Unit Four: Weather Systems

SCIENCE 1206

- **Topic 1:**

  Weather

  versus

  Climate

Global climate and local weather patterns are affected by many factors and have many consequences.

Consider the following questions:

- What decisions do we face because of weather conditions?
- How are our lives affected by changing weather conditions (short-term) and changing climate (long-term)?
- What causes these weather patterns?

Observing the weather

In Atlantic Canada, weather patterns change frequently.

- Each season provides interesting weather conditions that influence:
  - how we dress,
  - how we feel physically and psychologically, and
  - how we interact socially.
  - Writing of Songs/ poems
  - Vacations (Planes, boats
  - School and business openings

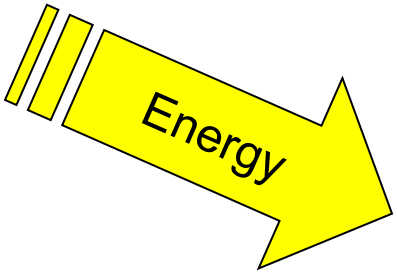
Weather Dynamics

- ***Weather dynamics*** *is the study of how the motion of water and air causes weather patterns.*

The main components of Earth that affects weather are the atmosphere, the land forms, and water in the forms (solid, liquid, and vapor).

What causes weather?

- Energy transfer from the sun to the earth.



The sun is our primary source of energy and this energy is transferred to air, land and water.

The sun is the ultimate cause of changing weather systems

WHAT FACTORS AFFECT OUR WEATHER PATTERNS?

Global

-Global Warming
– Ocean Currents
– Air Masses
– Seasons/Angle of Sunlight
– Earth's rotation
– Latitude
– Longitude
– Air Pressure

Local

– Elevation/Topography
– Proximity to Water
– Distance Inland
– Vegetation
– Cloud Cover

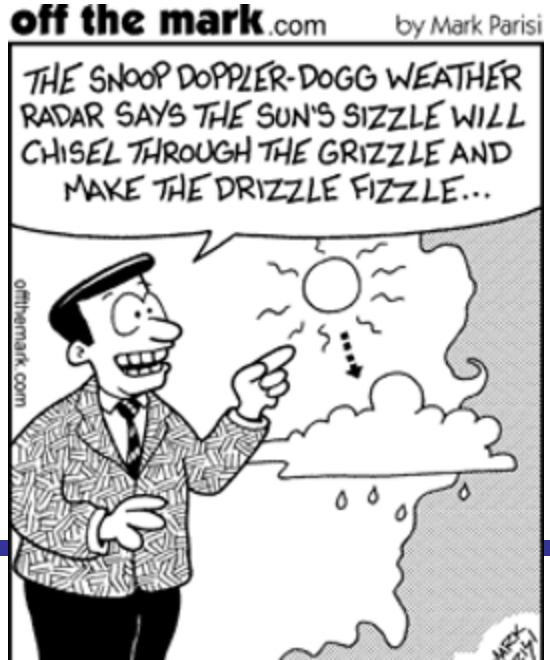
Weather vs. Climate

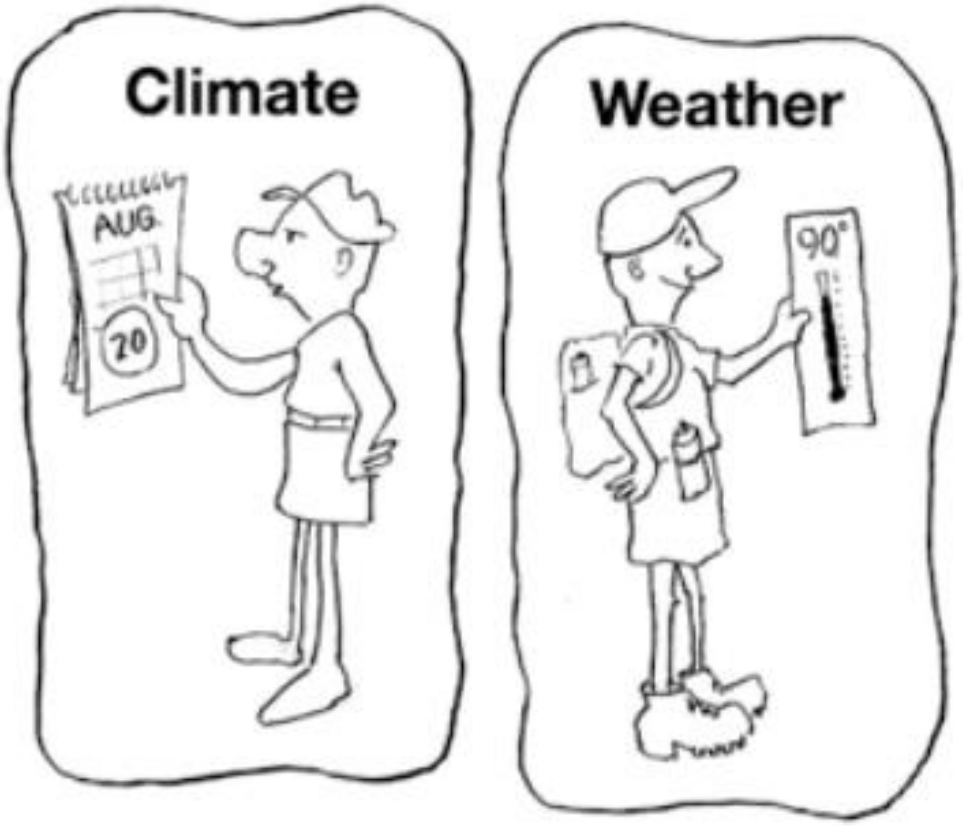
Weather - *The short-range forecast; daily conditions.*

Ex: temperature, precipitation, wind, humidity, UV

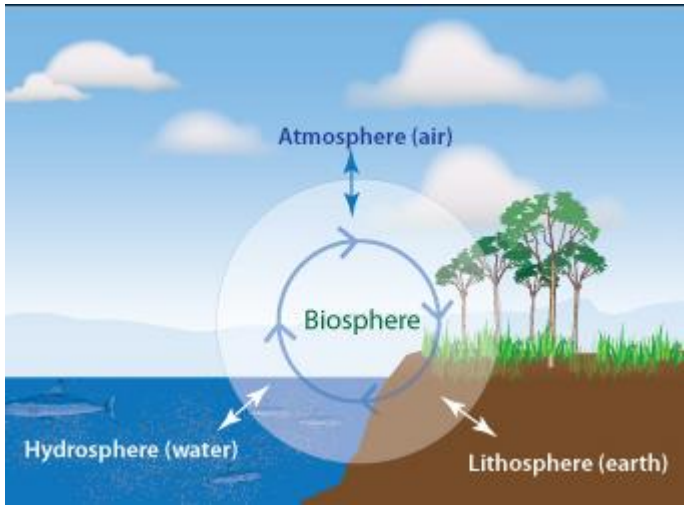
Climate - *Long-term seasonal trends averaged from annual data*

Ex: In the Atlantic Canada Climate region, winters are cold and summers are Warm




Climate
AUG
20
It'll probably hit 90. I'd better take lots of water.
Weather
90°
It's 90 !!! I'm glad I brought lots of water.

GLOBAL WEATHER PATTERNS



3 MAIN PARTS OF THE EARTH influence GLOBAL WEATHER:

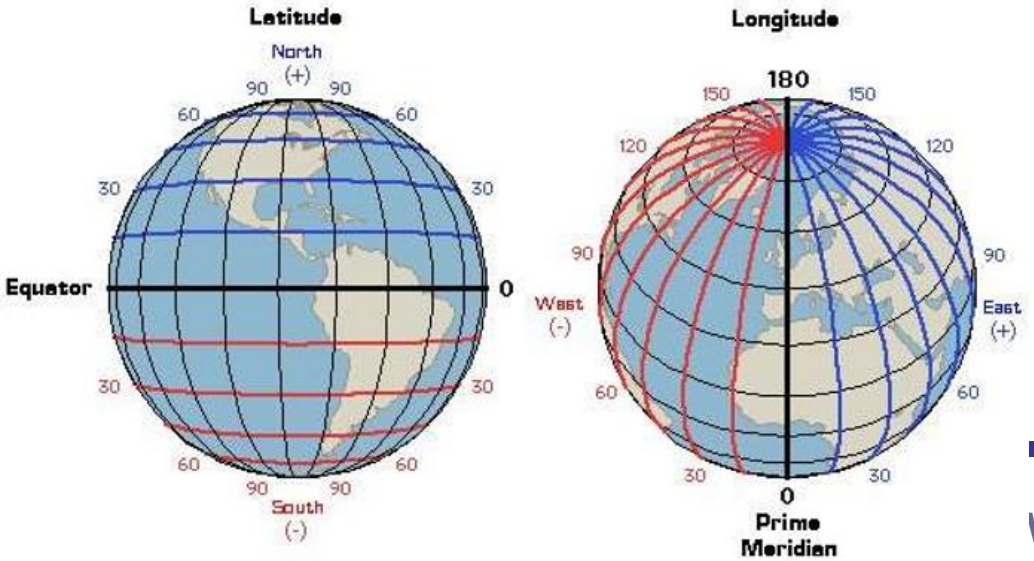
– **ATMOSPHERE** :AIR
– **HYDROSPHERE** : WATER
– **LITHOSPHERE/GEOSPHERE** : LAND

SOME GLOBAL WEATHER TERMINOLOGY

Geography – The study of oceans, continents, countries, ocean currents, and air currents.

