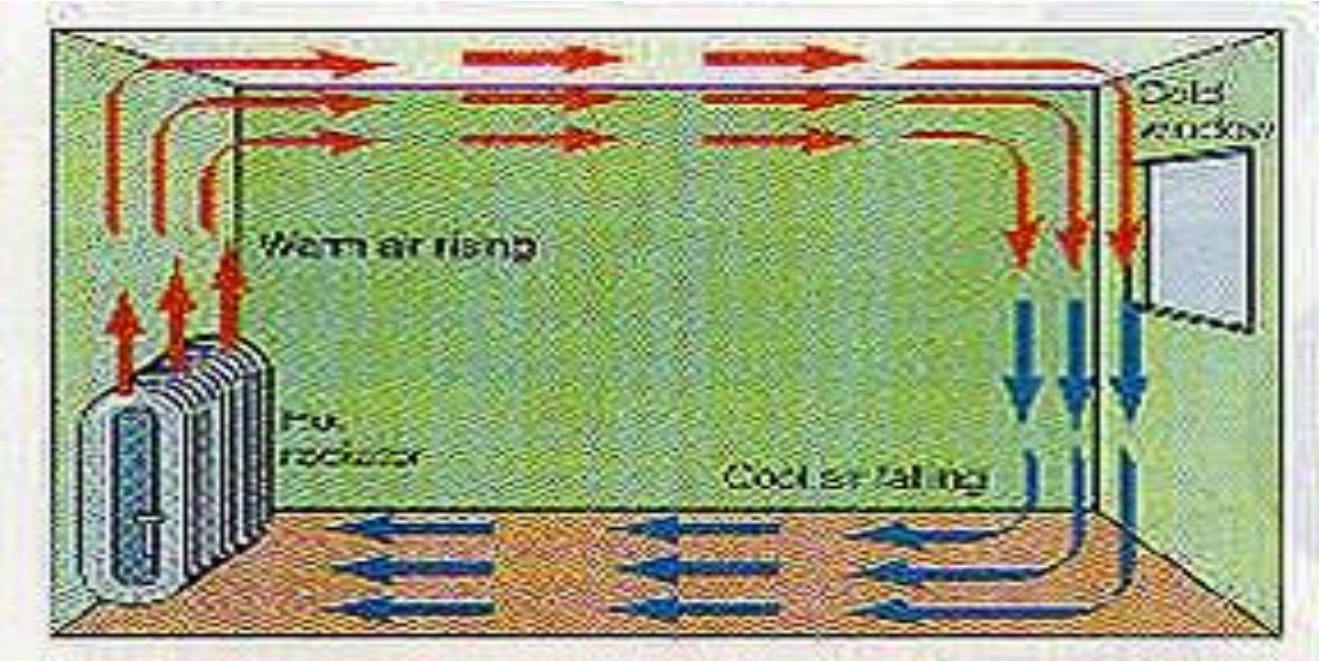
A Bunch of Hot Air!

- Cold air contracts and then sinks. The air molecules get closer together, which makes the air heavier or more dense.

- Hot air expands and then rises. The molecules get further apart, become less dense and they get lighter.

Air Circulation

- Since warm air rises, the upper part of the room is the warmest. The coolest part of the room would be closer to the floor.



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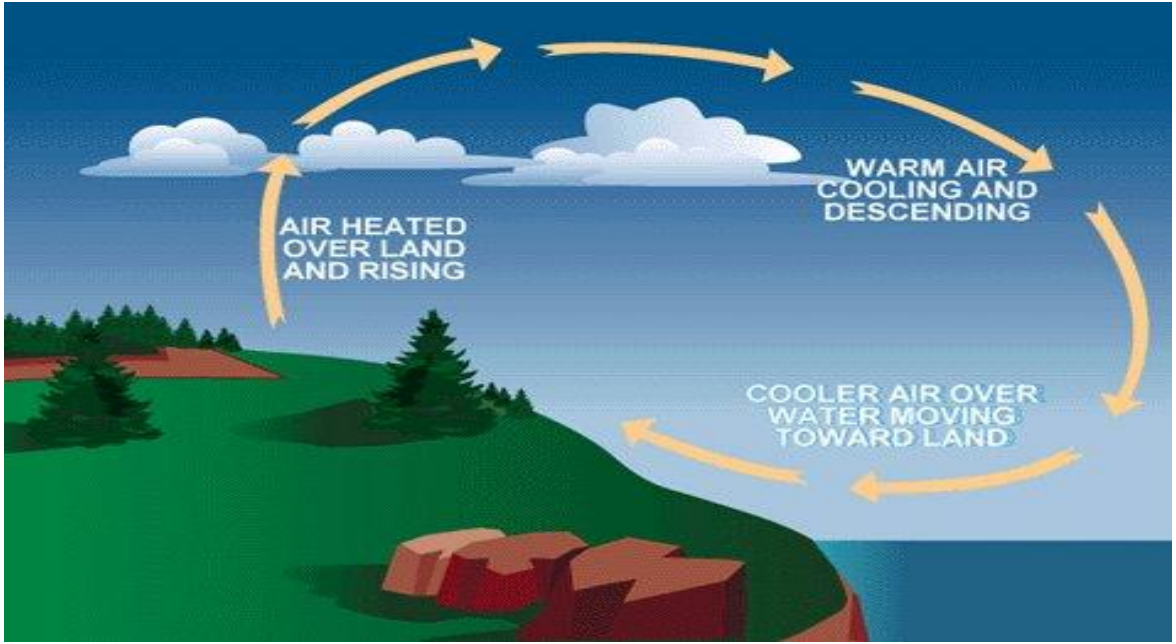
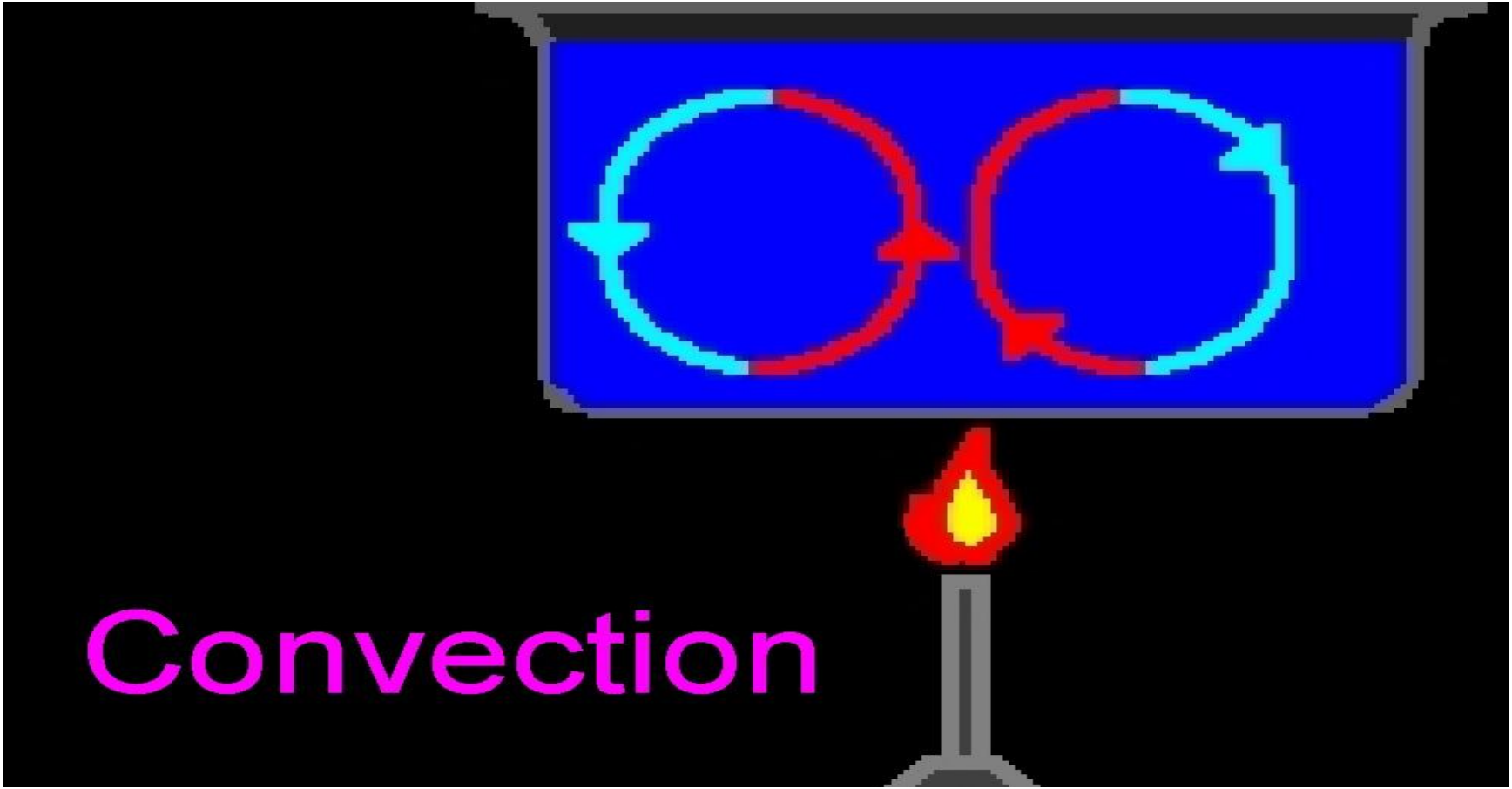
Convection Currents

Is the act of a cold fluid or gas pushing a warmer, more dense fluid or gas out of the way.




Convection

Other examples of convection

- A fridge door
- The door to your house
- Ovens

Clouds

- Clouds come in many shapes and forms.
- Some are high in the sky, while others are so low they touch the ground.
- No matter what shape or elevation, clouds form the same way, by having water vapor condense onto small solid particles like dust, sea salt, and pollution

Clouds

- Clouds serve several important functions.
- They provide rain and snow.
- They also help retain heat, so it doesn’t escape quickly back into space.
- On hot days, clouds provide shade

Types of Clouds

- There are **Four** main types of clouds

- **Cirrus-** found high in the atmosphere
- **Cumulus-** found in mid-atmosphere
- **Stratus-** found in the low atmosphere
- **Nimbus-** storm clouds.

Cirrus

- They are thin, wispy clouds blown by high winds into long streamers.

- They usually mean fair to pleasant wheather.

Cumulus

- They are puffy clouds that sometimes look like pieces of floating cotton

- They can develop into a giant cumulonimbus, which is a thunderstorm

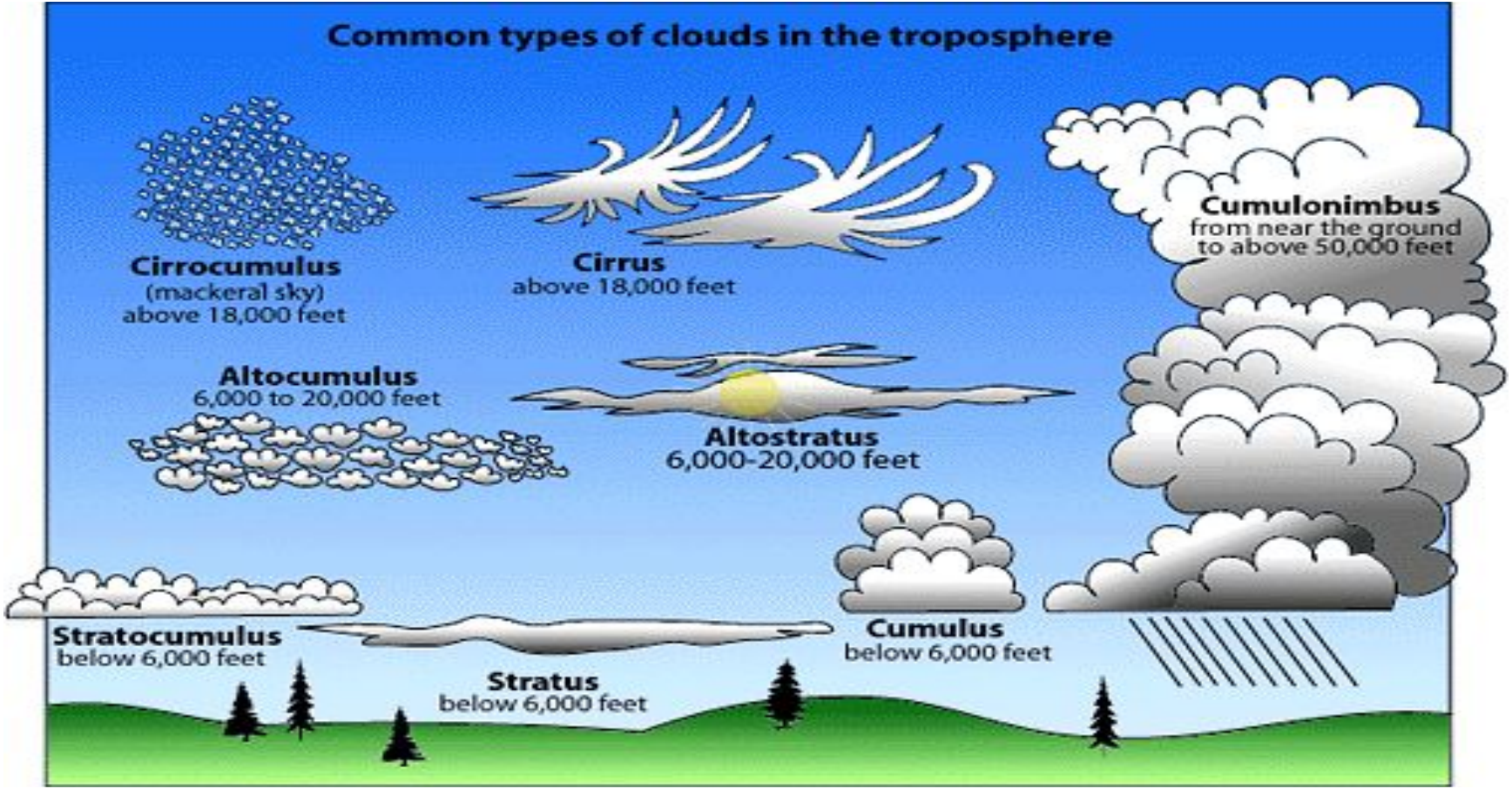
Stratus

- are uniform grayish clouds that often cover the entire sky.
- They resemble fog that does not reach the ground.
- Usually no precipitation falls from stratus clouds, but sometimes they may drizzle.

Nimbus (Cumulonimbus)

- They are thunderstorm clouds that form if cumulus clouds continue to grow vertically.

- Lightning, thunder, and even violent tornadoes are associated with the cumulonimbus.


Common types of clouds in the troposphere
Cirrocumulus
(mackeral sky)
above 18,000 feet
Cirrus
above 18,000 feet
Cumulonimbus
from near the ground
to above 50,000 feet
Altocumulus
6,000 to 20,000 feet
Altostratus
6,000-20,000 feet
Stratocumulus
below 6,000 feet
Cumulus
below 6,000 feet
Stratus
below 6,000 feet

Can you identify these clouds?

Wind Spiral

- Why is the spiral able to turn?

- The hot air “rising” is turning the spiral.

Wind

- Wind is moving air in the atmosphere.
- Air is always moving from high pressure to low pressure.
- The strongest winds are tornadoes, the air pressure is extremely low.

How to measure wind speed

- Wind speed is measure in kilometres per hour (kph). We use a device called an **anemometer.**

- **Wind Direction is always stated in terms of where the wind is coming from.**

Measuring Wind Direction

- Wind Sock

- Weathervane

Air Pressure

- The force that is applied on everything on the Earth caused by the weight of the air.
- Air particles are mobile, the exert pressure on objects.
- High air pressure brings warm, dry air. Low air pressure brings rain or moisture

Air Pressure

- Air pressure can change quickly, ie- when a storm comes in.
- There are three factors that affect air pressure: altitude, air mass temperature and the amount of moisture in the air.

- A Barometer is used to measure air pressure.

Humidity- Moisture in the Air

- The sun heats up the water on land and causes evaporation.
- The moisture the is in the air is called humidity.
- Saturated is when the air has too much moisture and cannot hold anymore.