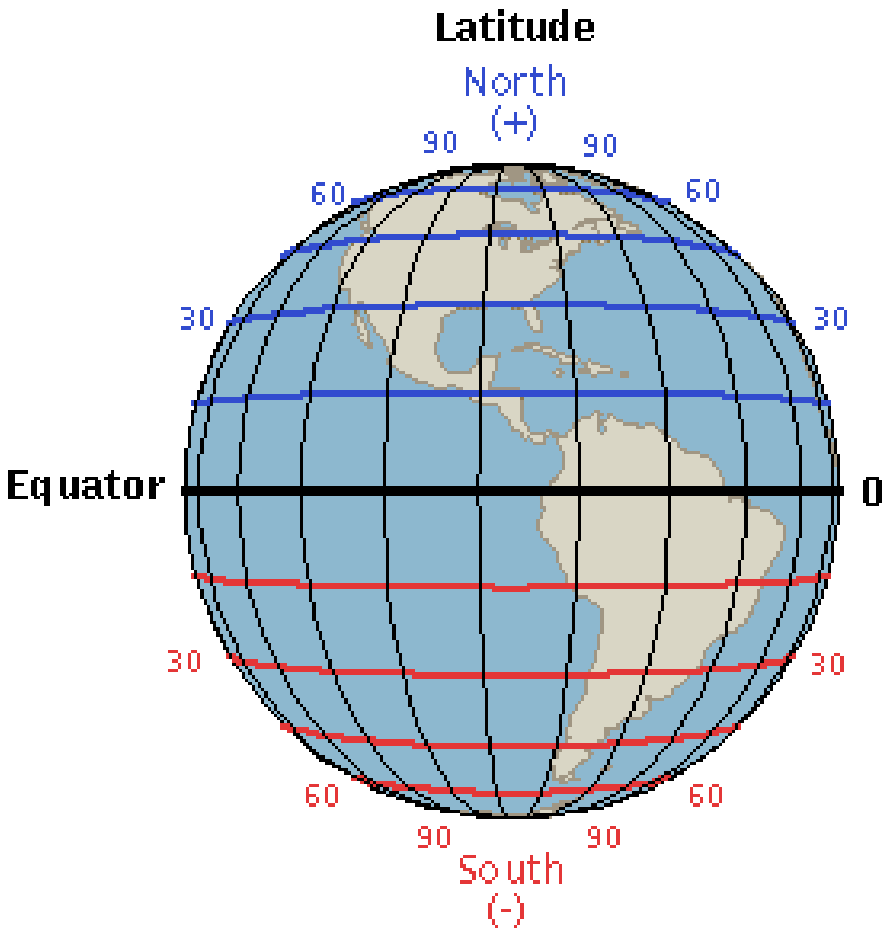
Longitude: Vertical lines on maps/globes that show our position EAST or WEST of the PRIME MERIDIAN line

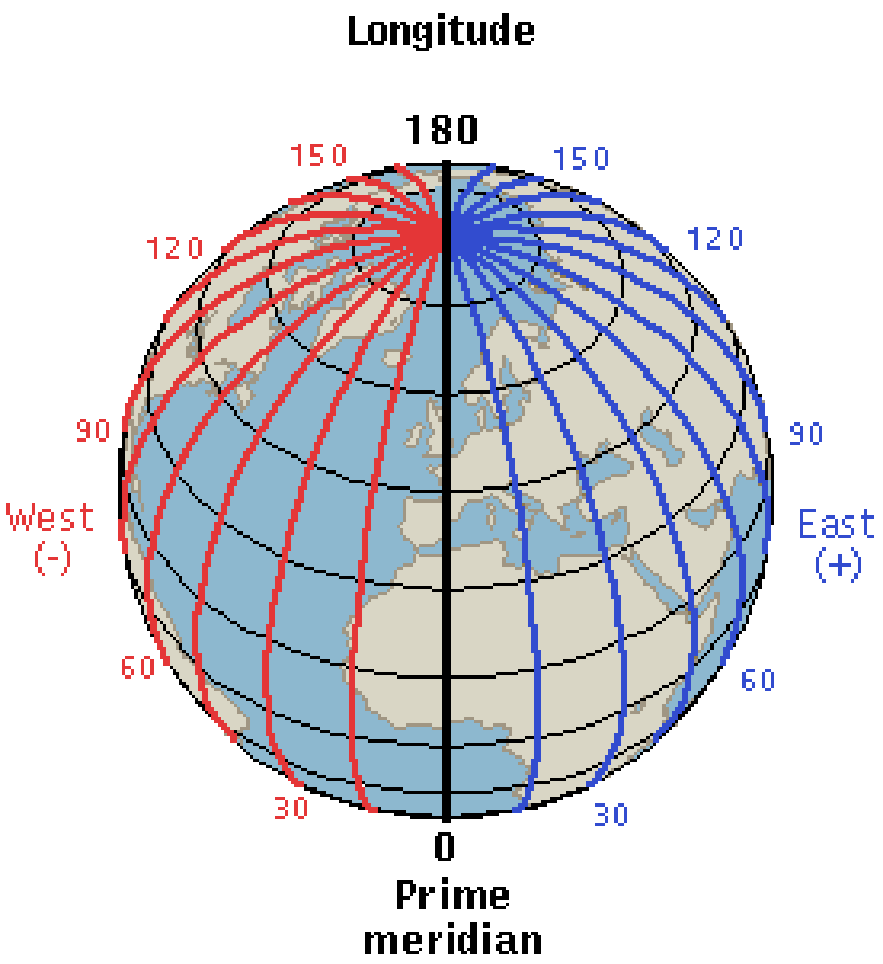
Latitude - *the angle measured south or north of the equator*.



Global Geography

- **Longitude** - *the angle measured east or west from the 0° line, which passes through Greenwich, England.*
- **Latitude** - *the angle measured south or north of the equator*.
- **Equatorial Region** - *region located between the Tropic of Cancer and the Tropic of Capricorn.*
- **Polar Regions** - *Region north of the Arctic Circle and the region south of the Antarctic Circle.*
- **Mid-latitude Regions** - *Regions between the tropics and the polar regions.*


Latitude
North
(+)
90
90
60
60
30
30
Equator
0
30
30
60
60
90
90
South
(-)


Longitude
180
150
150
120
120
90
90
West
(-)
East
(+)
60
60
30
30
0
Prime
meridian

Some Special Latitude Lines

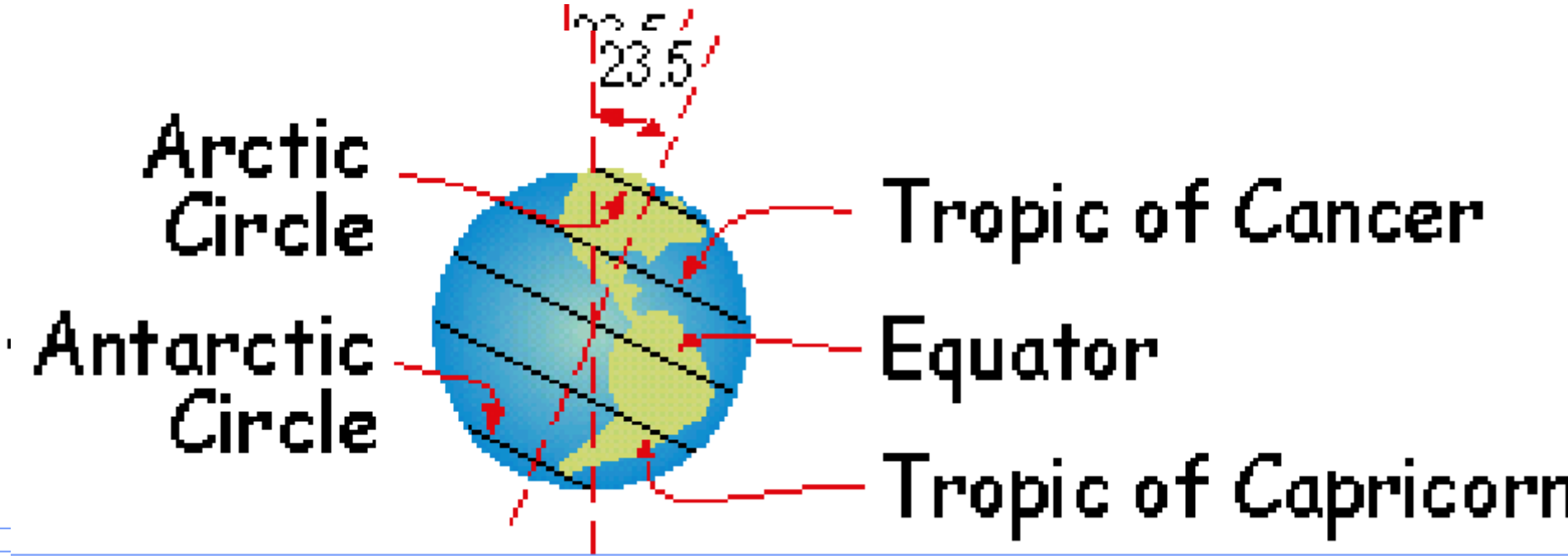
ARCTIC CIRCLE: – 66.5^{o}N, most Northern latitude to receive sun's rays on December 21st

ANTARCTIC CIRCLE: – 66.5^{o}S, most Southern latitude to receive sun's rays on December 21st

TROPIC OF CANCER: – 23.5^{o}N, most Northern latitude to receive sun's vertical rays on June 21st

TROPIC OF CAPRICORN: – 23.5^{o}S, most Northern latitude to receive sun's vertical rays on June 21st