Forms of Precipitation

Snow

- If the air is cooled below the freezing point of water, the condensing moisture is quickly freeze into ice crystals.
- The ice crystals join to make snowflakes
- Snowflakes are always six sided.

Rain

- When droplets of moisture join together becoming heavy enough to fall to the ground.

Hail

- Formed in cumulonimbus (storm) clouds. They are frozen droplets of moisture.

Sleet

When falling rain starts off in warmer air, but passes through air below freezing, the rain drops cool and freeze onto surfaces when they hit the ground.

Facts on Precipitation

- It takes 10 centimetres of snow to make one centimetre of rain.

- Dew is moisture in the air cools off at night. In the morning it is found on everything. In colder temperatures, dew is frost.

Air Mass Map


Continental Arctic
Bitterly cold, dry
Maritime Polar
Cool, moist
Continental Polar
Cold, dry
Maritime Polar
Cool, moist
Continental Tropic
Hot, dry
Maritime Tropic
Warm, moist
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Types of Precipitation

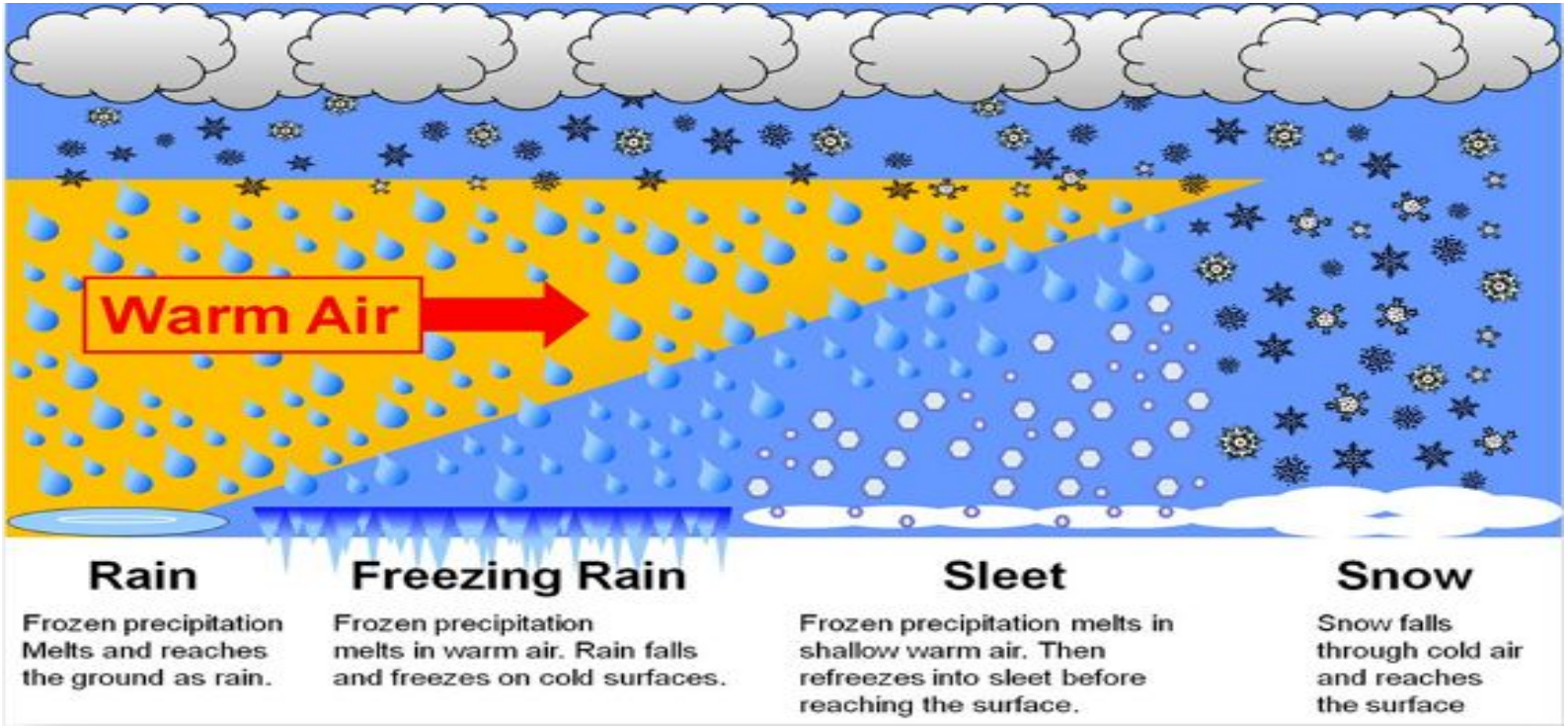
Rain

Sleet

Snow

Hail

Freezing Precipataion



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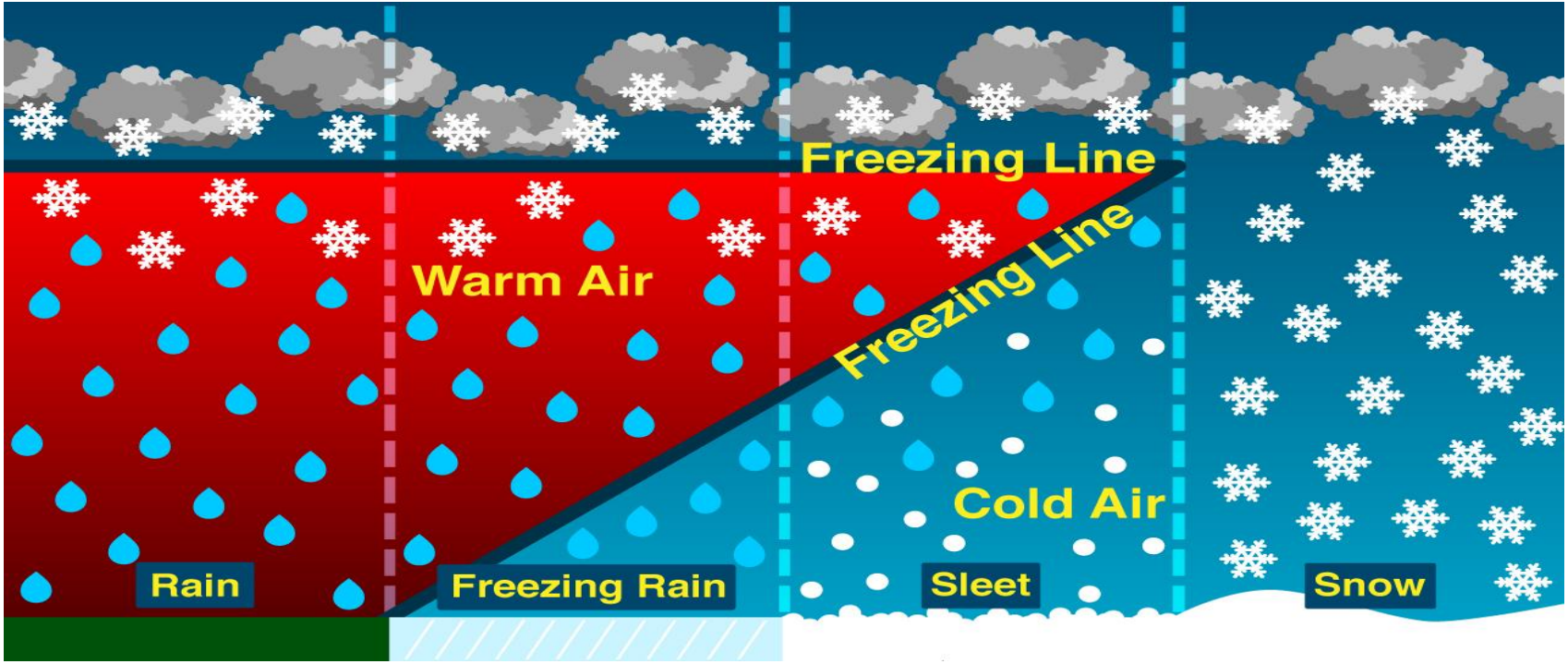

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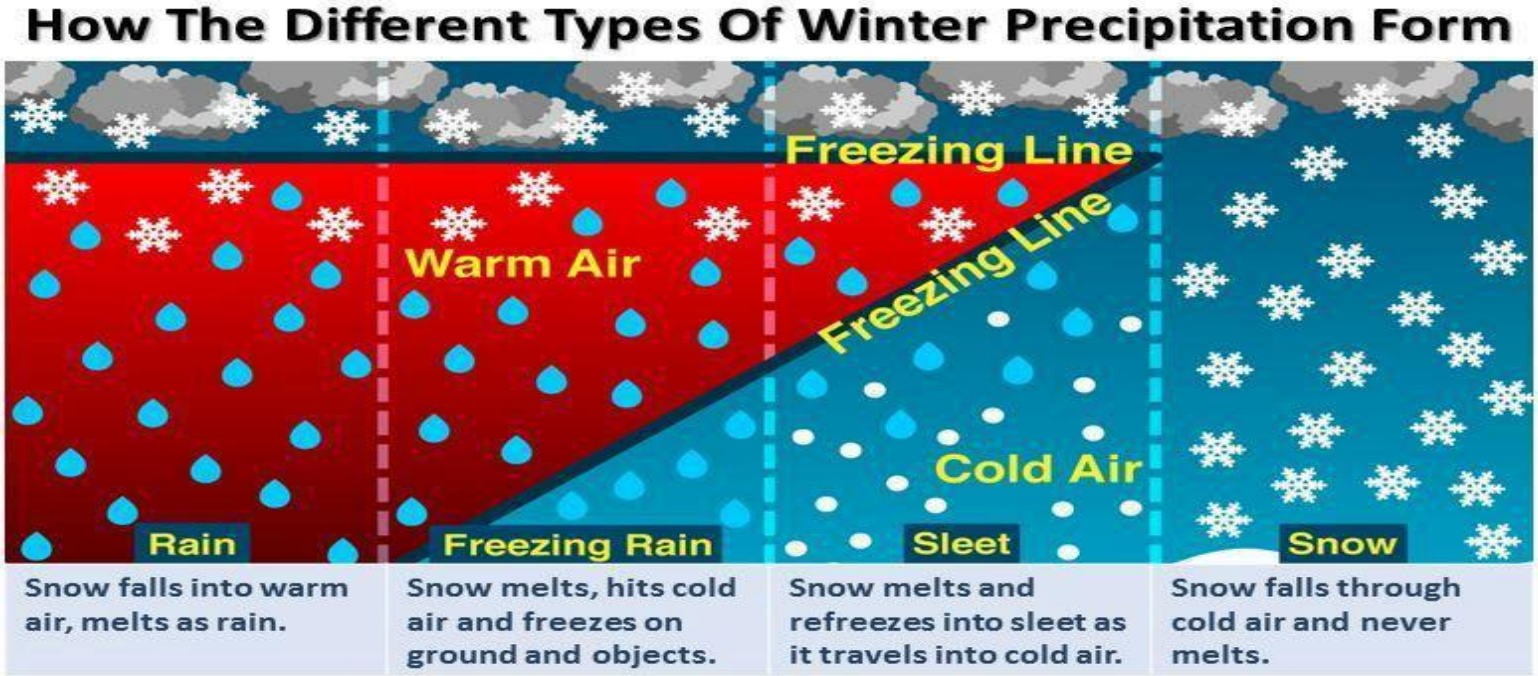

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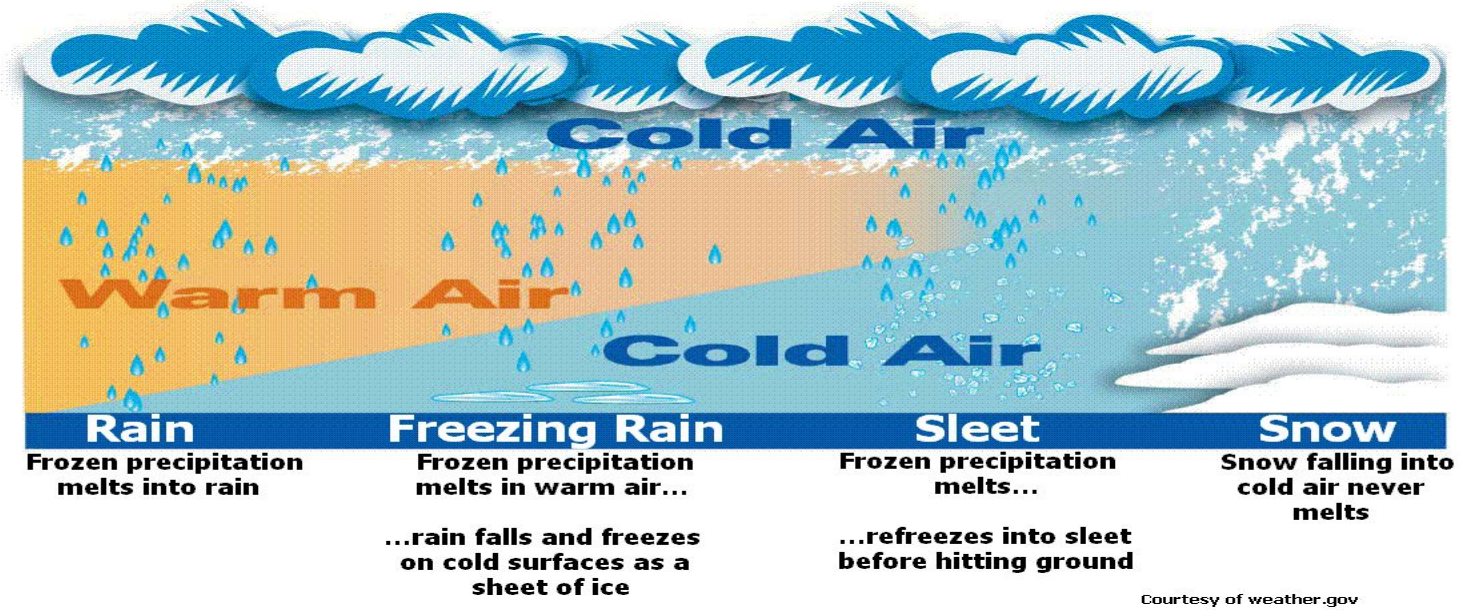
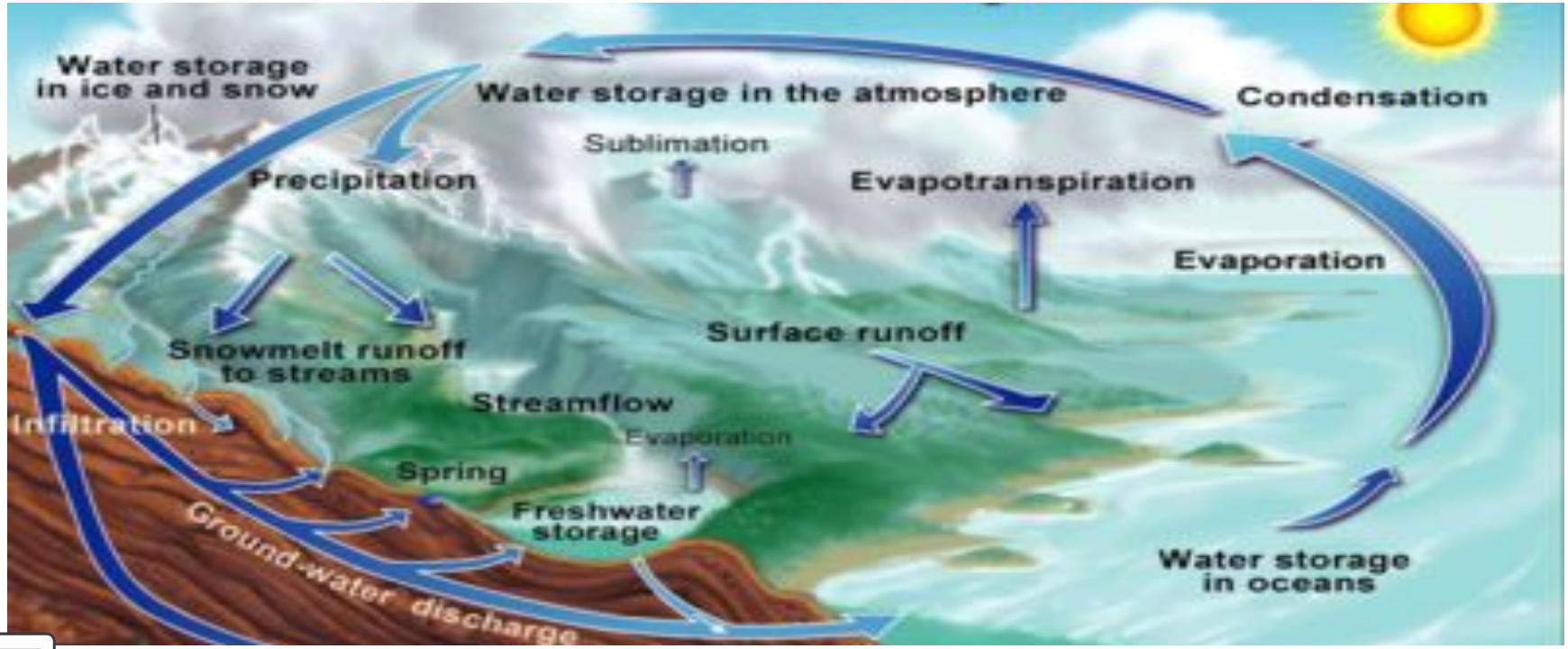


The Water Cycle



Students, write your response!

The Water Cycle

- The sun heats up the water- **evaporation**
- The water vapor (gas) **condenses** into clouds
- The clouds become saturated and **precipitation** is the result.
- The precipitation pools in lakes, oceans and rivers. Waiting to evaporate again.

Students, draw anywhere on this slide!

Relative Humidity

- It is the ratio of how much moisture is in the air and how much the air can hold.
- 50% humidity means the air is holding 50% moisture

Precipitation

- When there is too much moisture, the water will fall as precipitation.
- Precipitation will fall in two main forms: rain or snow depending on the temperature of the air through which the moisture will fall.
- Other forms of precipitation are sleet and hail.

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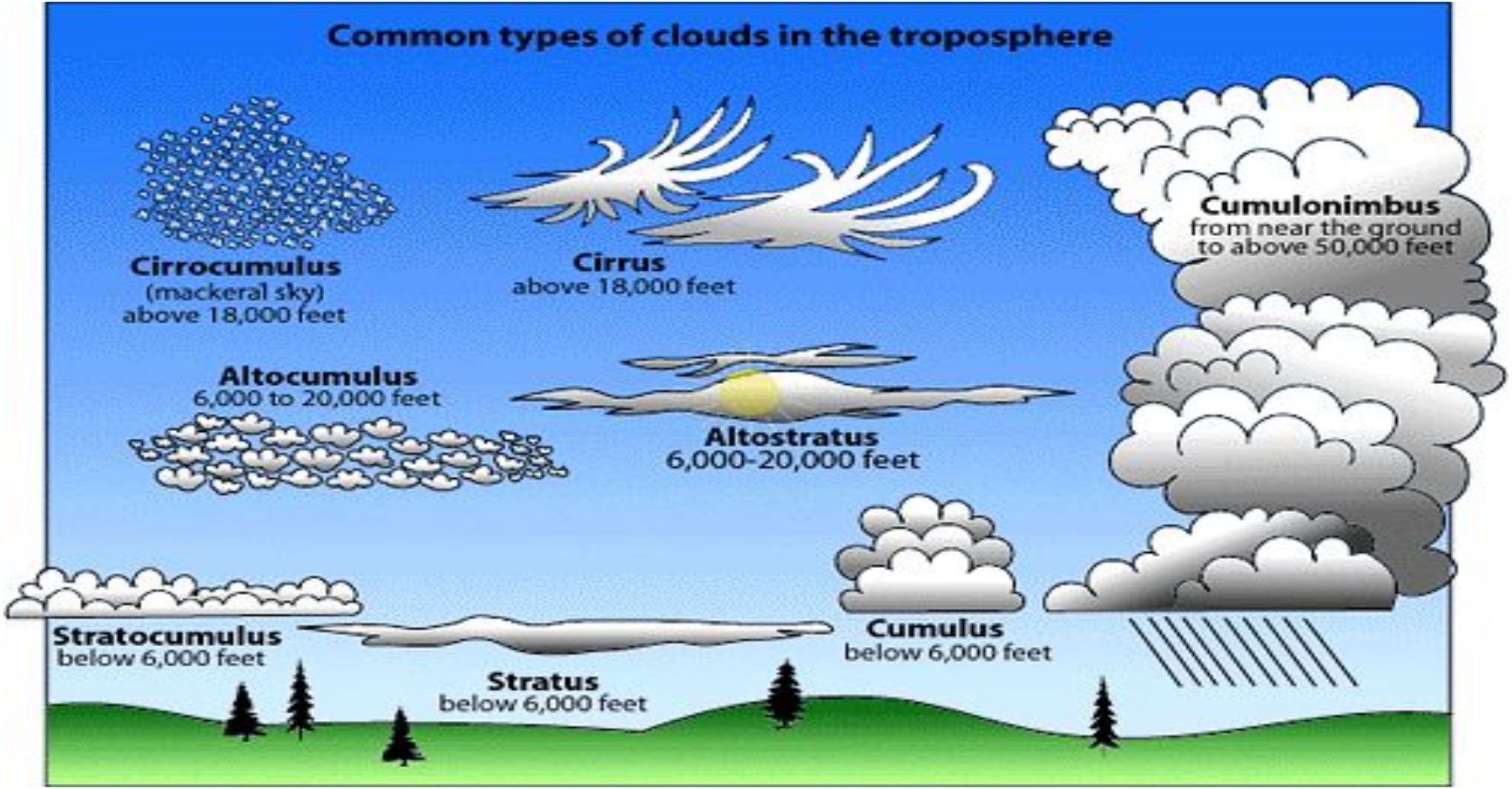
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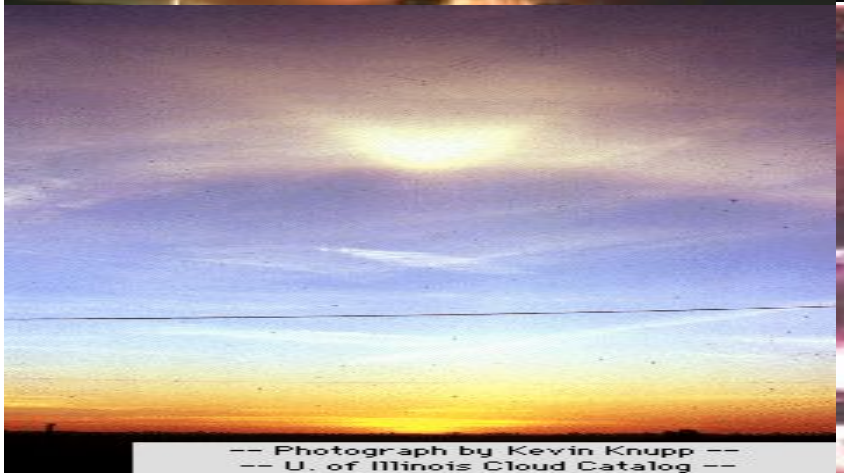
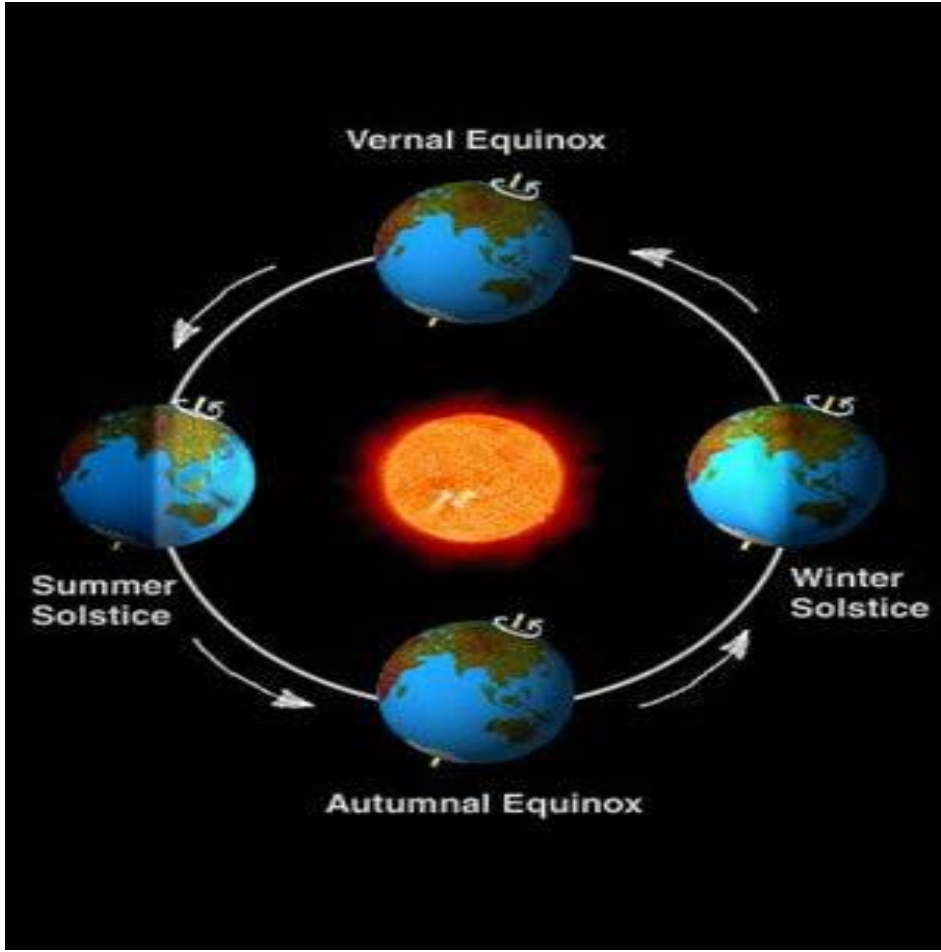


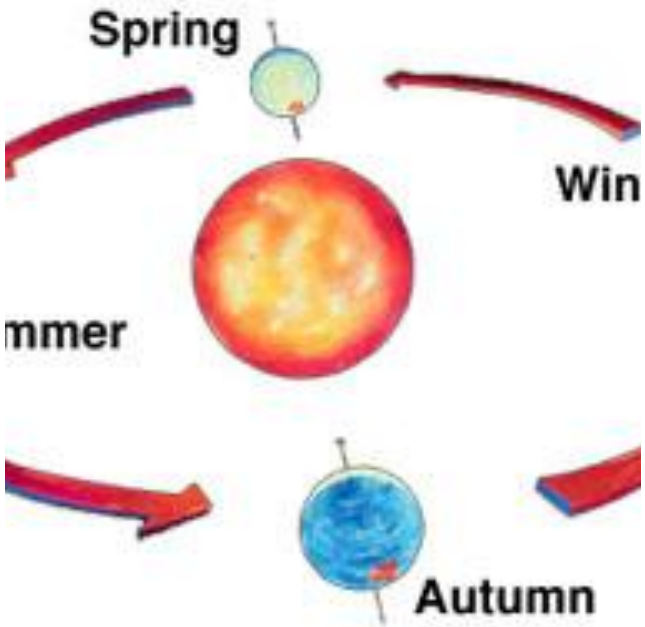
Seasons

- The Earth orbits around the sun.
- The Earth tilts on its axis 23.5 degrees.
- The area of the Earth, that heats up more, is closer to the sun.



Seasons

- When Canada is tilted away from the sun, it is winter.
- When Canada is tilted towards the sun, it is summer.
- Spring and Autumn are the in between



Daylight

- The Earth turns on its axis, one complete rotation in one day. (24 hours)
- The Sun rises in the east and sets in the west
- The amount of daylight is related to the Earth’s orbit around the sun.
- Spring and summer have more daylight hours, because we are tilted towards the sun.

Daylight

- The sun give off sunlight, that heats the Earth.
- Direct Sunlight is hotter than indirect sunlight.
- What time of the day is the hottest?

Noon

- The sun is directly over our heads at lunch time.
- At noon you do not have hardly any shadow.
- In the morning and evening, sunlight is spread out more.
- You have more of a shadow, because the sunlight has to travel a greater distance.

Hot Sun, Cool Sun

- Measure the heat of the sun, at different times of the day.
- When are the sun’s rays most spread out?
- When is it the warmest?

Predicting the Weather

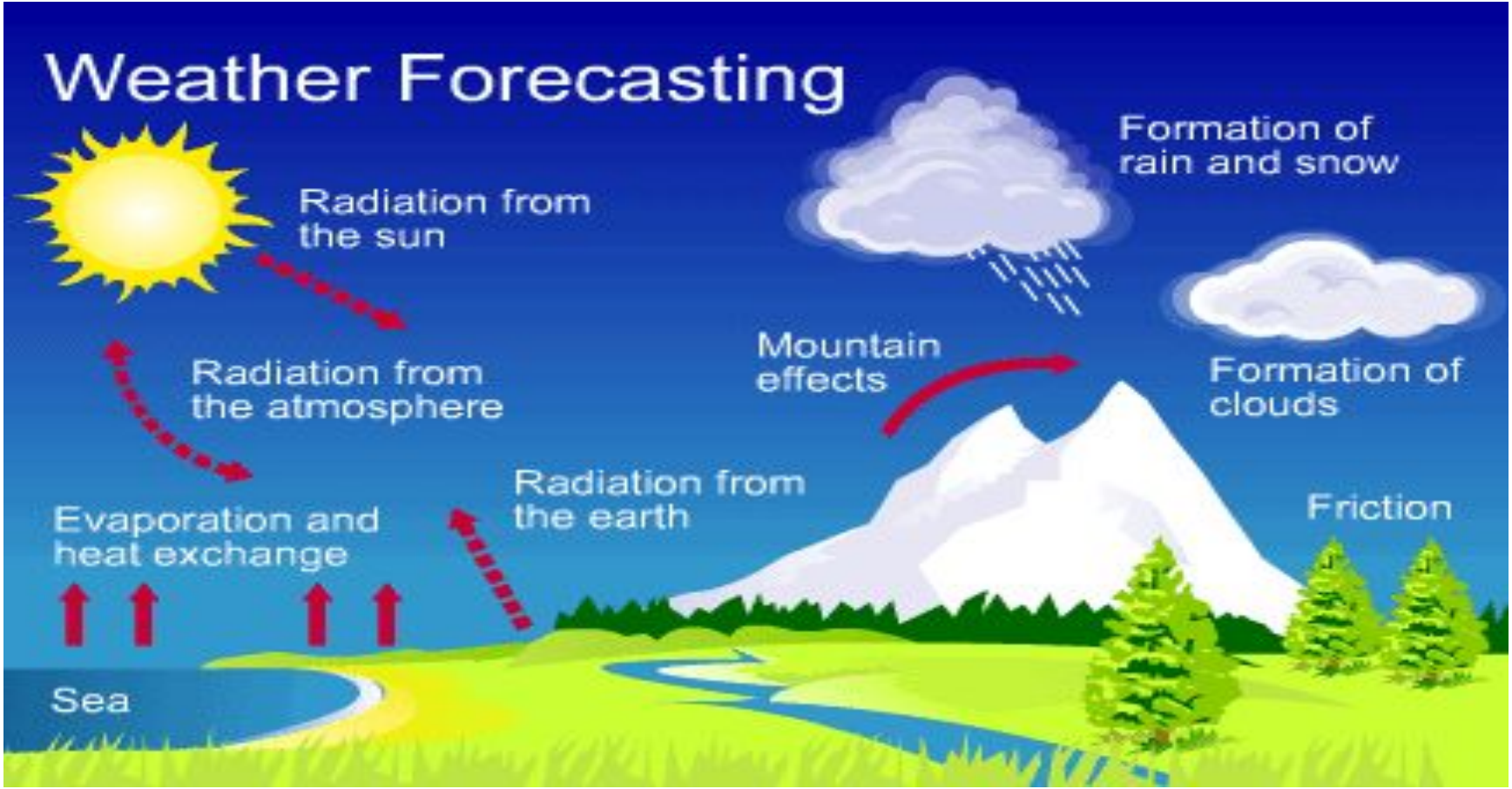
- http://weather.msn.com/local.aspx?wealocations=wc:CAXX0126
- Monitor the weather for a week.
- Use www.theweathernetwork.com

Examples of Weather Forecasts

- What do all the numbers mean?