Be able to label these



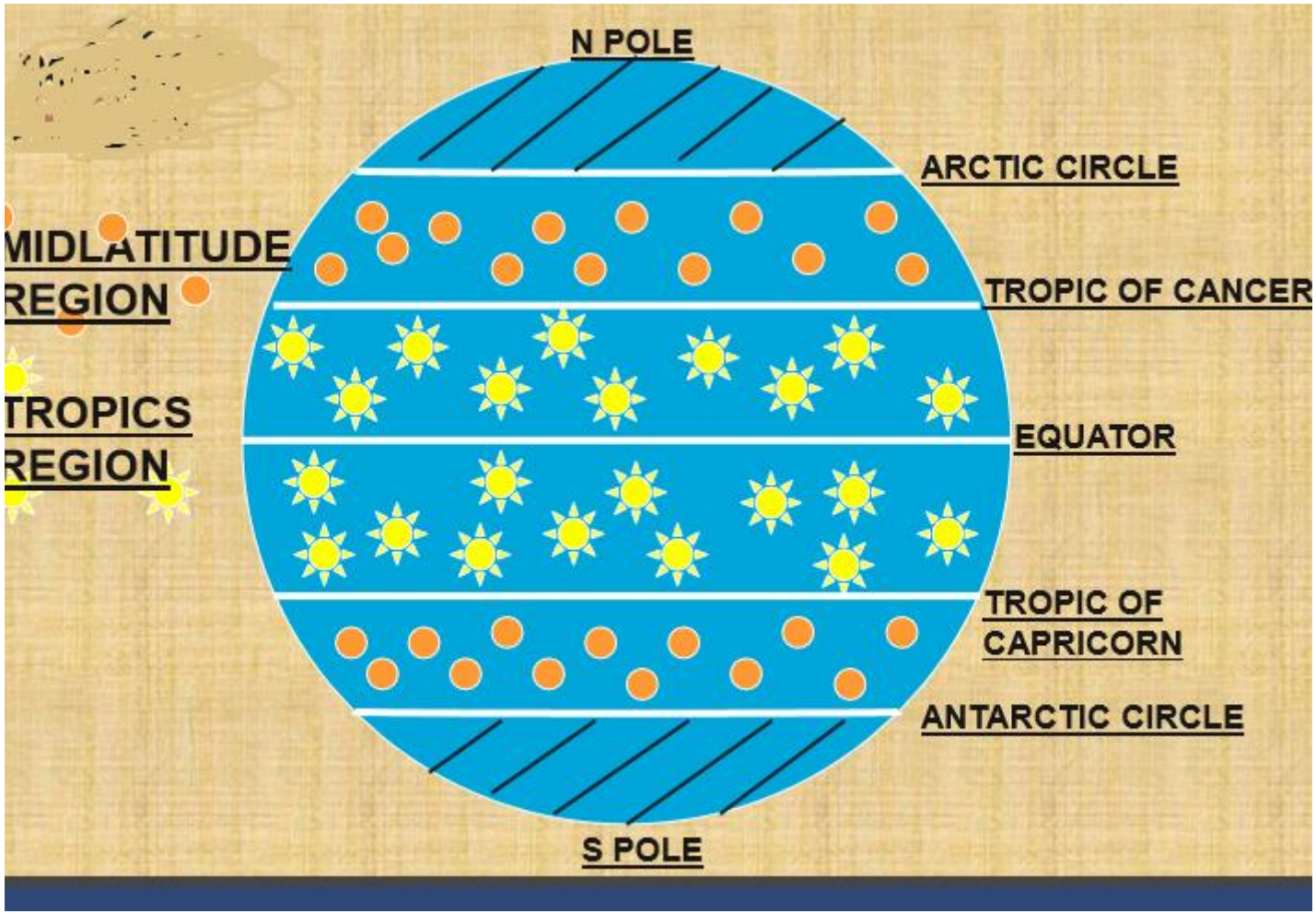
GLOBAL REGIONS

POLAR REGION – Area between the Arctic Circle Line and North Pole, and Antarctic Circle Line and South Pole

MIDLATITUDE REGION – Area between the Circle Lines and the Tropics Lines

TROPICAL REGION – Area between the two Tropics Lines

LATITUDE LINES AND GLOBAL REGIONS



Science 1206 - Movie

- Weather systems

Worksheet 1:

- CLIMATE AND VERSUS WEATHER

Web sites to know and love!

- Environment Canada
  - http://weatheroffice.ec.gc.ca/canada_e.html
  - USA Today site – Weather basics

    http://www.usatoday.com/weather/resources/basics/wworks0.htm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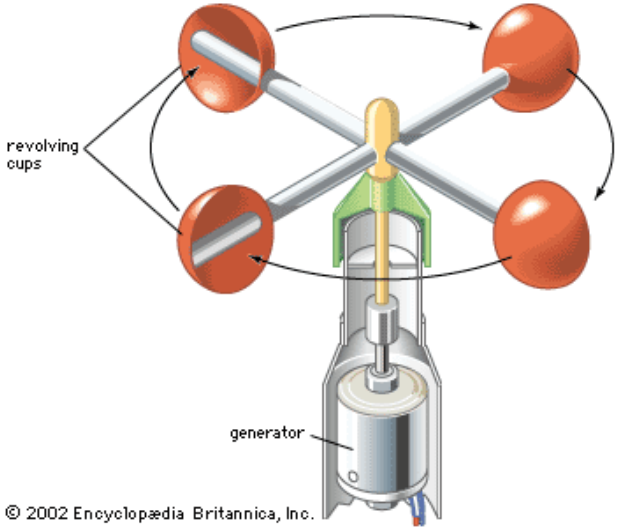
SCIENCE 1206

- **Topic 2:**

Measuring change - Weather Instruments

Measuring Wind Speed

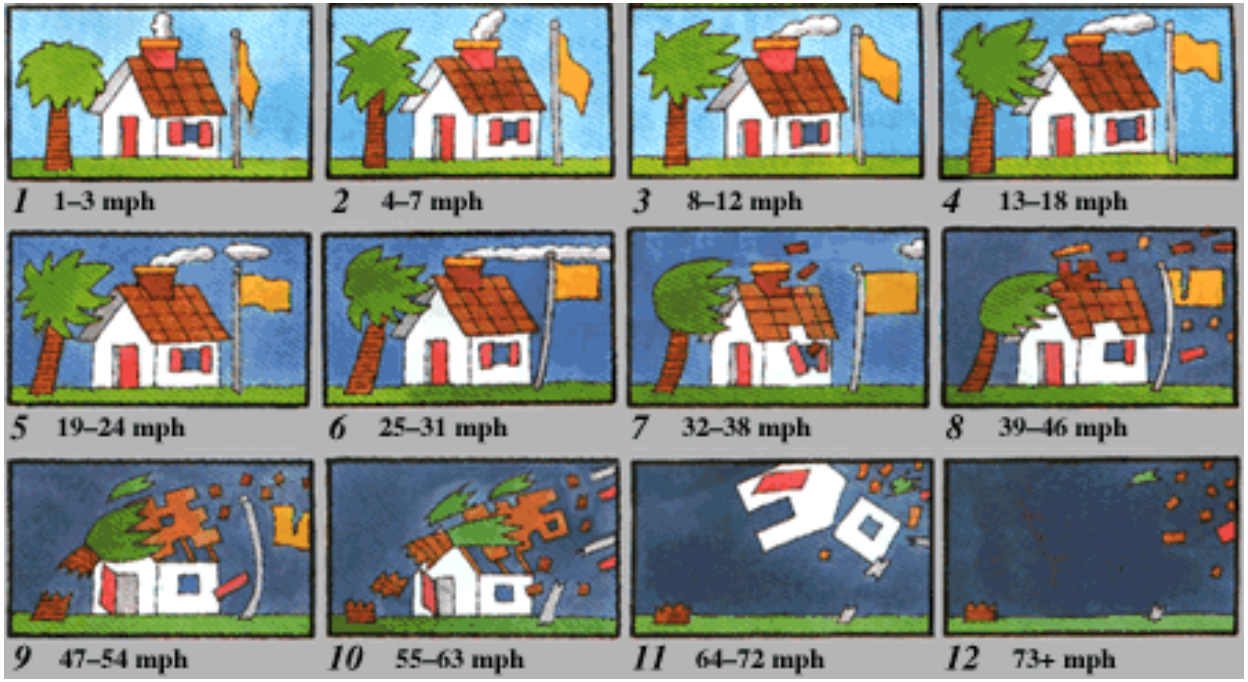
- **1) Anemometer (a-nə-mä-mə-tər)** is the device use to measue wind speed.



This device spins around at different rates depending on the speed of the wind.

The anemometer is then calibrated to convert the number of revolutions per minute into wind speed which is measured in kilometers per hour (km/h).

- The **Beaufort Wind Scale** may also be used as a measure of wind speed. This scale is based on the characteristics of smoke exiting from the top of a chimney. You may also make use of the smoke coming from the top of a chimney to determine wind direction.



Measuring Wind Direction

2) Wind sock or wind vane is used to measure wind direction

- Measured using north, south east and west

Measuring Temperature

- **3) Thermometer** to measure temperature.

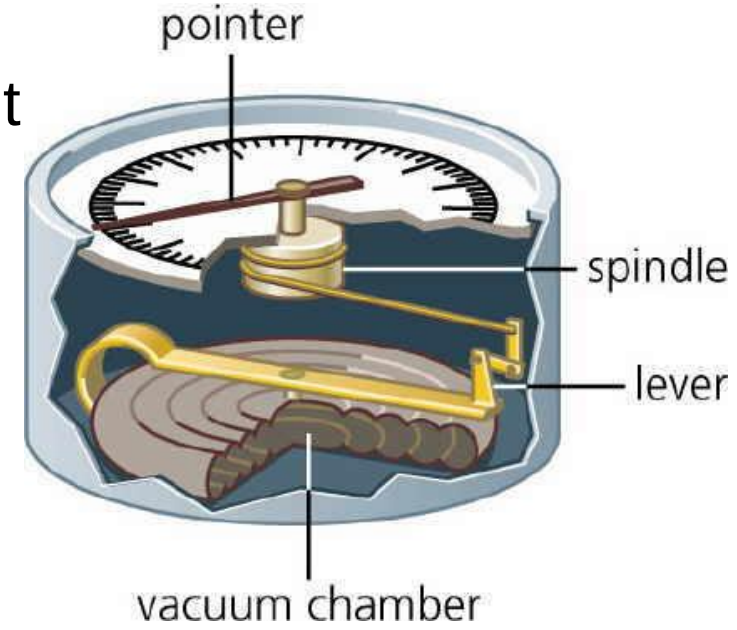
Temperature is defined as the measure of the average kinetic energy of a sample of matter. The higher their kinetic energy, that is the faster they move, the higher their temperature.

Measured in Degrees Celsius or degrees Fahrenheit

Measuring Atmospheric Pressure

- **4. Aneroid Barometer** is used to measure atmospheric pressure.

Atmospheric pressure is the amount of air pushing down on you over a given area



Unit of measure is Kilopascal (kPa), Millibars (mb) and inches of Mercury

Measuring Humidity

- **5) Hygrometer measures** relative humidity

- **Humidity** is a measure of the amount of moisture (water vapour) in the air.

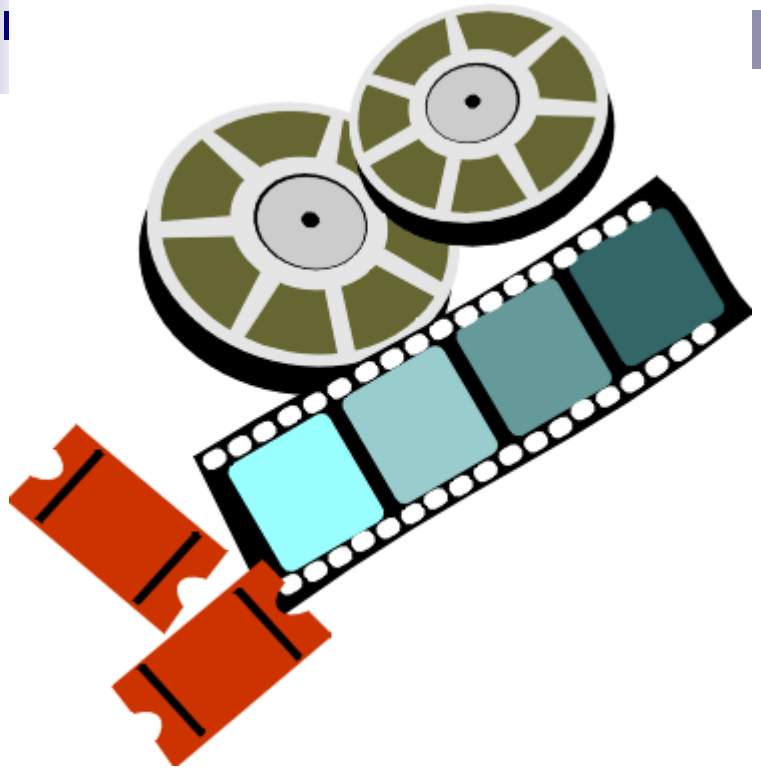
Unit of measure is from 0% to 100 %

Measuring Precipitation:

6) **Rain gauge** The instrument used to measure precipitation

- **Precipitation** means the amount of moisture that falls to earth from the sky. Precipitation may be either in liquid or solid form (rain, snow, etc.).