Forecasting the Weather

- You have keep track of the weather for ten days.
- Was the weather forecast accurate?
- Why is it so difficult to predict the weather?


Weather Forecasting
Radiation from the sun
Formation of rain and snow
Radiation from the atmosphere
Mountain effects
Formation of clouds
Radiation from the earth
Evaporation and heat exchange
Friction
Sea

Factors that influence weather in different areas.

- Land Elevation
- Location- lattitude and longitude
- The sun
- Cloud cover
- Air pressure
- Earth’s orbit (seasons)

What are 4 conditions that “make” weather happen?

heat energy, air pressure, winds, and

Four air mass types:

continental tropical, continental polar, maritime tropical, and maritime polar

The states in Tornado Alley are generally very flat, dry, and warm, and it’s the perfect spot in the U.S. for cool, dry air from the west to collide with warm, moist air from the Gulf of Mexico. This mixing of different air masses often creates violent storms

Greenhouse Effect:

The process in which CO_2 and other gases in the atmosphere absorb infrared radiation from the sun, forming a “heat

Part Two

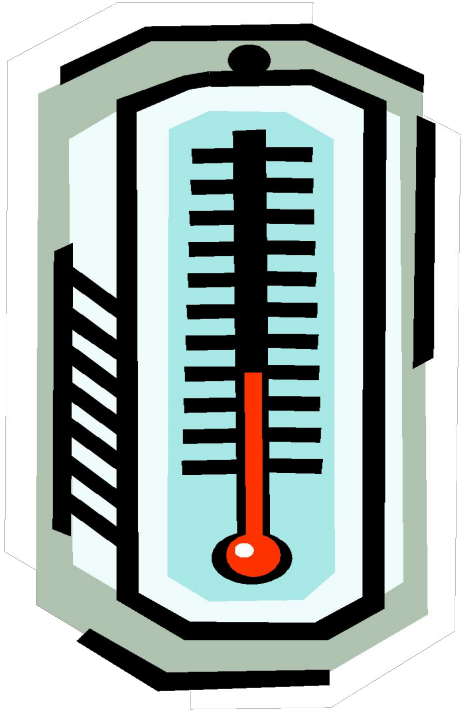
Weather

What is weather?

- Refers to the state of the atmosphere at a specific time and place.
- The one thing that you can talk to anybody about
- If you don’t like the weather just wait around it will change in Tennessee
- What are some of the factors that affect the weather?

Air Temperature

- Temperature is the measure of the average amount of motion in particles.



Wind

a natural movement of air of any velocity; *especially* **:** the earth's air or the gas surrounding a planet in natural motion horizontally

Humidity

- The amount of water vapor present in the air

- <u>Relative Humidity</u> -is a measure of the amount of water vapor present in the air compared to the amount needed for saturation at a specific temperature

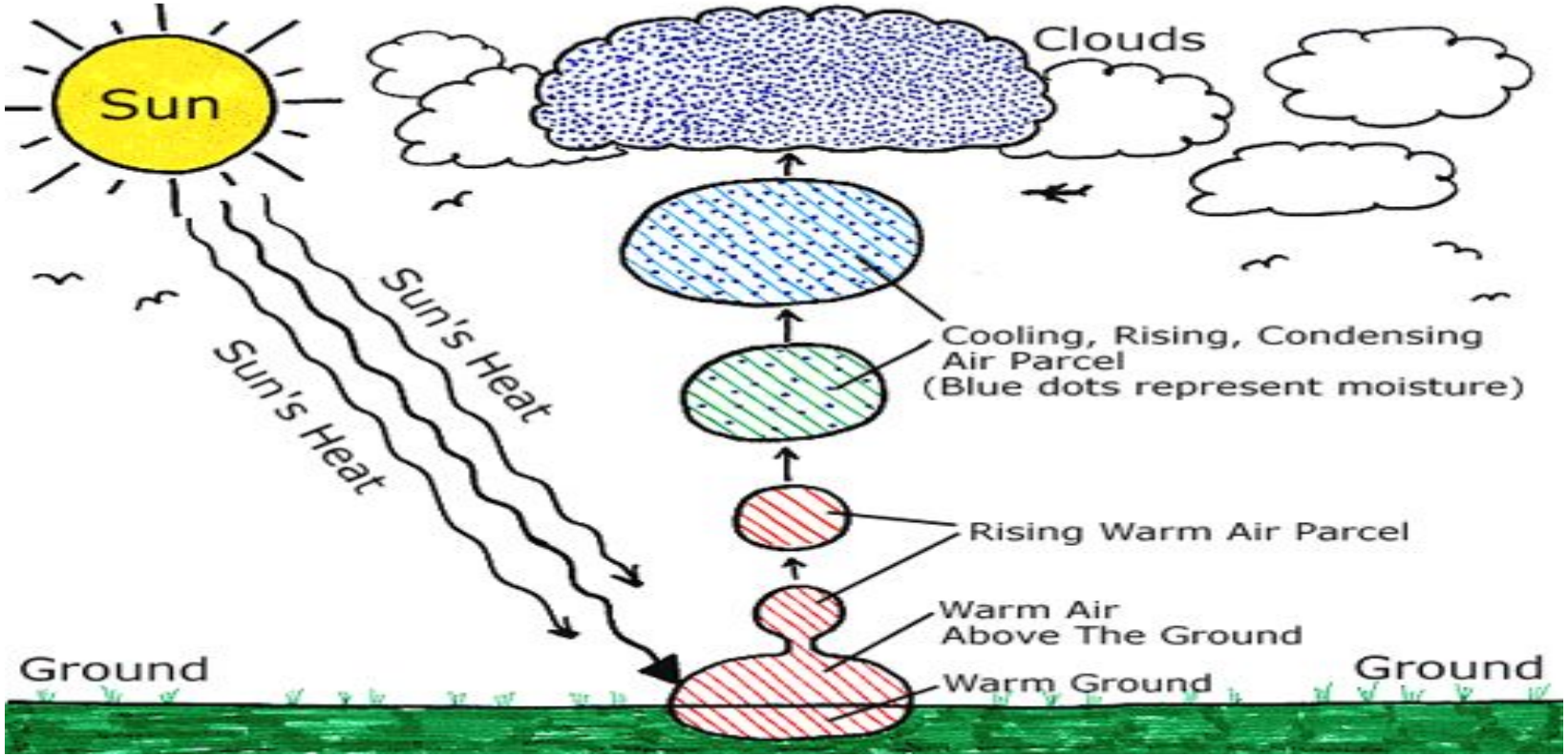
Clouds

- Masses of small water droplets or tiny ice crystals that float in the air.
- Three main types are cirrus, cumulus, and stratus.
- Other clouds are a mixture of these three main types.

Precipitation

Any form of water that fall to the ground from clouds…

- Rain
- Snow
- Hail
- Sleet


Sun
Clouds
Sun's Heat
Sun's Heat
Cooling, Rising, Condensing
Air Parcel
(Blue dots represent moisture)
Rising Warm Air Parcel
Warm Air
Above The Ground
Warm Ground
Ground
Ground

Cirrus

- Cirro- means “curled” or “feathery”
- Form highest in the sky; are made up of ice crystals; and appear as curls, tufts, or wisps.
- Usually signal the end of clear weather.

Cumulus

- Cumulo- means “heaped” or “piled”
- Cottony clouds with flat, usually gray bases, and puffy, bright tops.
- Usually signal good weather, but if atmosphere is unstable, can build into towering clouds that produce showers and thunderstorms.

Stratus

- Strato- means “layer-like” or “sheet-like.”
- Low-lying, dull-colored clouds that form in layers or sheets.
- Usually bring drizzling rain or light-falling snow.

Alto

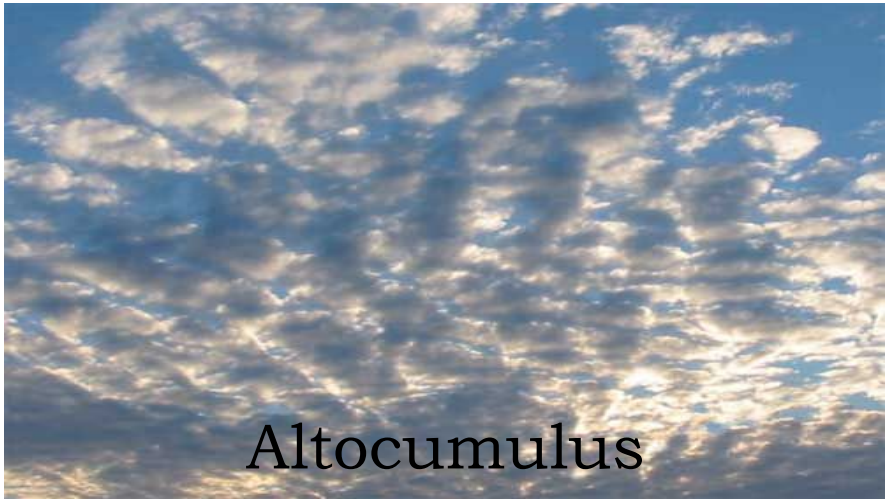
- A prefix meaning “middle range of clouds “ and used to describe clouds that lie from 6,500-18,500 ft. (1,980-5,640m).

Nimbus

- A rain cloud

Other Cloud Types

More Cloud Types



Precipitation

- Water that falls from the clouds
- Air temperature determines the form of precipitation that falls
- 4 main types of Precipitation: Rain, Sleet, Snow and Hail

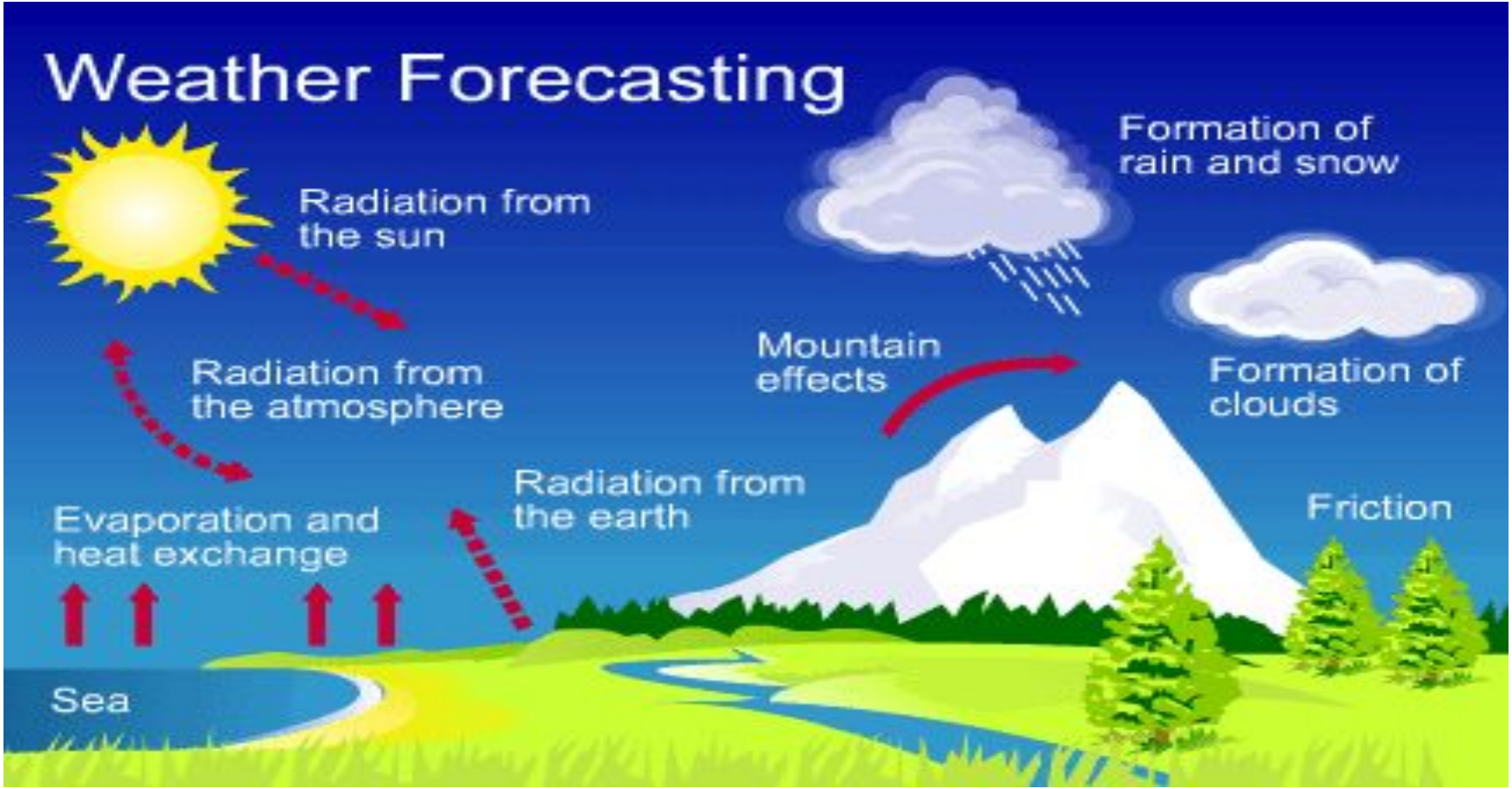
Types of Precipitation

Rain

Sleet

Snow

Hail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Air Masses

- ***A large body of air that has properties similar to the part of the Earth's surface over which it develops.***

Air Mass Map


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Bitterly cold, dry
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Types of Precipitation

Rain

Sleet

Snow

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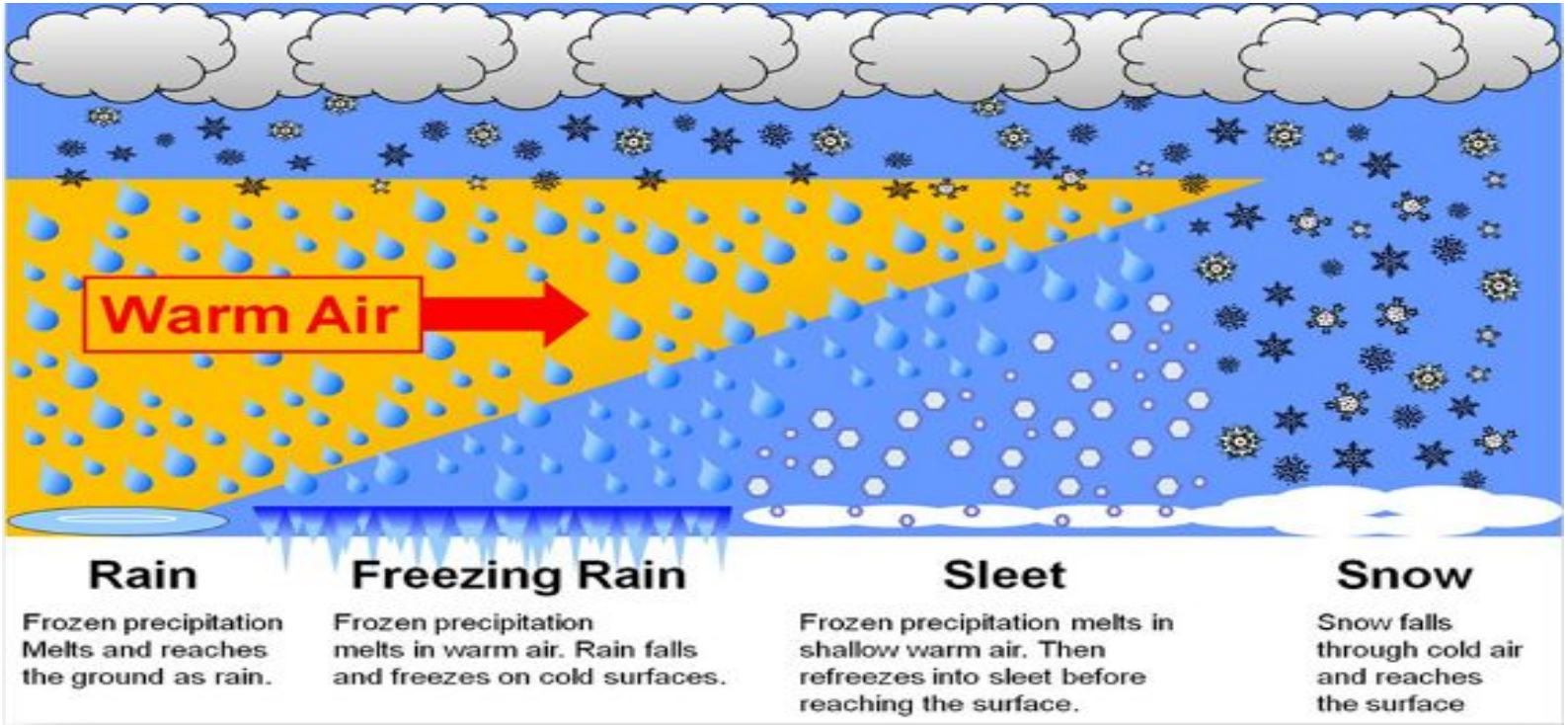
Freezing Precipataion



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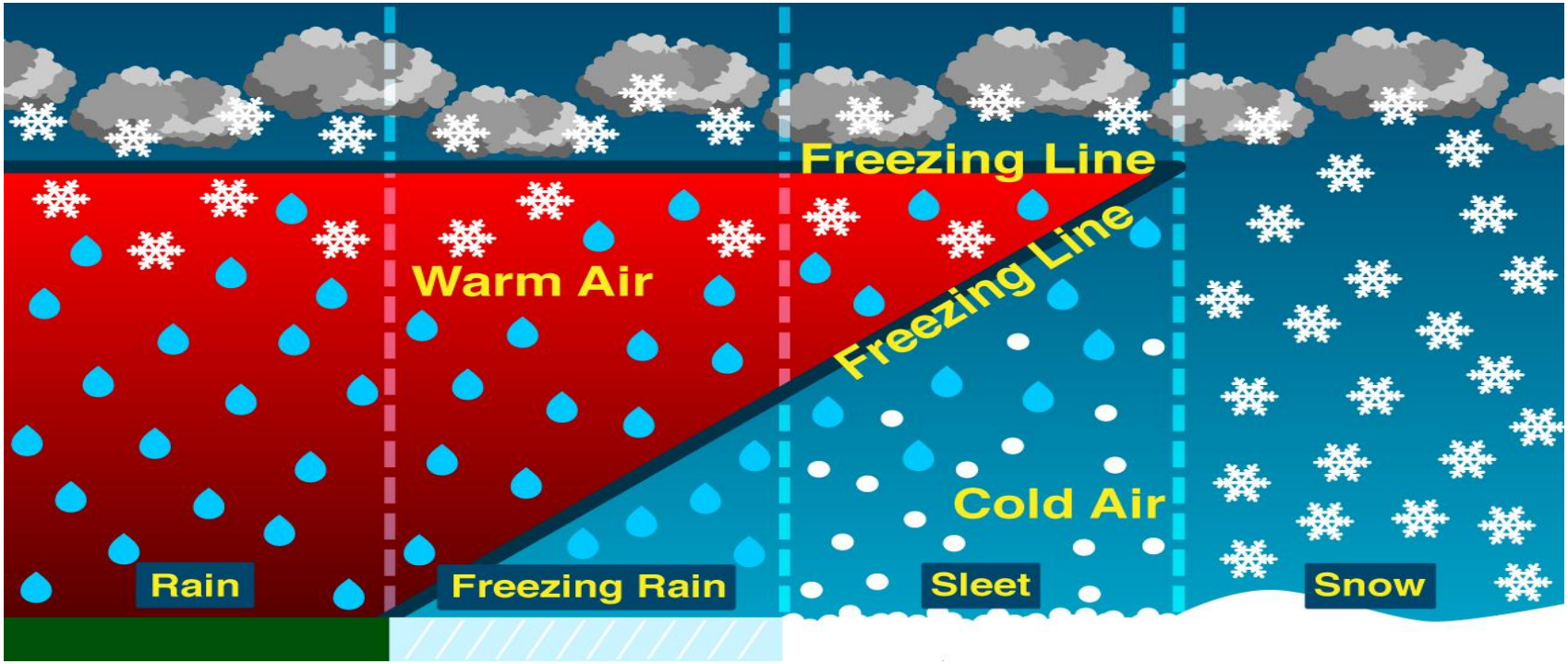

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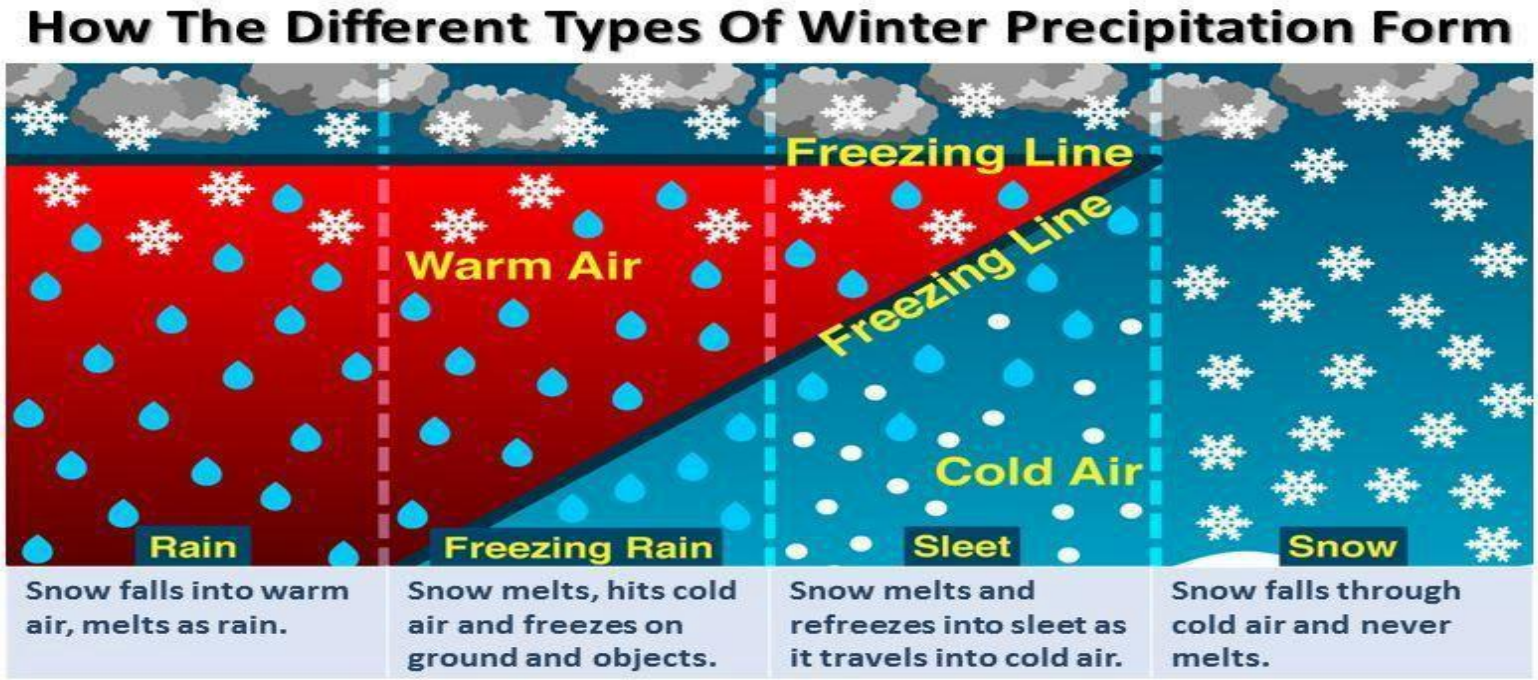
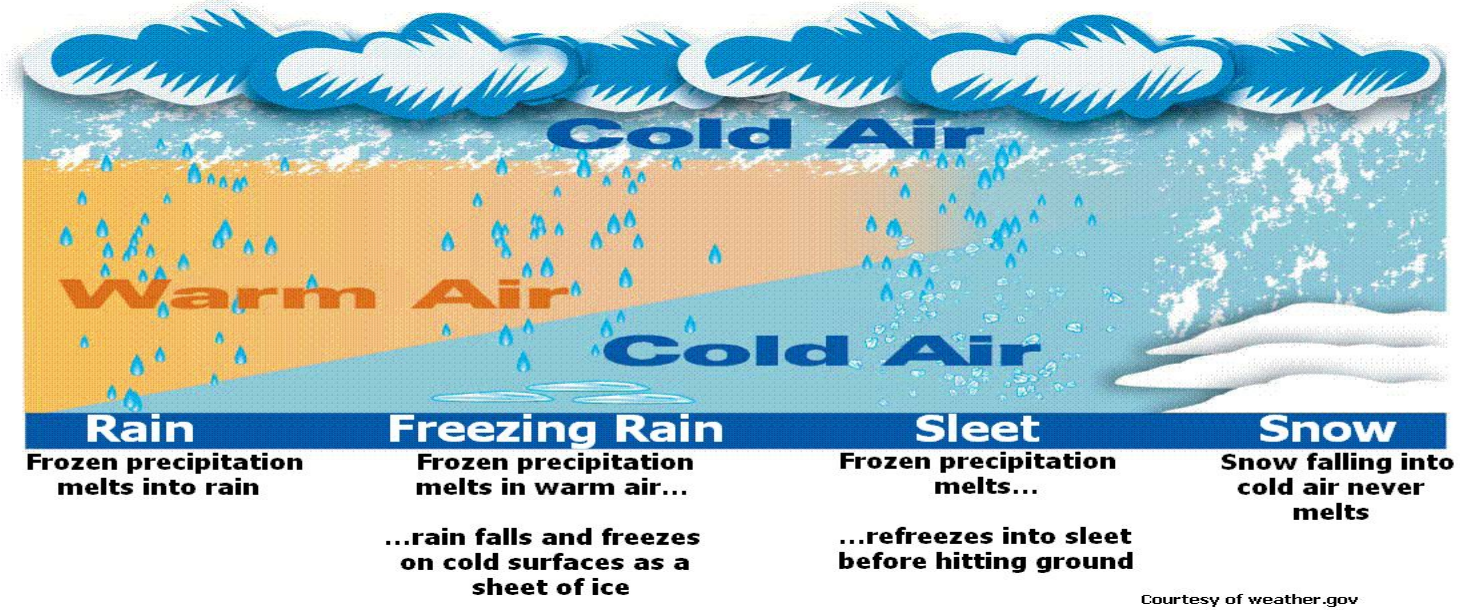


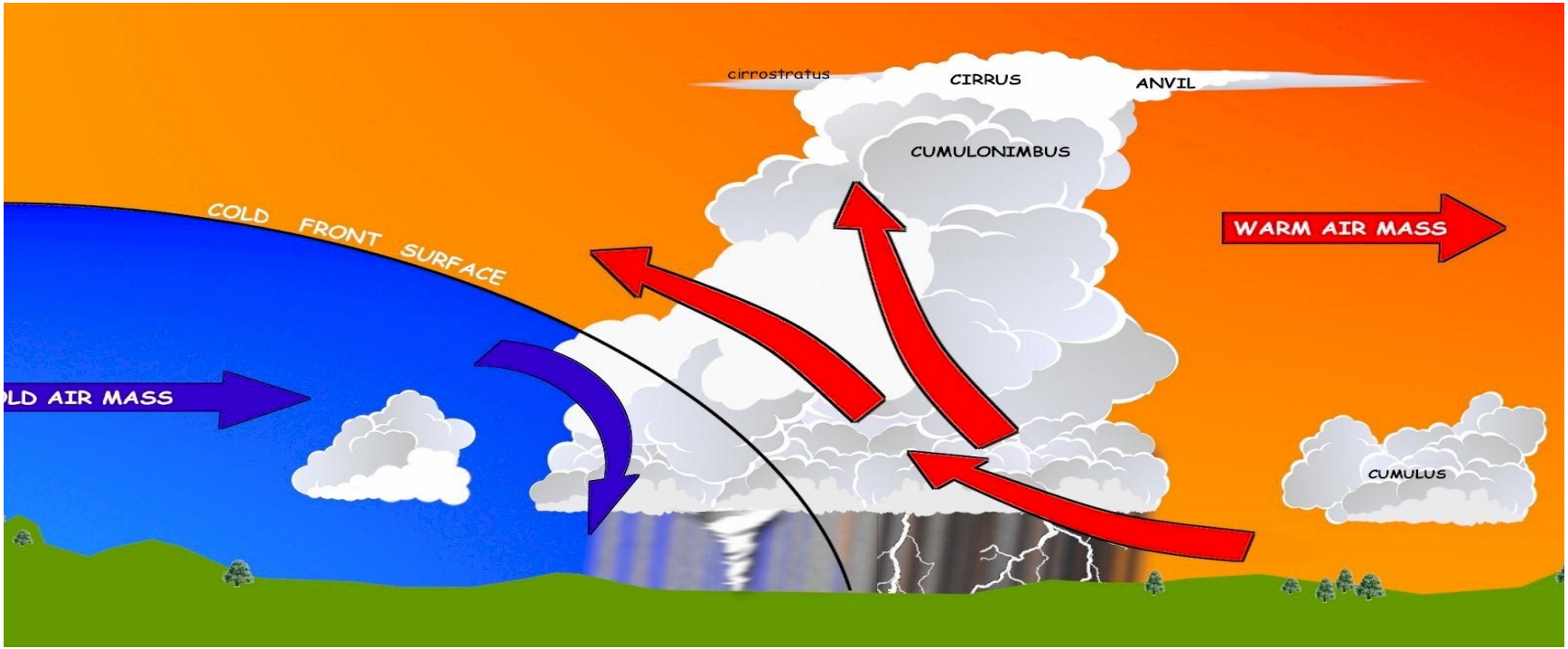
Freezing Precipitation



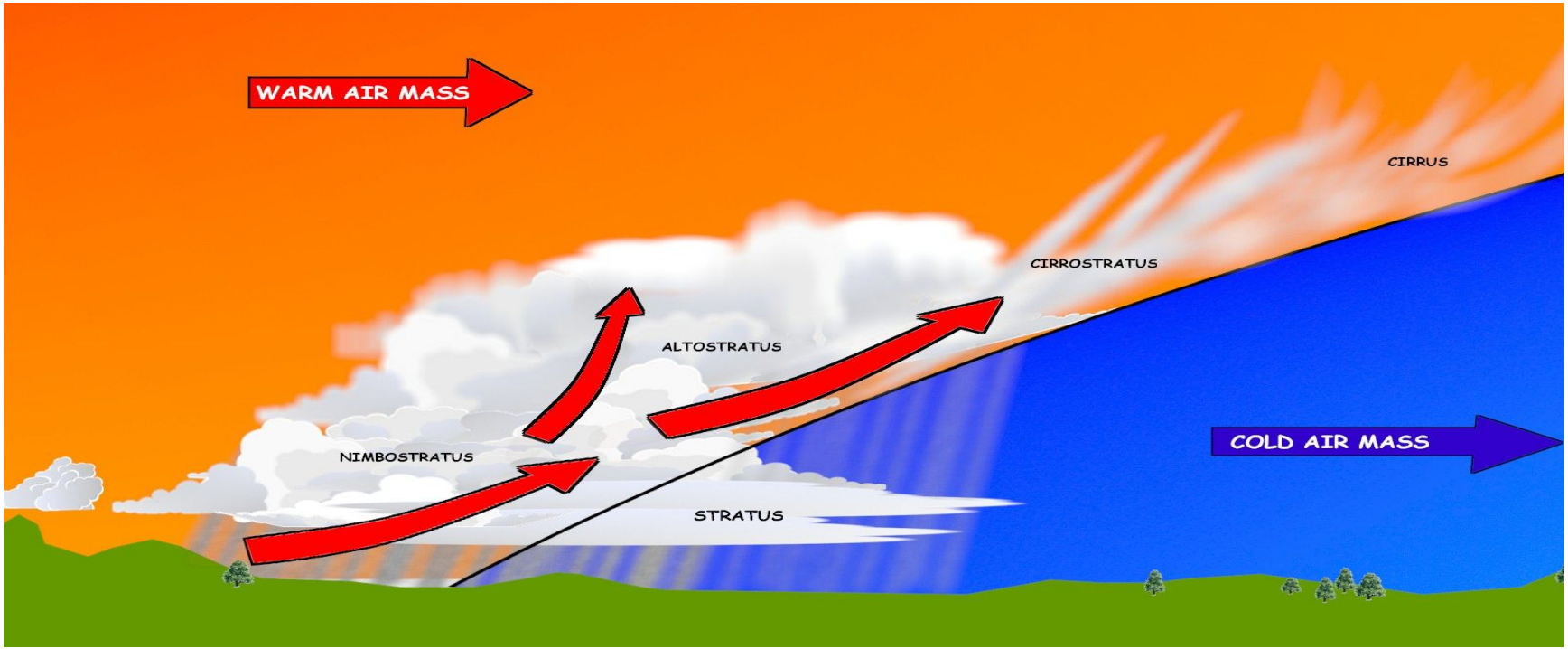
Fronts

- A boundary between two air masses of different density, moisture, or temperature.