Measured in centimeters (cm) or millimeters



Weather Instruments

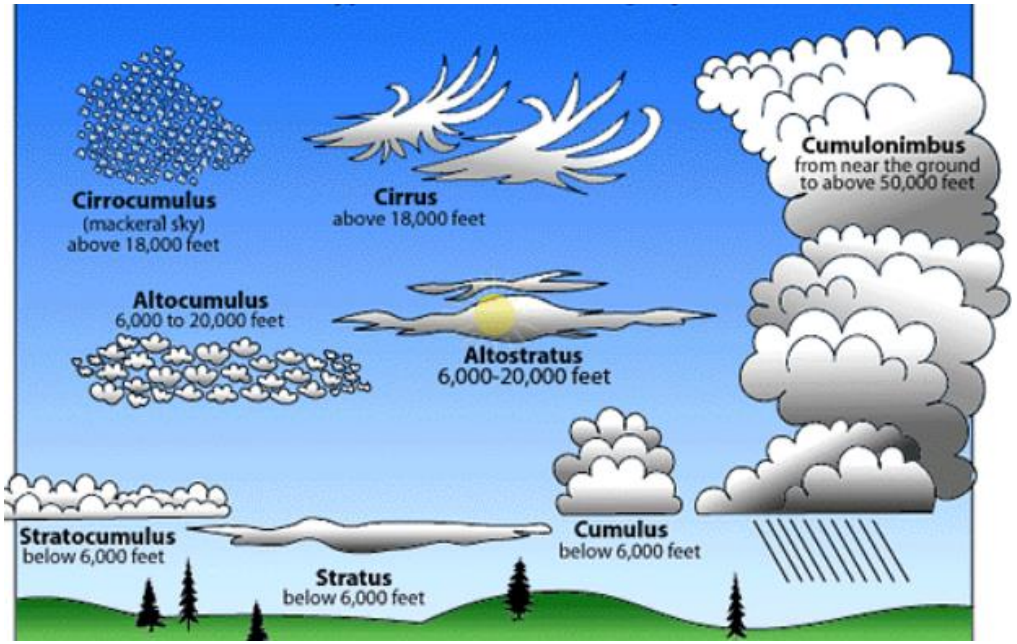
Worksheet 2:

- Weather Instruments

SCIENCE 1206

- **Topic 2:**

  Cloud Formation and Classification



Clouds

Clouds are a collection of water droplets or ice particles that has become dense enough to be visible.

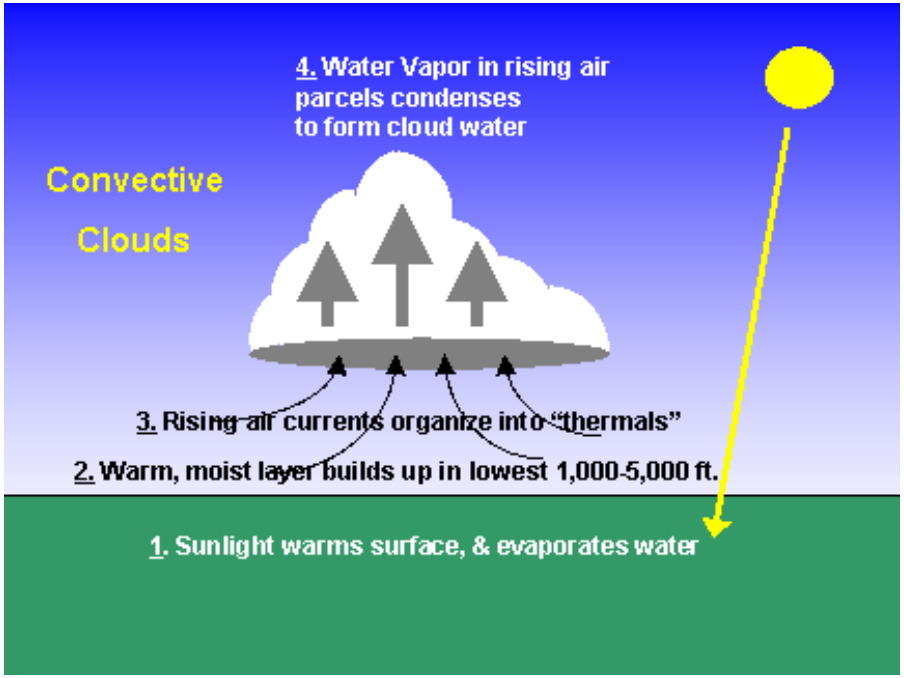
Water evaporates and cools as it rises, and condenses into clouds.

They are important indicators of weather patterns

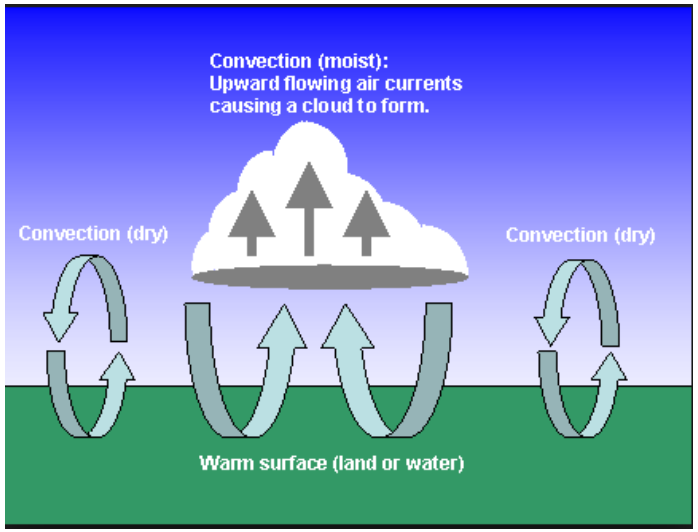
Clouds can be grouped according to how they form, how they are shaped, whether or not they will lead to precipitation, and how high they are.

Three categories of Clouds formation

- **1. Convective Clouds -** formed when air near the ground absorbs energy from heated surfaces and rises in the atmosphere. The water vapor cools, condenses, forming clouds.



CONVECTION CLOUDS

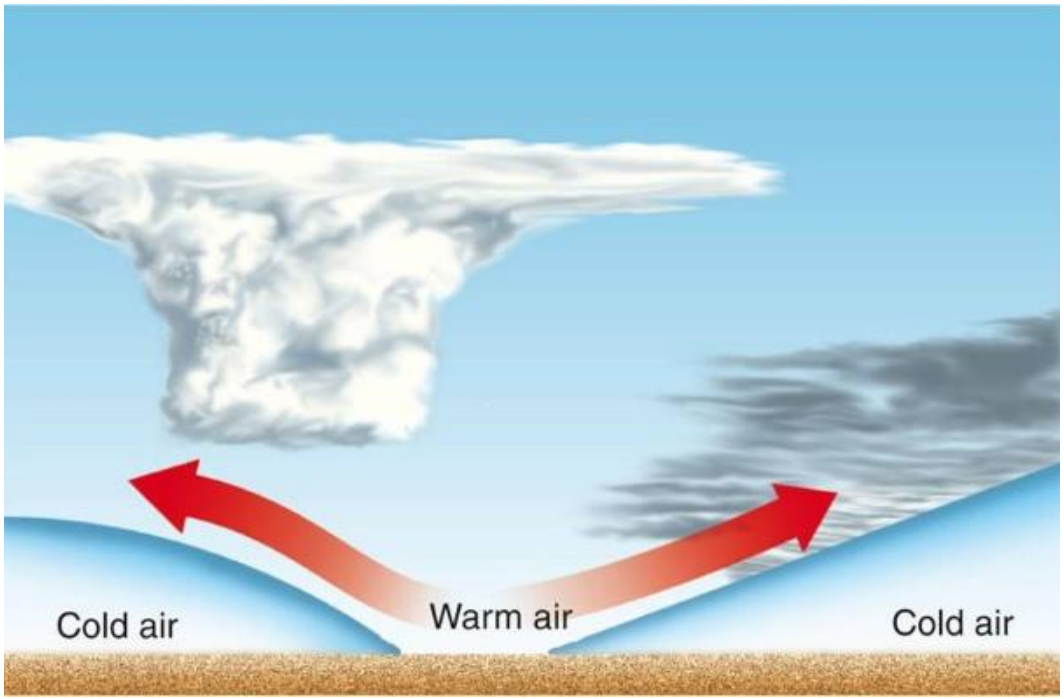


Convection clouds form when warm air near heated surfaces such as the Earth gain energy from these sources

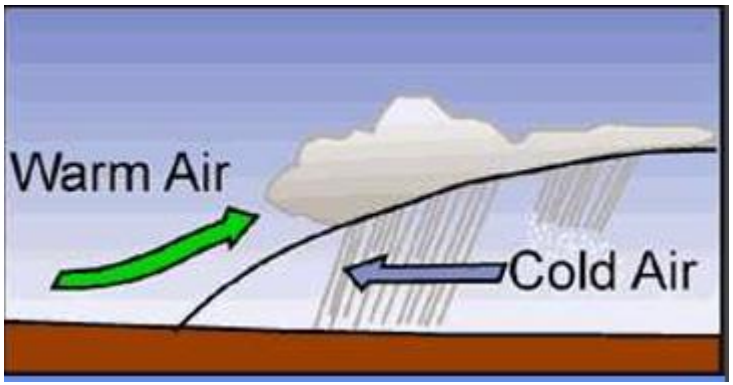
As this warm air rises in heat, it expands and carries water vapour into the atmosphere

The water vapour cools in the upper atmosphere, forming a convection cloud. These clouds are often puffy

- **2. Frontal Clouds** - form where the leading edge, or front, of a large moving mass of air meets another mass of air at a different temperature. Warm air contains more water vapor and will be pushed up by a cold air mass. The rising warm air will cool and water vapor condenses to form clouds.