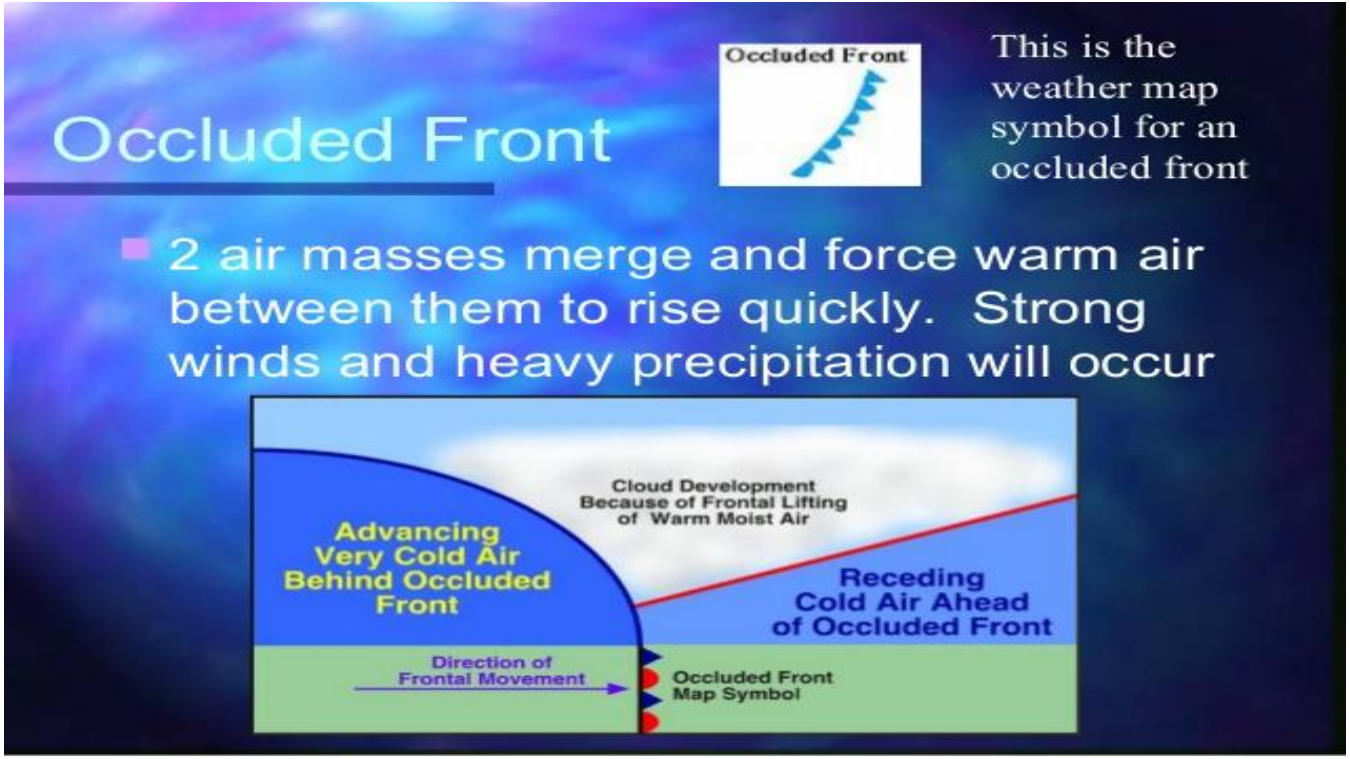
Cold Front


cirrostratus
CIRRUS
ANVIL
CUMULONIMBUS
COLD FRONT SURFACE
WARM AIR MASS
LD AIR MASS
CUMULUS

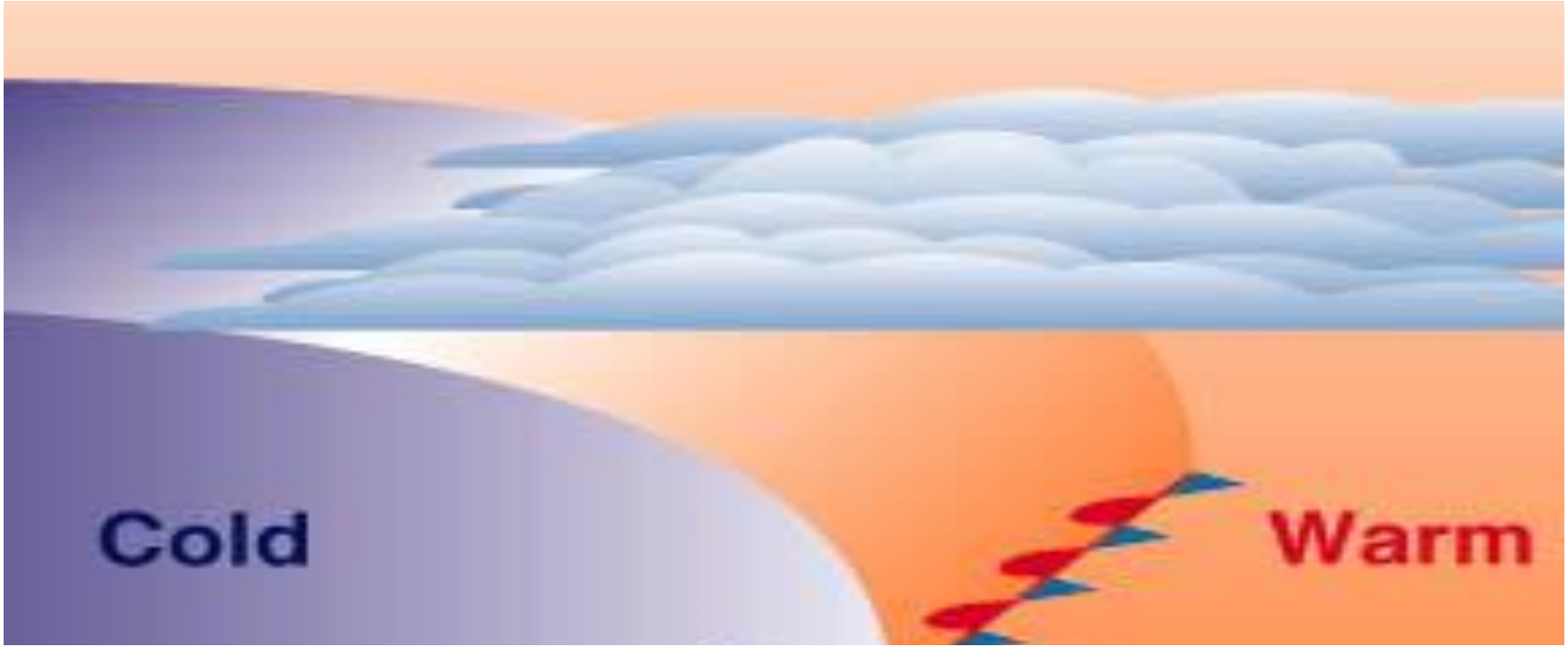
Warm Front


WARM AIR MASS
CIRRUS
CIRROSTRATUS
ALTOSTRATUS
NIMBOSTRATUS
COLD AIR MASS
STRATUS

Occluded Front



Stationary Front



What is a Front?

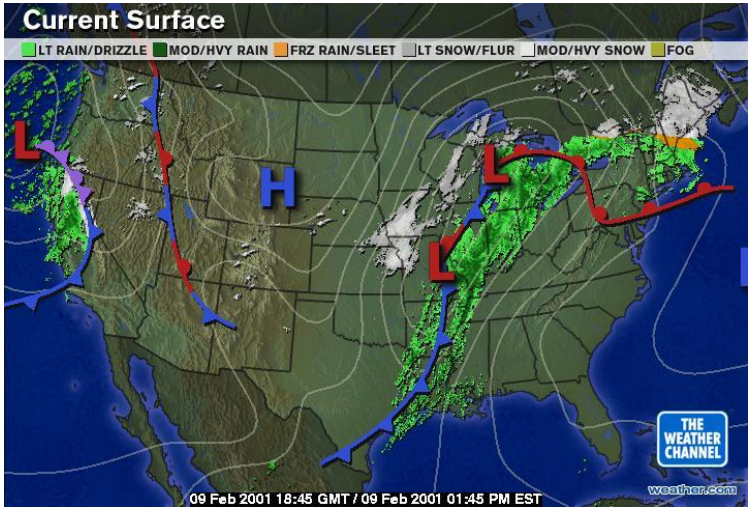
- Definition: A narrow transition zone, or boundary, between disparate synoptic scale air masses whose primary discontinuity is density. It is synoptic scale along the length of the front but mesoscale across the front itself.
- Commonly associated with ..
  - Moisture gradient
  - Temperature gradient
  - Wind shift
  - Pressure Trough

Rules for finding fronts

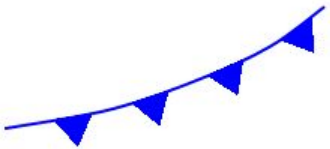
- Look for a strong temperature gradient. The front is located on the warm side of the sharpest gradient.
- Likewise, look for a strong dewpoint gradient. The front is located on the moist side of the sharpest gradient.
- Generally found in a pressure trough – look for three hour pressure changes. Fronts will show a decrease in pressure followed by a rapid increase in pressure after the frontal passage.
- Look for a sharp change in wind direction. A cyclonic shear in the wind direction usually indicates a frontal passage
- Check weather and cloud patterns that are usually associated with different kinds of fronts (more later on this.)

Types of Fronts

- Cold
  - Noted by cold air advancing and displacing warmer air that exists.
- Warm
  - Noted by cold air retreating from an area.
- Stationary
  - While differing air masses exist along a boundary, little movement is analyzed of the air masses.
- Occluded
  - A complicated process where the surface low becomes completely surrounded by cooler/cold air. Occlusion processes can be a “cool type” or “cold type” (more later.)



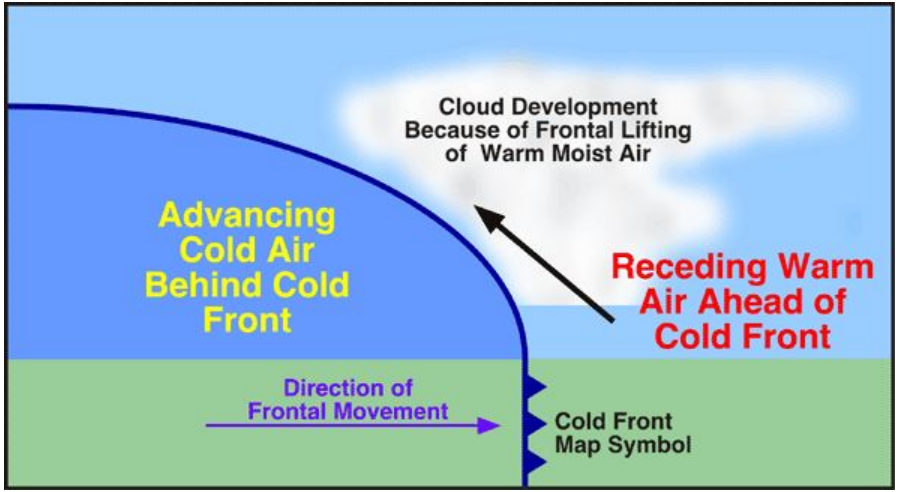
Cold Front



- Marked on a map with a blue line and blue triangles pointing towards the warm air.
- Slopes of 1/50 to 1/150
- Associated with cumulus & cumulonimbus clouds ahead of the front in the warm air, producing showers and thunderstorms.

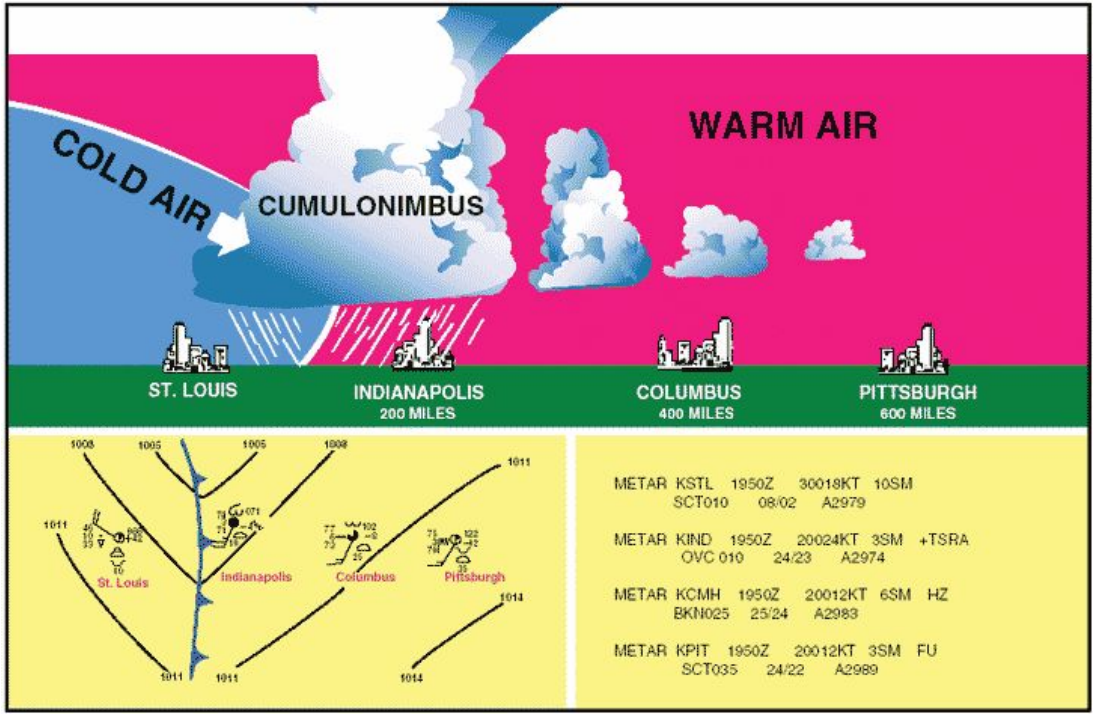
Cold Front

- Simple 3-D idea:



http://www.physicalgeography.net/fundamentals/7r.html

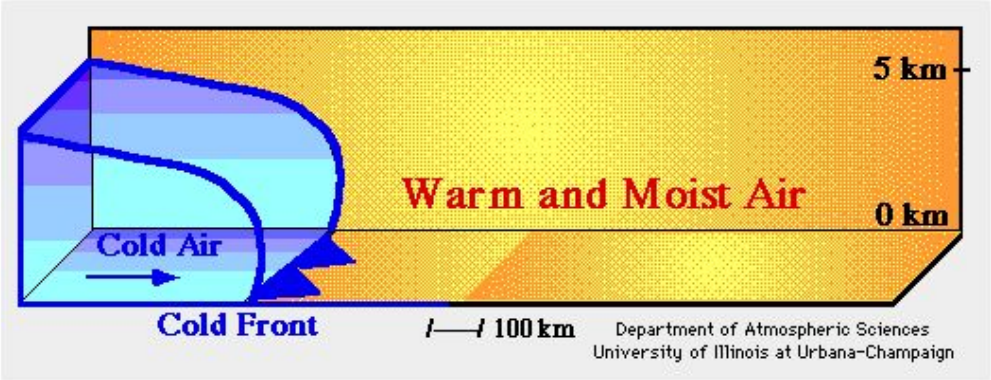
Cold Front



http://www.free-online-private-pilot-ground-school.com/images/cold-front.gif

Cold Front

- An animation:

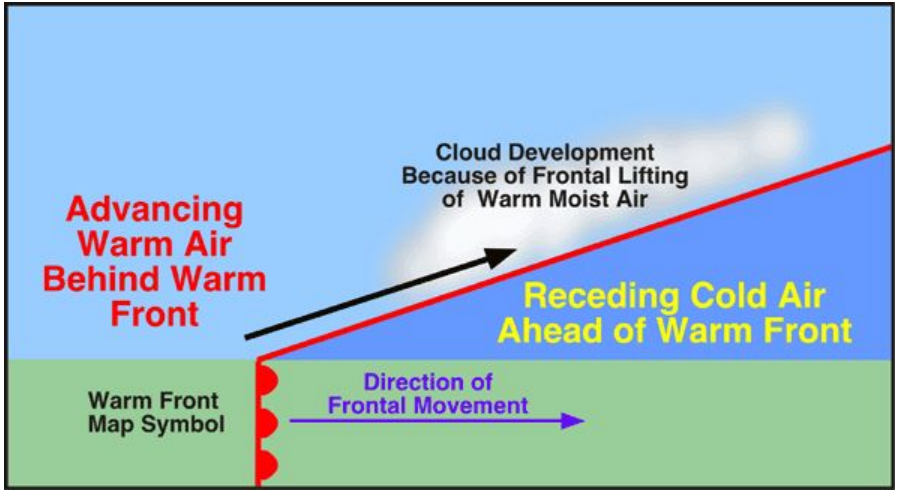


Warm Front

- Marked on a map by a red line with red semi-circles pointed towards the cool air (in the direction the warm air is retreating to.)
- Slope ranges from 1/100 to 1/300.
- Generally associated with stratus type clouds, overcast skies, fog, and general rain or snow.

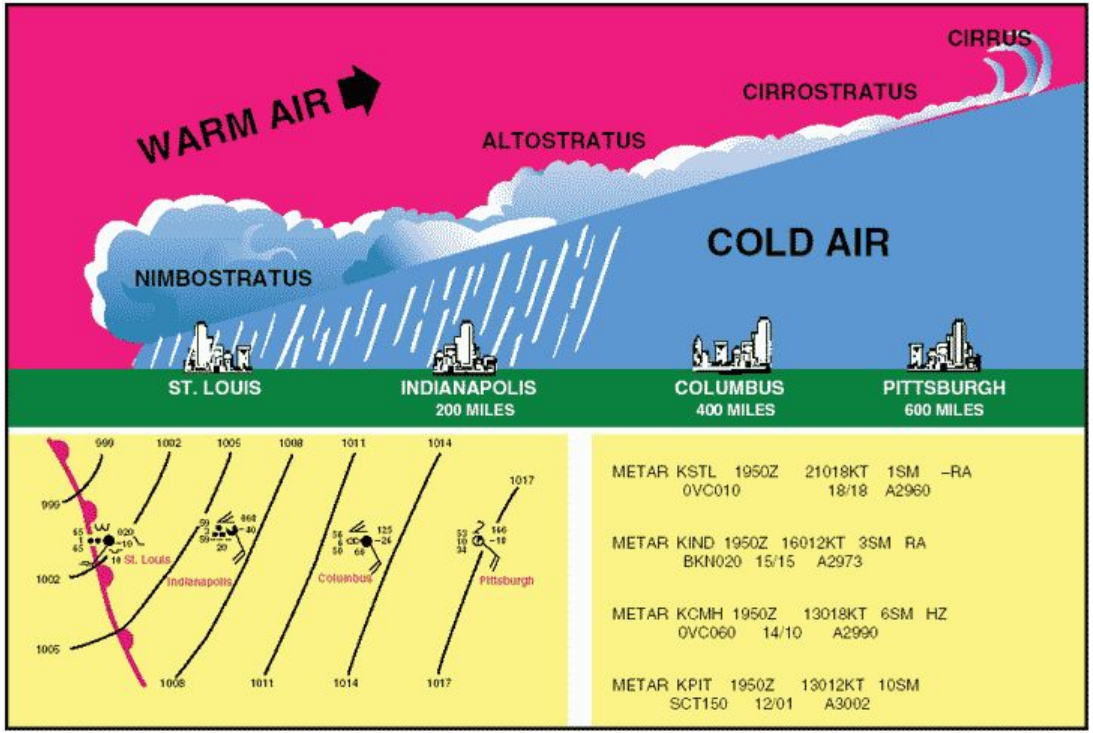
Warm Front

- Simple 3-D idea:



http://www.physicalgeography.net/fundamentals/7r.html

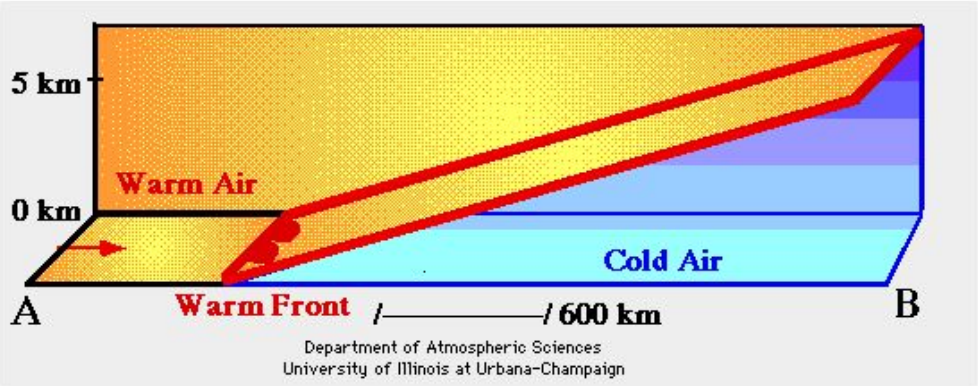
Warm Front



http://www.free-online-private-pilot-ground-school.com/images/warm-front.gif

Warm Front

- An animation:



Stationary Front

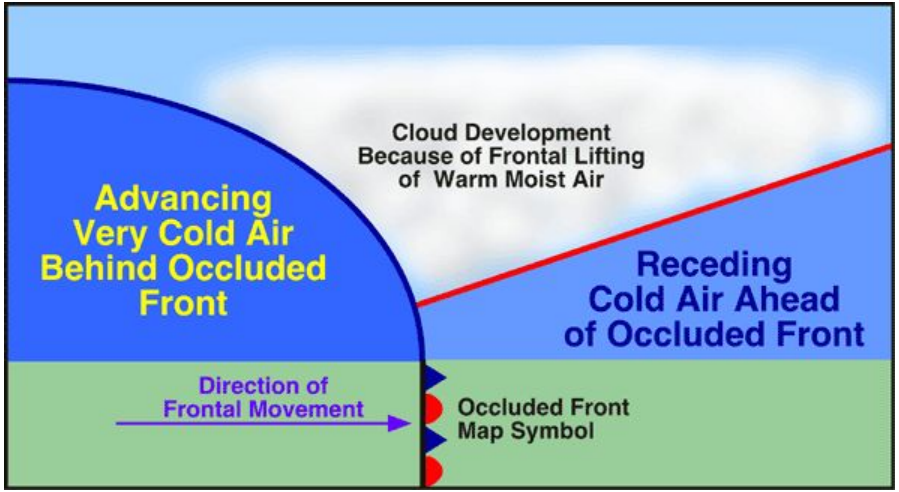
- Marked by alternating blue lines & blue triangles (pointed in the direction of the warmer air) and red lines & red semi-circles (pointed in the direction of the cooler air)
- Usually noted as *quasi*-stationary as it is rarely ever completely stationary. It tends to meander a bit

Occluded Front

- Marked by a purple line with alternating purple triangles and purple semi-circles, all pointing in the direction of the frontal movement.
- There are two general types of occlusions, cool-type and cold-type. Examples to follow.

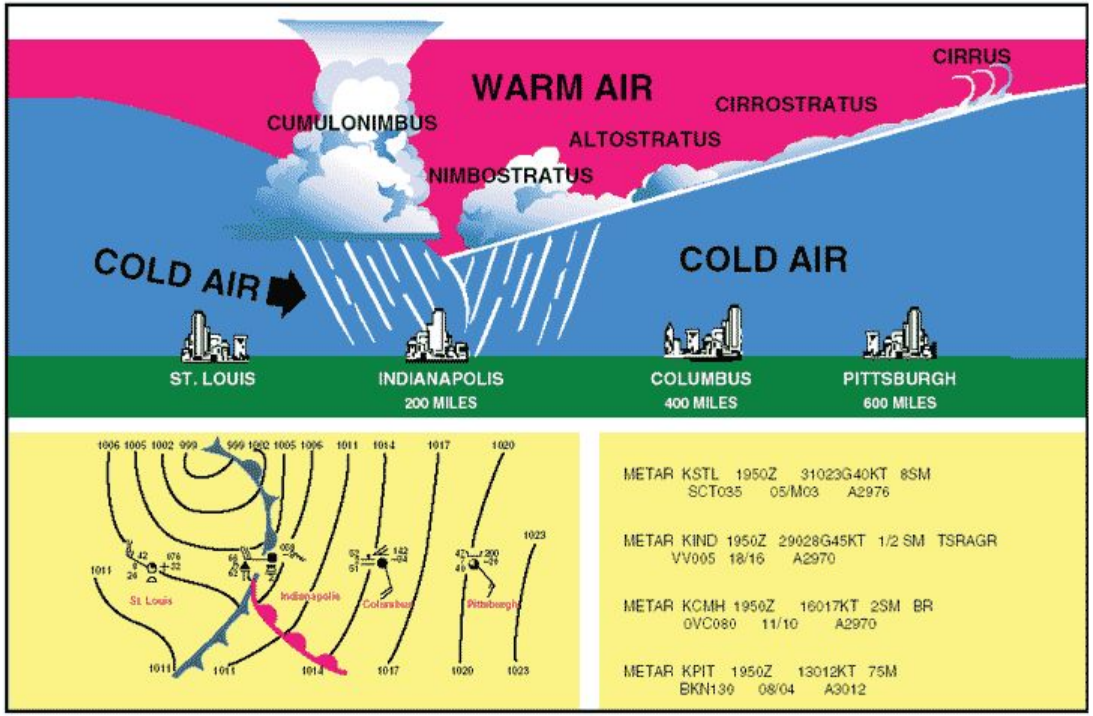
Occluded Front

- Simple 3-D idea:



http://www.physicalgeography.net/fundamentals/7r.html

Occluded Front



http://www.free-online-private-pilot-ground-school.com/images/occluded-front.gif

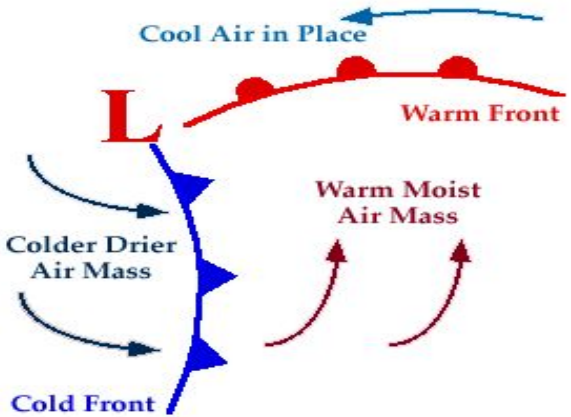
Cyclones: Putting it all together

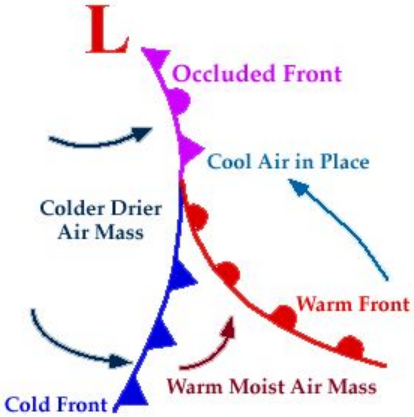
- There are two types of cyclones, tropical/warm core and extratropical/cold core.
- Extratropical cyclones are characterized by having differing air masses frontal movements where tropical cyclones do not.
- We will concern ourselves with extratropical cyclones in this presentation

Cyclones: Putting it all together

- Typically, cyclones are represented by using the Norwegian Cyclone model. It is simplistic, but a good way to start when understanding surface lows and cyclones.
- Students must begin to understand the four dimensional view of a cyclone
  - North-South
  - East-West
  - Up-Down

The cyclone


Cool Air in Place
L
Warm Front
Warm Moist
Air Mass
Colder Drier
Air Mass
Cold Front


L
Occluded Front
Cool Air in Place
Colder Drier
Air Mass
Warm Front
Warm Moist Air Mass
Cold Front

Severe Weather

Thunderstorms

Lightning

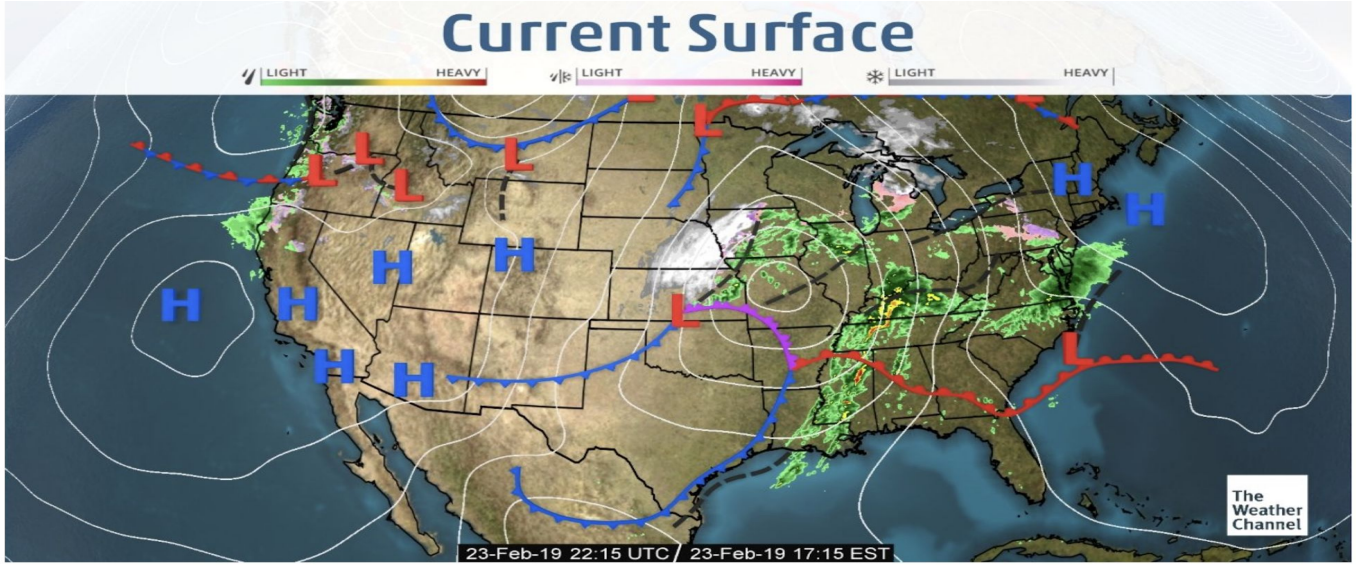
Tornadoes

More Severe Weather

Hurricanes

Blizzards

February 23, 2019



Notice the low pressure system (L) to the west of Nashville (in Kansas). Notice the warm front and to the south the cold front (south and west of that)