FRONTAL CLOUDS

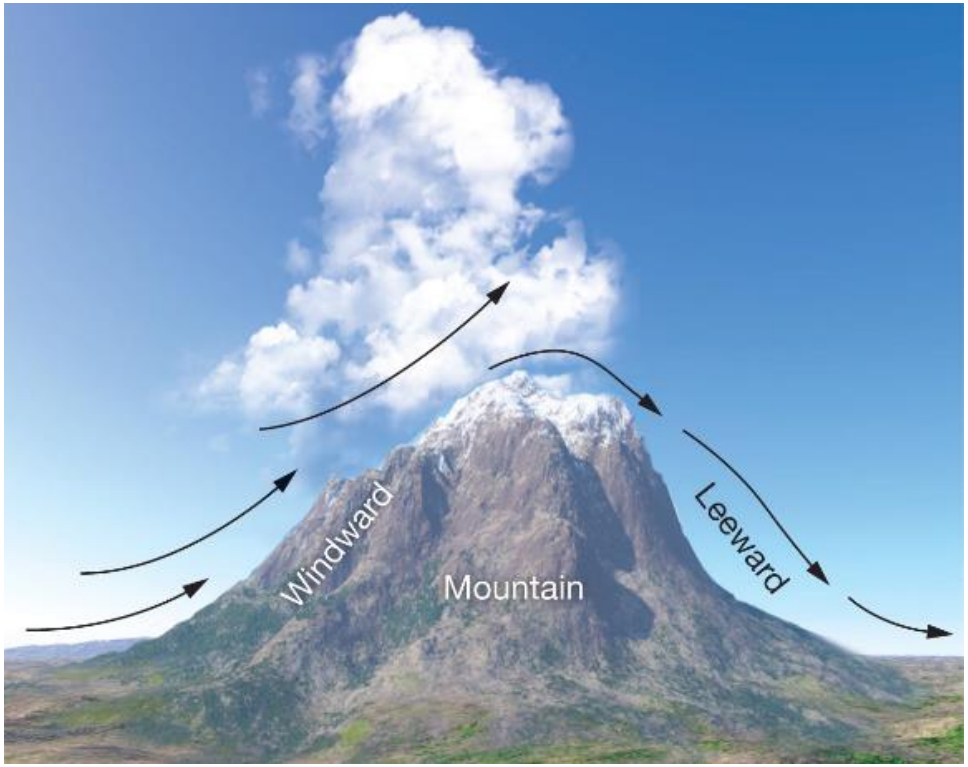


Frontal clouds form when two air masses of different temperatures meet. •

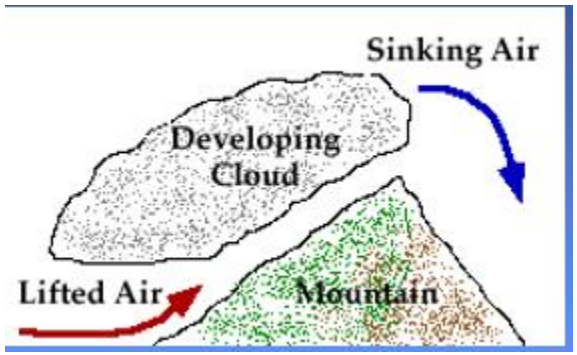
Warm air masses generally are less dense and contain more moisture than cold air masses, thus rising over, or being pushed upward and over, cold air. The rising air cools and condenses forming a frontal cloud.

Where the two air masses meet, this leading edge is called a FRONT

- **3. Orographic Clouds -** form when air moves up a mountain, expands at the lower pressure, and cools. Clouds are formed when water vapor in this air cools and condenses.



OROGRAPHIC CLOUDS



Orographic clouds result from warm, moist air ascending up a mountain, forming clouds on the upwind slope as the temperature decreases

Thus, the near side of the mountain has precipitation, and the far side of the mountain is often dry.

Fog

Fog is actually a cloud at ground level.

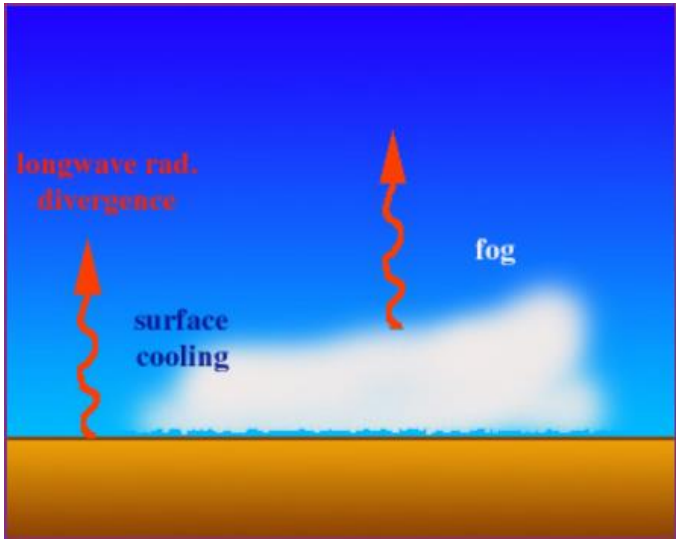
Although there are many different types of fog, it basically forms such that water vapour, as it condenses, attaches itself to little particles such as dust specks.

Some types of conditions that cause fog include heat rising from the Earth's surface and cooling rapidly, warm air passing over snow, and warm ocean air meeting cold ocean air.

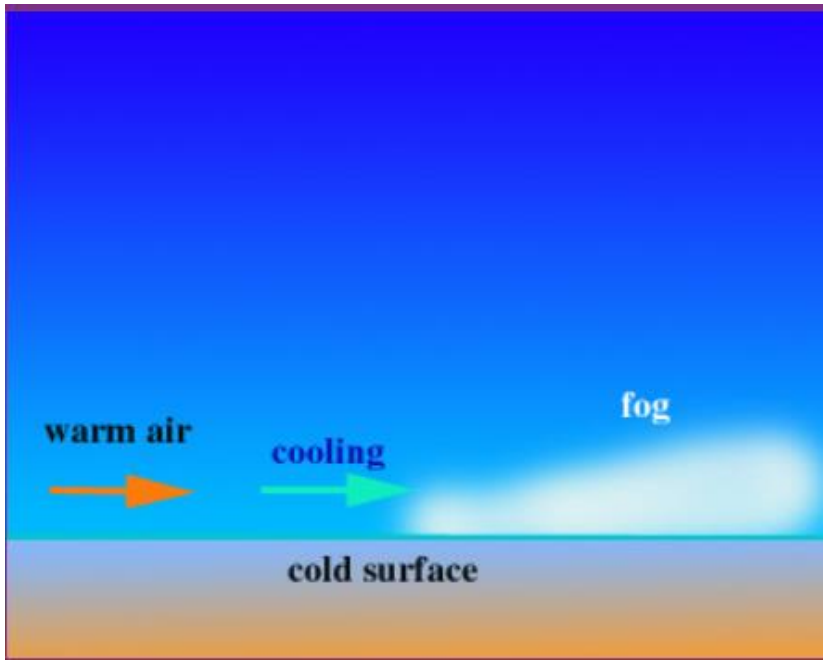
Fog is produced when:

There are four main types of fog

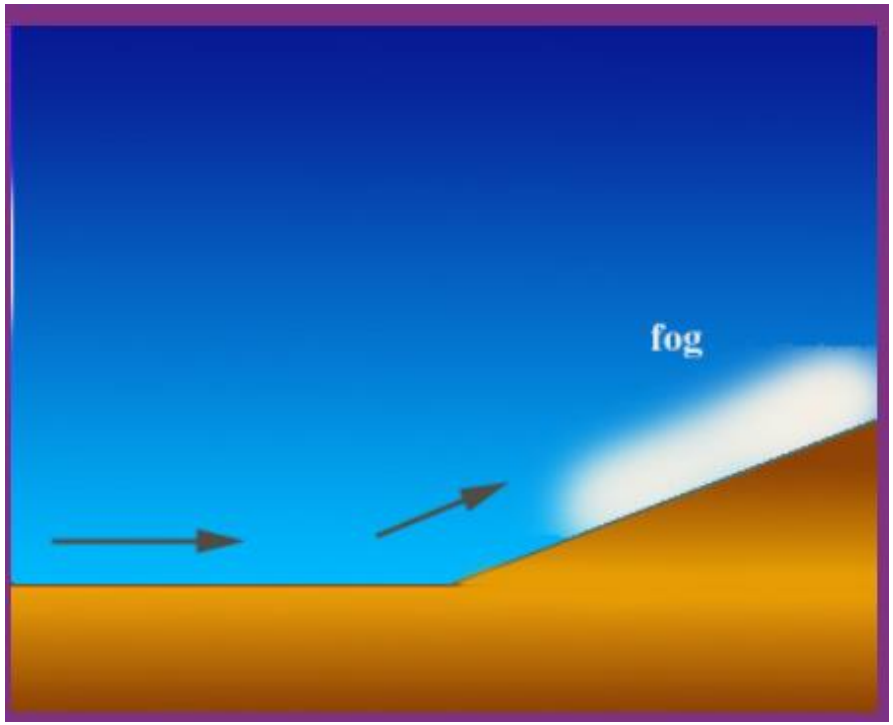
1. **Radiation Fog:** On clear nights, energy from the Earth's surface radiates upward but is not reflected back to Earth by clouds. The air near the ground cools, allowing water vapor to condense into fog.



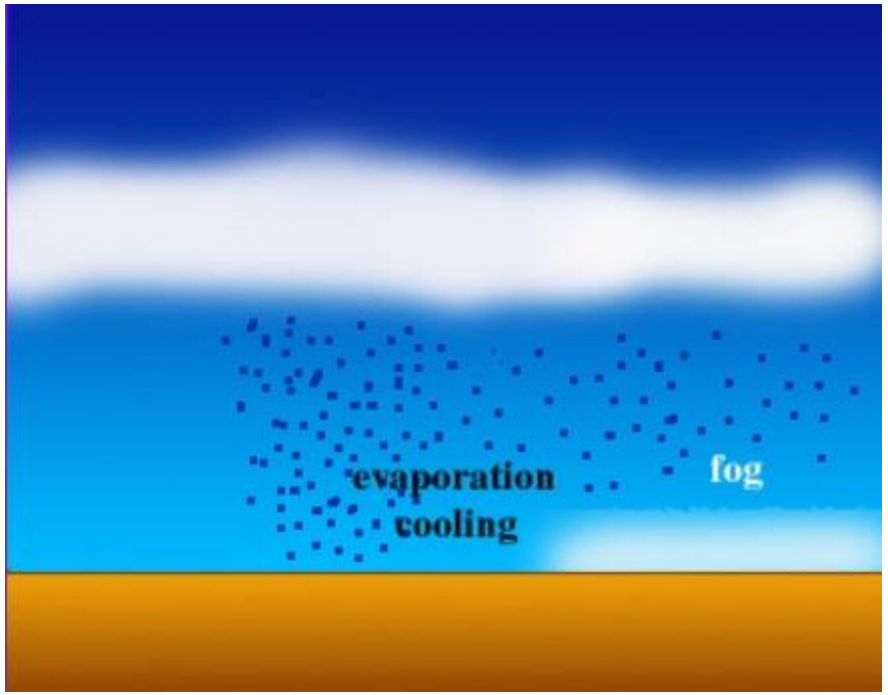
2. **Advection Fog** : When warm air passes over a snow-covered ground or moist sea air drifts over a cold current (or seashore), fog forms.



3. **Upslope Fog:** When warm air rises up the sides of a mountains during orographic lifting.



4. Evaporation fog : additional water vapor enters air that already nearly saturated, the additional water vapor causes the air to reach the dew point, forming fog.



Cloud Classification

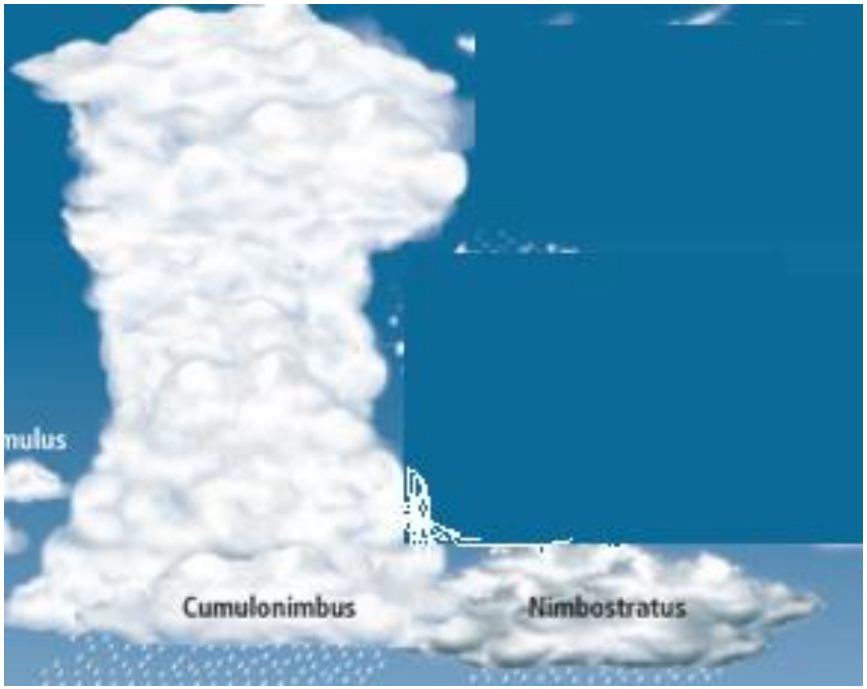
1. BASED ON SHAPE –

CUMULUS clouds, from a term meaning “pile” or “heap”, referring to a TALL CLOUD –

STRATUS clouds, from “stratum,” or layer, referring to low-level layered clouds

BASED ON PRECIPITATION –

NIMBUS clouds, from a term meaning “rain”, referring to rain-bearing clouds



BASED ON ALTITUDE

LOW LEVEL: NO PREFIX (0 – 2000 m)

MEDIUM LEVEL: ALTO (2000-5000 m)

HIGH LEVEL: CIRRUS (5000 + m)

HIGH

cirrus

cirrocumulus

cirrostratus

Cumulonimbus

MIDDLE

altocumulus

altostratus

LOW

Cumulus
(fair weather)

Cumulus
(with development)

Stratus

Try Yourself

1. When are convective clouds formed?
a. in a high pressure system with cool, dry, falling air
b. moist air near the ground absorbs energy from a heated surface such as a lake, asphalt, or dirt
c. when a mass of moist air rises up the side of a mountain
d. the leading edge of a large moving mass of air meets another mass at a different temperature

2. When are frontal clouds formed?
a. in a high pressure system with cool, dry, falling air
b. moist air near the ground absorbs energy from a heated surface such as a lake, asphalt, or dirt
c. when a mass of moist air rises up the side of a mountain
d. the leading edge of a large moving mass of air meets another mass at a different temperature

3. When are orographic clouds formed?
a. in a high pressure system with cool, dry, falling air
b. moist air near the ground absorbs energy from a heated surface such as a lake, asphalt, or dirt
c. when a mass of moist air rises up the side of a mountain
d. the leading edge of a large moving mass of air meets another mass at a different temperature

4. Which type of clouds reach the highest altitude?
a. cirrus
b. cumulus
c. stratus
d. nimbocumulus

5. Which type of clouds are billowing, fluffy, and rounded in shape?
a. cirrus
b. cumulus
c. stratus
d. nimbocumulus

6. Which cloud type is associated with stable weather conditions?
a. cirrus
b. cumulus
c. stratus
d. nimbocumulus

7. Which type of cloud is formed very close to land?
a. cirrus
b. cumulus
c. stratus
d. fog

Answers:

1. B
2. D
3. C
4. A
5. B
6. C
7. D

Science 1206 - Movie

- **Clouds And Patterns of Weather**

or

Weather Smart Water Cycle and Clouds

Worksheet 2:

- CLIMATE AND VERSUS WEATHER

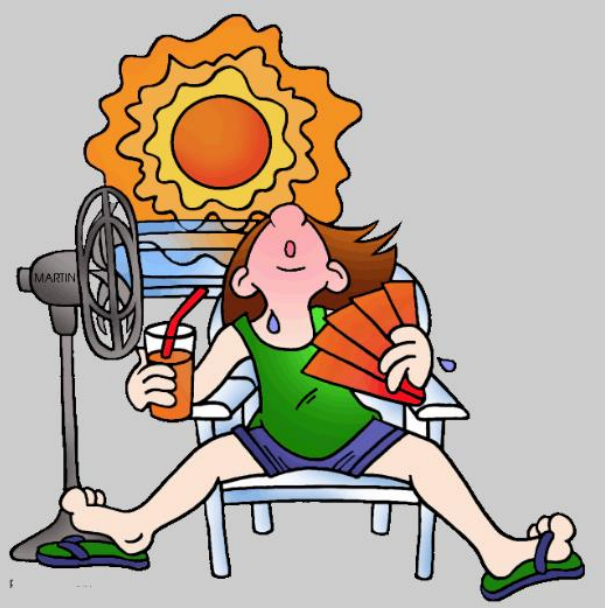
SCIENCE 1206

- Topic 4:

  Humidity- Water in the Air

- **humidex scale** refers to the degree of comfort based on temperature and relative.

During summer, we are less comfortable on a hot, humid day than we are on a hot, dry day, even if the temperatures on both days are identical. This is due to the cooling effect of evaporation from our skin. **"**. This is one of the reasons that weather reports often include information on temperature, wind speed, and humidity.

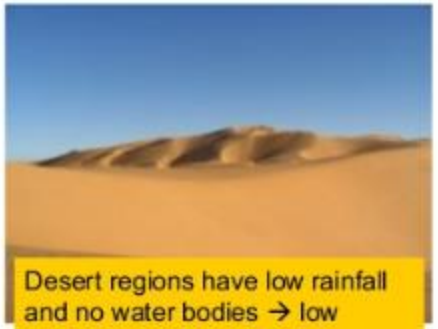


Humidity is a measure of the amount of water vapour in the atmosphere. It affects the weather as well as how comfort we feel. Also refereed to (absolute Humidity)

Low Humidity : means that evaporation can occur from bodies of water and other sources. Relative humidity is often low in the warm indoors resulting in dry skin. People use humidifiers to add moisture to their homes and offices.

High Humidity :means that clouds or fog may form. Here, you may feel uncomfortable during physics activity when the relative humidity is high because evaporation does not take place fast

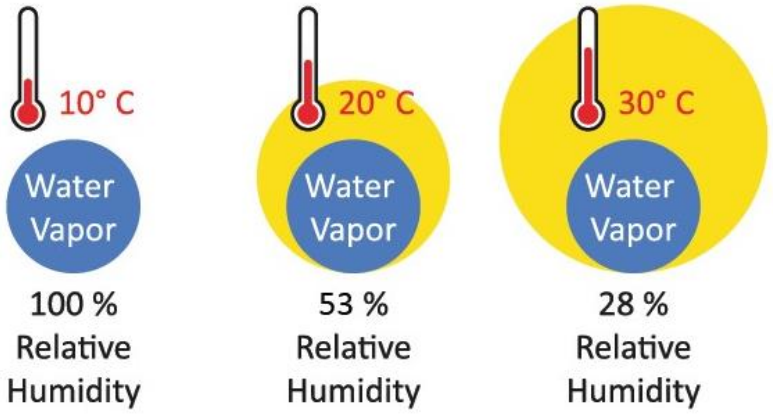
High rainfall and many water bodies → high relative humidity and the growth of thick vegetation.



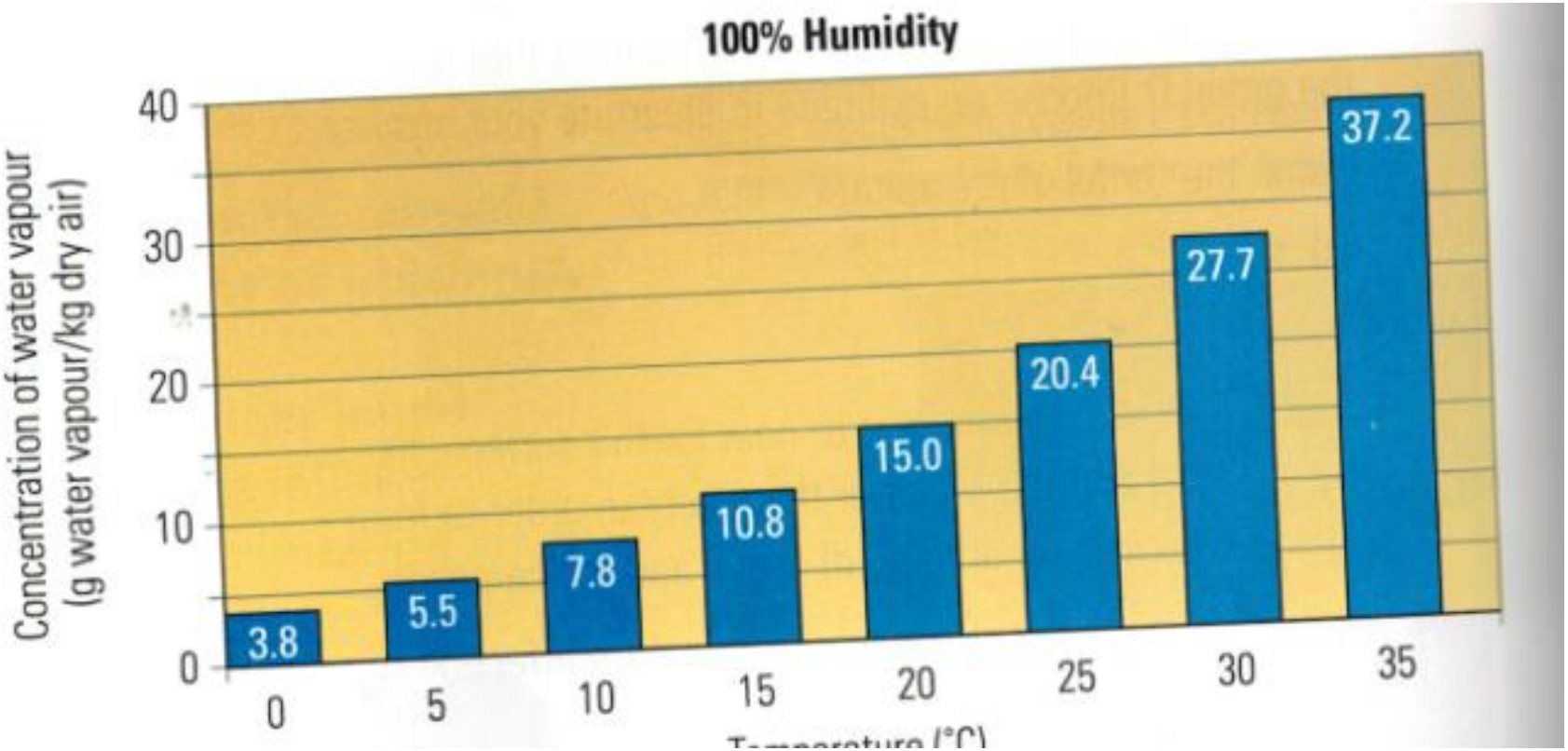
Desert regions have low rainfall and no water bodies → low relative humidity.