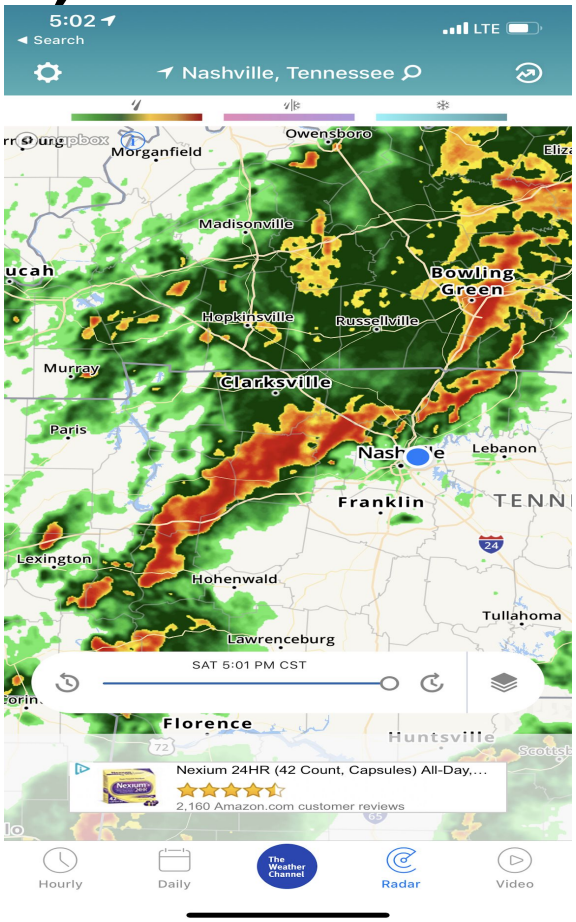
February 23, 2019

US Midday Surface Map

February 23, 2019

February 23, 2019

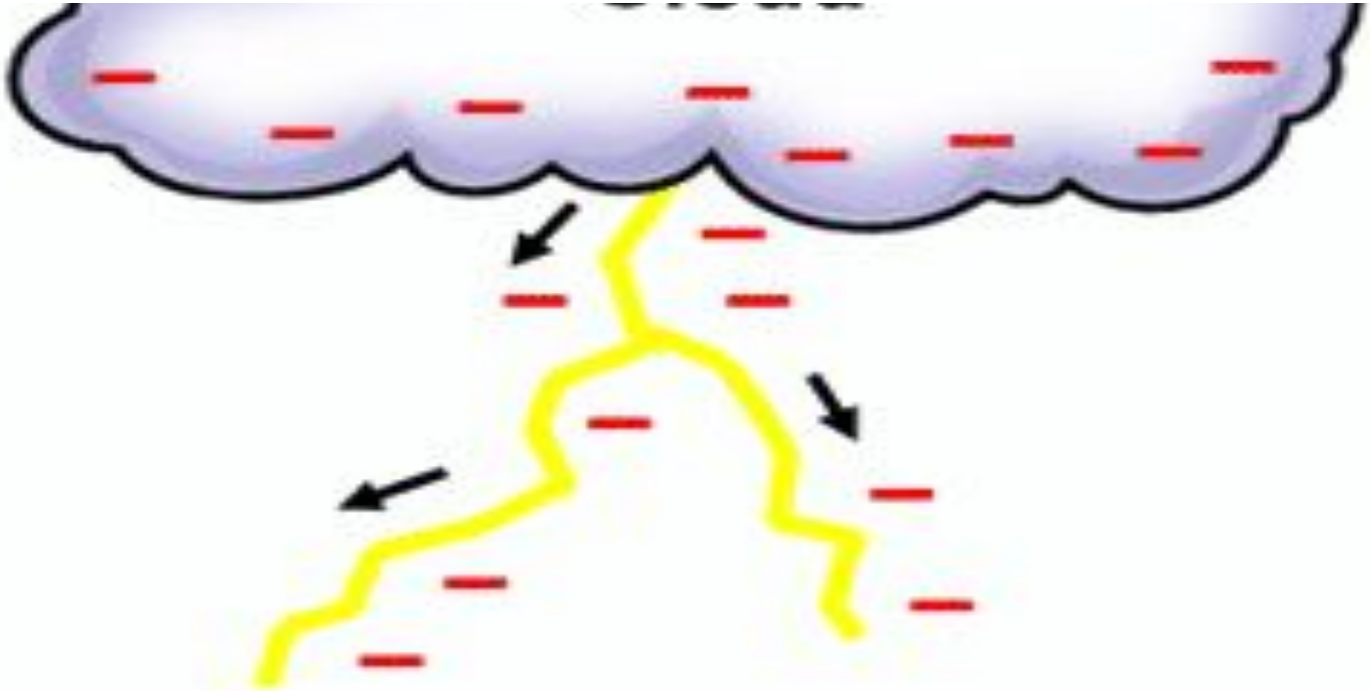
Notice the line of storms ahead of the cold front on Saturday about 5PM



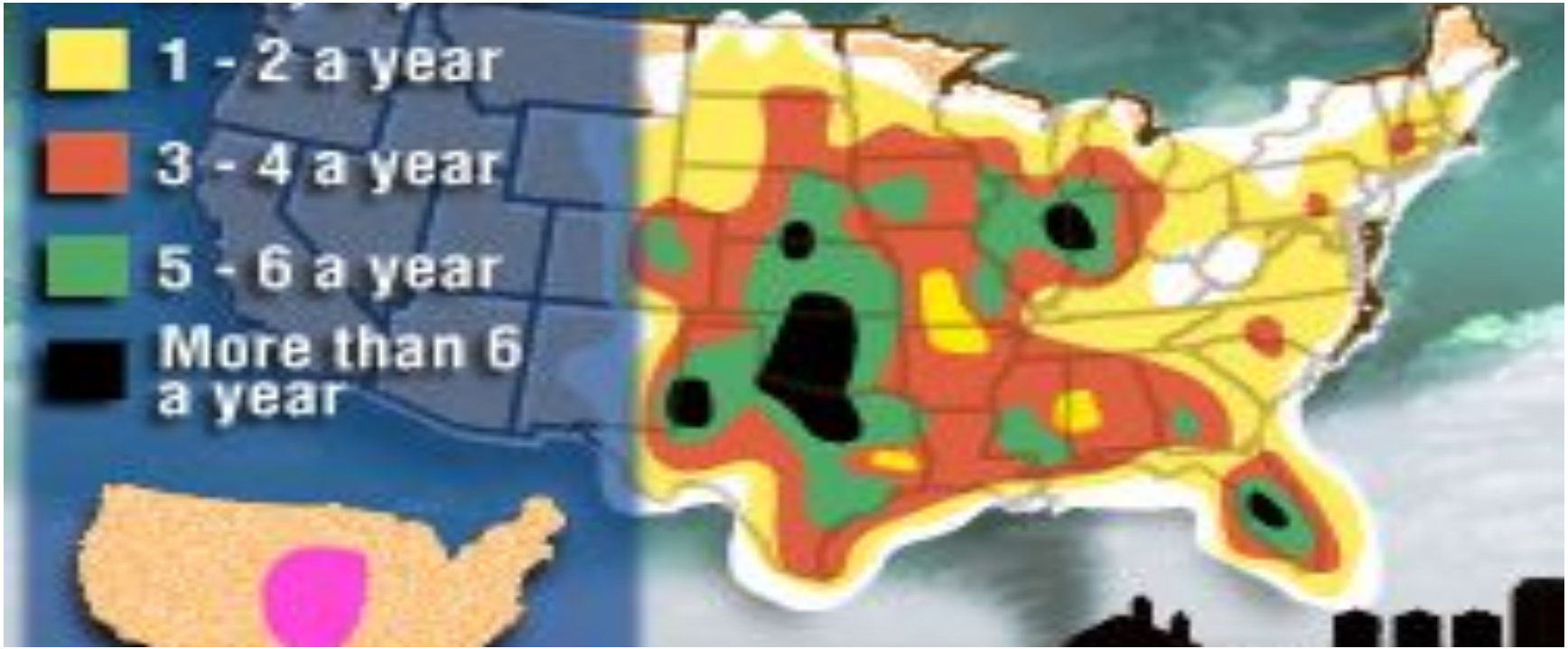
Severe Weather Safety

- Watches- conditions are favorable
- Warnings- conditions already exist
- Examples- Tornadoes, Flooding, Thunderstorms, Blizzards, Winter Mixes and Hurricanes

Lightning



Tornado Alley



Fujiti Scale

SCALE	CATEGORY	FORCE	DAMAGE
F0	WEAK	0-72MPH	LIGHT
F1	WEAK	73-112	MODERATE
F2	STRONG	113-157	CONSIDERABLE
F3	STRONG	158-206	SEVERE
F4	VIOLENT	207-260	DEVASTATING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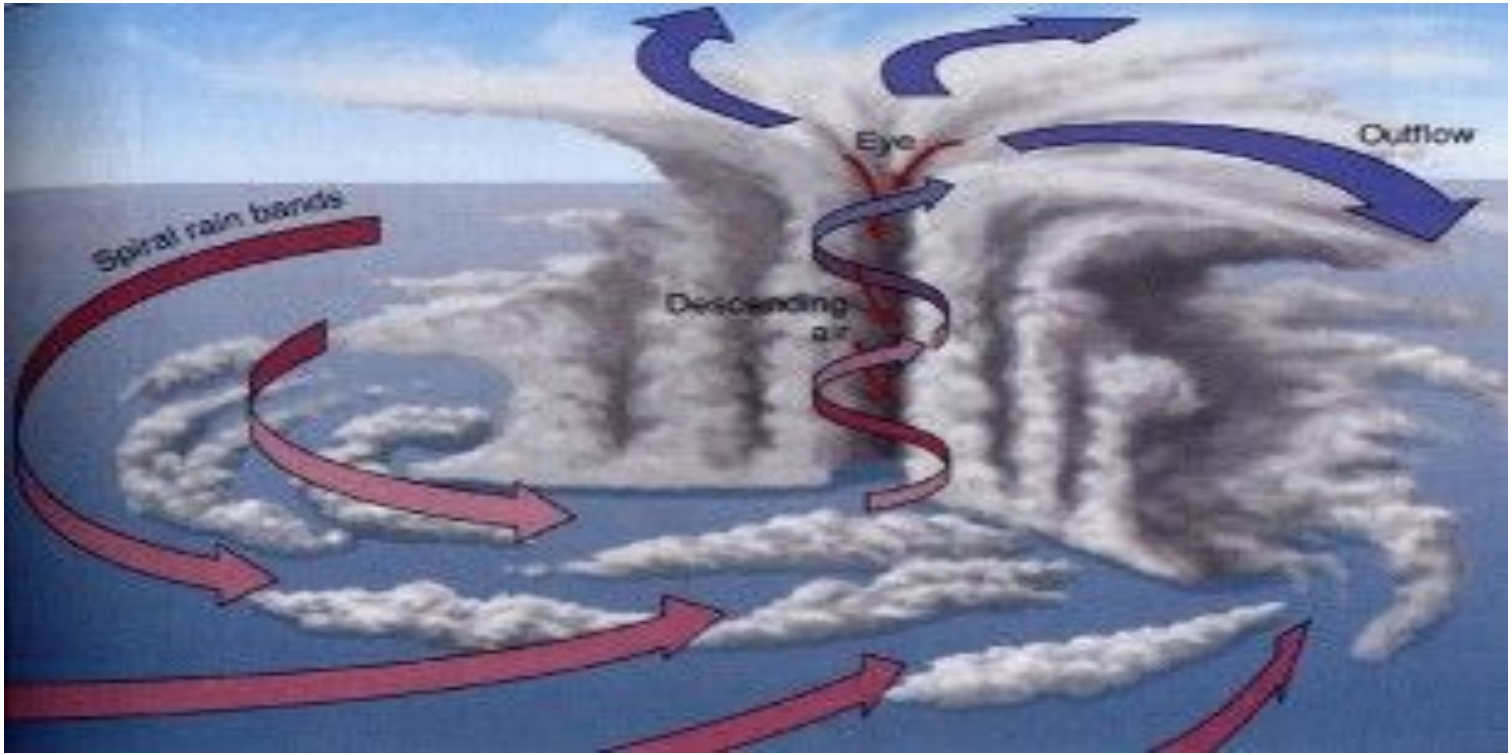
StormStock
Reel #9/95

Weather Map

Hurricane



Hurricane Scale

JUNE 1st - NOVEMBER 30th (ATLANTIC/GULF)

	Winds	Storm Surge	Barometric Pressure
CATEGORY 5	Over 155 mph.	Over 18 ft.	27.17" or less
CATEGORY 4	131 to 155 mph.	13 ft. to 18 ft.	27.17 to 27.90"
CATEGORY 3	111 to 130 mph.	9 ft. to 12 ft.	27.91 to 28.49"
CATEGORY 2	96 to 110 mph.	6 ft. to 8 ft.	28.50 to 28.93"
CATEGORY 1	75 to 95 mph.	4 ft. to 5 ft.	28.94" or more

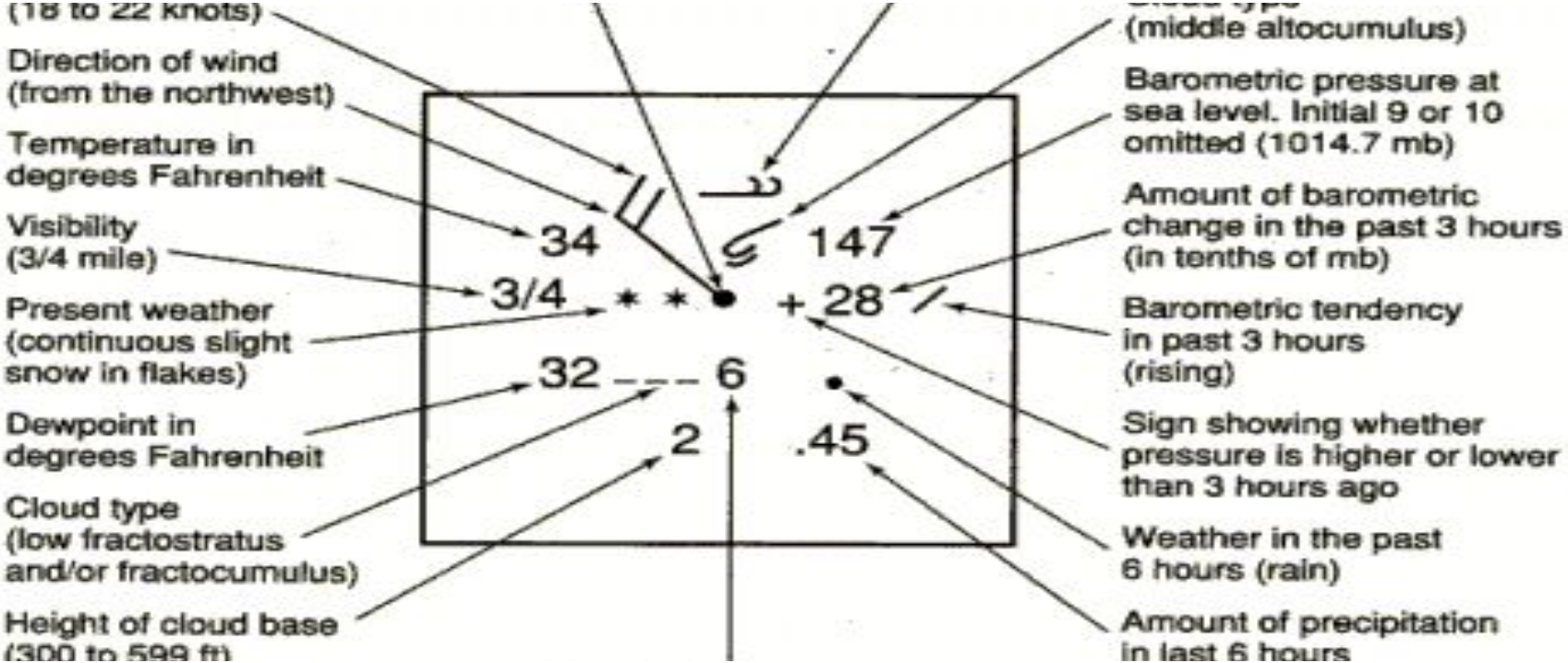
TROPICAL STORM: Sustained winds: 39 to 73 mph.
(Follow your local emergency instructions)

Hurricane Charley

NWS

- Two sources of forecasting weather
  - Data collected from upper atmosphere
  - Data collected on the Earth's surface

Weather Station Model



Isobars

- Isobars-connect points of the “same”
- Examples: temperature and wind speed
- The further away the lines the lower the wind speed