- **Relative Humidity** refers to the amount of water vapor in the air as a percentage of the maximum amount the air can hold at that temperature.

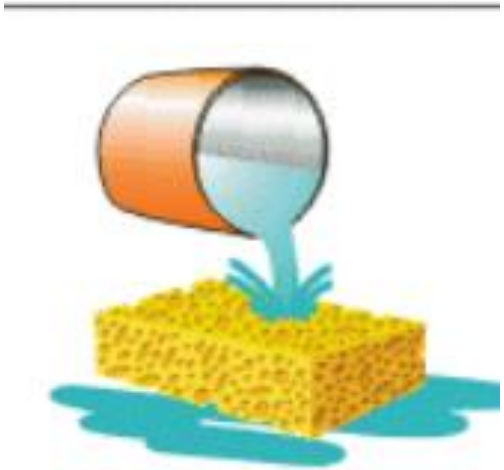
- warm air can hold much more water vapour than can cold air.



See figure 1 (p. 588) show the maximum concentration of water vapour in dry air (in g/kg) at different temperatures to give 100% humidity = saturated air.



- **Saturation** means that it is holding its maximum amount of water. Under this condition, the air sample would have a relative humidity of 100%



. If we could remove half of the water from our air sample, it would no longer be saturated. The relative humidity would now be 50% since it now holds half the maximum amount of water that it could hold when saturated

Example 1: Calculations involving relative humidity:

If the concentration of water vapor at 0 ^{o}C is 1.9 g/kg of dry air, what is the relative humidity?

$$\text{Relative Humidity} = \frac{\text{Concentration}}{\text{Maximum Concentration}} \times 100\%$$

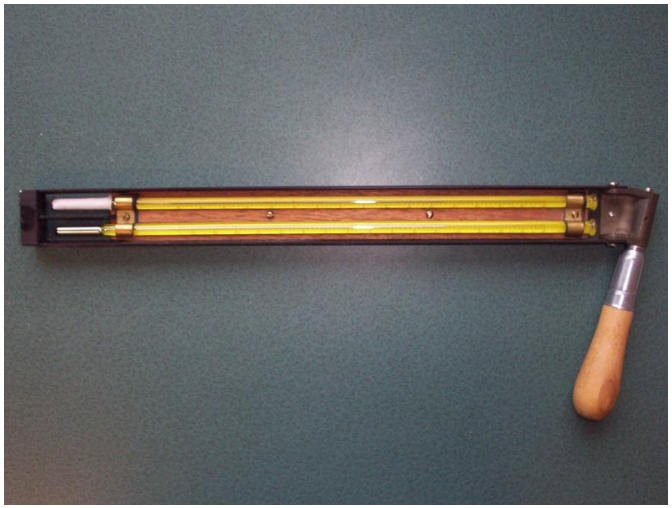
Example 2:

Determine the concentration of water vapor in air at 20 ^{o}C when the relative humidity is 50 %.

- Remember **hygrometer** is used to measure relative humidity.

psychrometer (**sī-ˈkrä-mə-tər)** is a special type of hygrometer . It uses a wet-bulb and dry-bulb of thermometers to make indirect measurement of relative humidity.

When air is saturated (100% humidity) both thermometers Will have the same temperature reading; if not saturated, the wet bulb will have a lower reading than the dry bulb



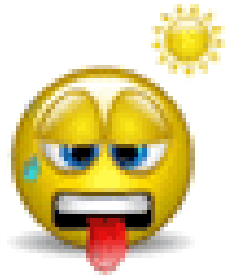
Determining Relative Humidity

Dry-bulb temperature (°C)	Difference between wet-bulb and dry-bulb temperatures (°C)								
	1	2	3	4	5	6	7	8	9
	Relative humidity (%)								
10	88	77	66	55	44	34	24	15	6
12	89	78	68	58	48	39	29	21	12
14	90	79	70	60	51	42	34	26	18
16	90	81	71	63	54	46	38	30	23
18	91	82	73	65	57	49	41	34	27
20	91	83	74	67	59	53	46	39	32
22	92	83	76	68	61	54	47	40	34
24	92	84	77	69	62	56	49	43	37
26	92	85	78	71	64	58	51	46	40
28	93	85	78	72	65	59	53	48	42
30	93	86	79	73	67	61	55	50	44

Example 3:

The air temperature in a classroom is 22 ^{o}C and the wet – bulb temperature is 17 ^{o}C. Determine the relative humidity of the room.

Effects of Humidity:



High Humidity:

Normally, when a person perspires, evaporation of perspiration removes heat from the body and cools it down

Perspiration cannot easily evaporate when humidity is high so the person can feel uncomfortably hot

Low Humidity:

Evaporation occurs quickly because the air can hold a lot more moisture, so the skin can become uncomfortably dry

Dew Point

Dew: forms when the air cools and the water vapour it contains condenses on a cool surface near the ground.

Dew Point: The temperature at which dew forms. When air reaches the saturation temperature, i.e., when the relative humidity is 100%

Higher the dew point temperature more moisture that is in the air

How Does Dew Form ?

Dew most often forms on clear and cool evenings or nights in autumn and spring .

Dew drops are formed due to condensation of humidity in the air.

Hot air contains more moisture as compared to cold air. During the night when hot air comes into contact with a cold surface, water vapour present in it condenses on the cold surface in the form of water droplets .

These tiny Drops of water are called dew drops. When temperature is low enough, dew takes on the form of frost.

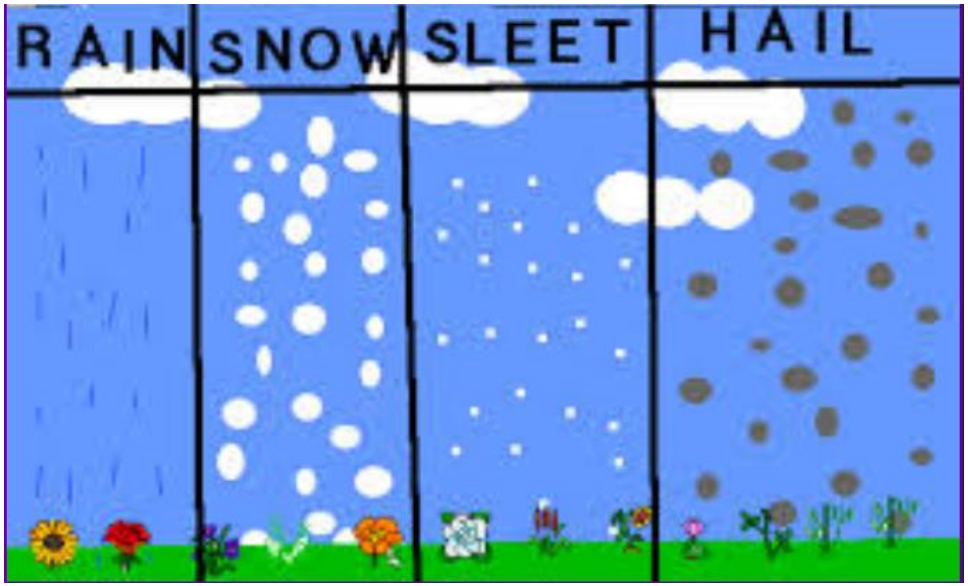
Worksheet 4:

- Weather instruments

SCIENCE 1206

- Topic 5:

  Precipitation



Fix this slide

The Hydrosphere

- The **hydrosphere**

All of the earth's water including salt water, fresh water and ice

Approximately 70% of the Earth's surface is water.

2.5 % of all water is fresh. (most of this is frozen in glaciers and in the ice caps.

97.5 % is salt water

Weather Dynamics

THE HYDROSPHERE

Water covers 70 % of the Earth's surface, or 320 million cubic miles.

The hydrosphere is all the water that exists on the planet. It includes water in:

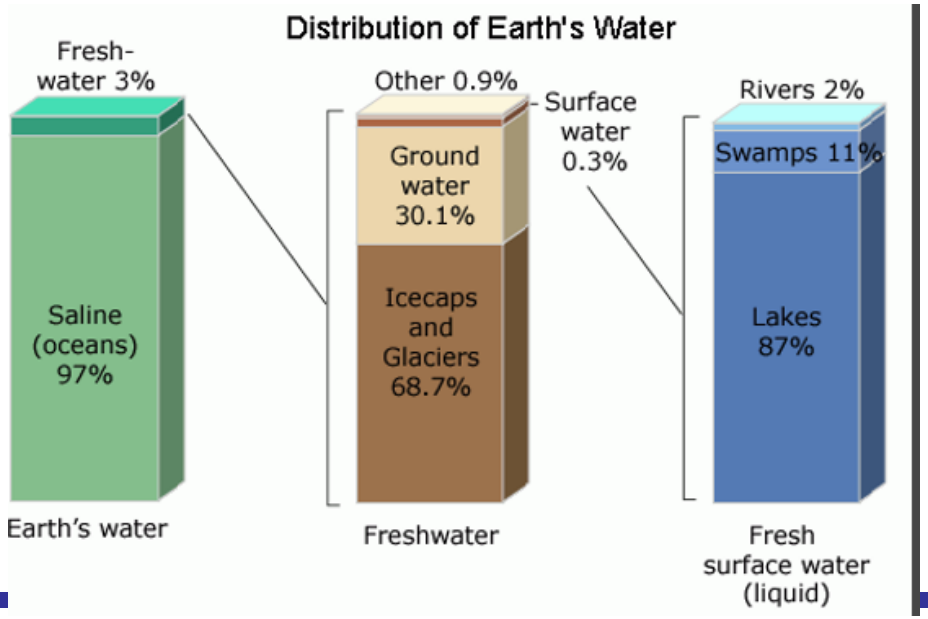
- Oceans
- Rivers
- Lakes
- Aquifers
- glaciers/ice
- Atmosphere

WATER DISTRIBUTION

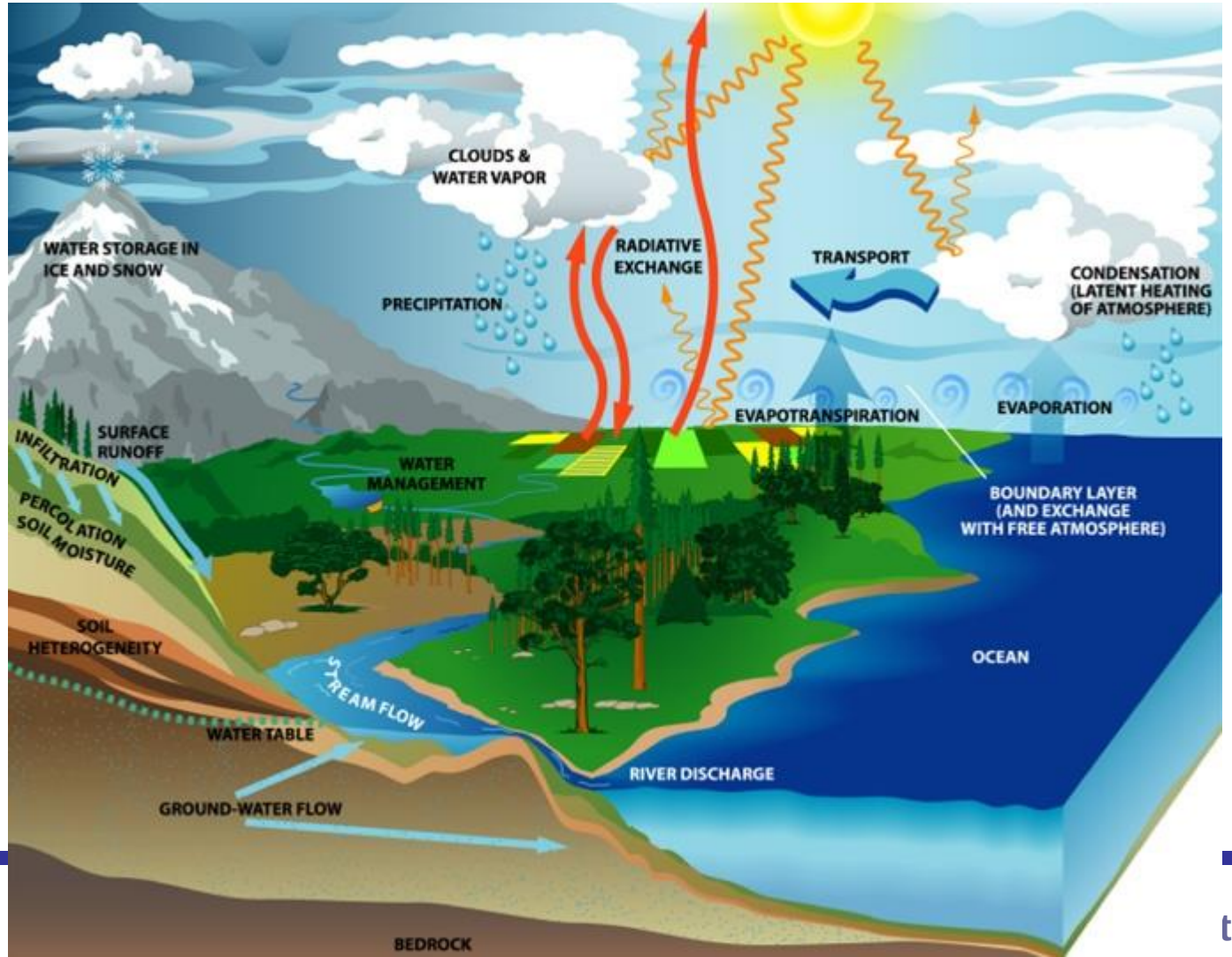
97.5% is salt water, 2.5% is fresh water.

Most of our fresh water supply is trapped in polar ice caps (87.3%)

Canada is rich in fresh water resources, having 10% of the total world supply

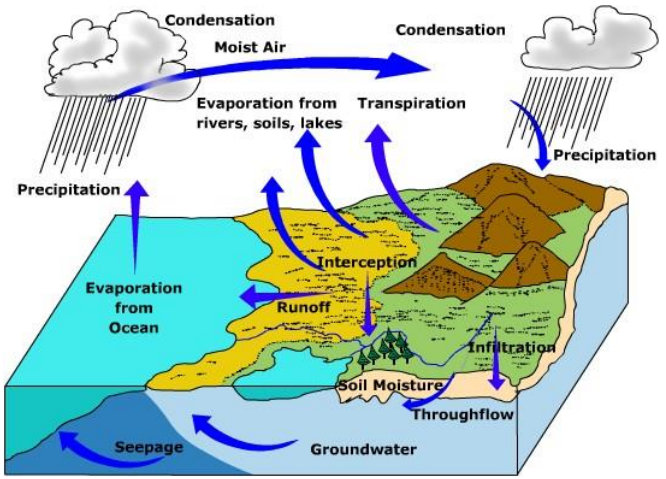


THE HYDROLOGICAL CYCLE



Hydrological cycle also know as the water cycle refers to how water is cycled through air, land, and water bodies.

Important processes that occur in the water cycle include



EVAPORATION: liquid to gas

CONDENSATION: gas to liquid

PRECIPITATION: rain, snow, hail, sleet

TRANSPIRATION: evaporation from leaves

RUNOFF water enters bodies of water from the land

PERCOLATION: water seeps into the ground

PRECIPITATION (p.556-557)

Precipitation refers to water that reaches the ground in either a liquid or solid form.

It is a stage in the water cycle.

When air reaches it's saturation point and the water vapor in the air condenses to form liquid droplets. When many droplets join together they become heavy enough to fall to the surface

The type of precipitation depends greatly on the temperature on the ground and in the atmosphere.

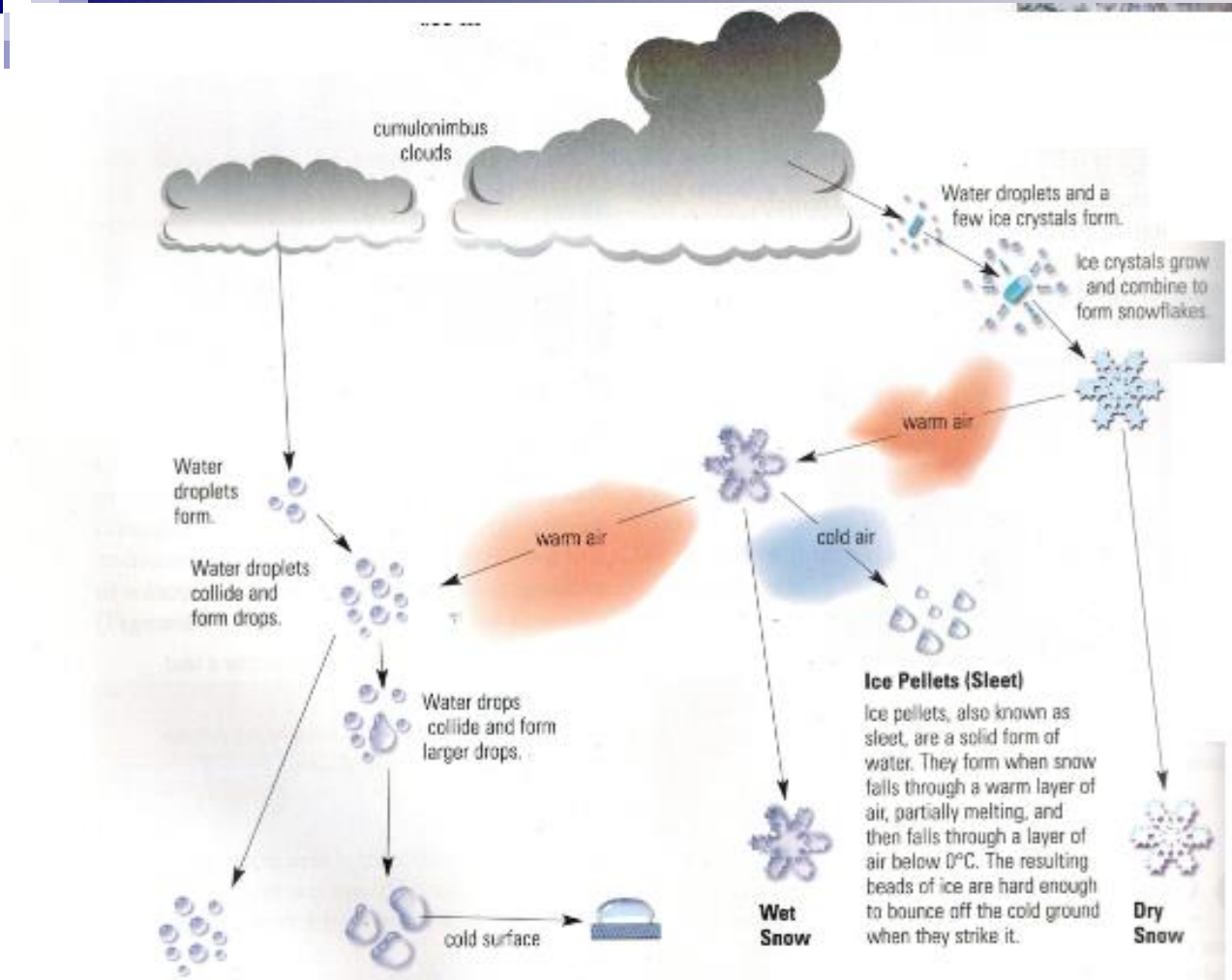
- There are five kinds of precipitation

1) rain
2) drizzle
3) snow
4) hail
5) sleet (ice Pellets)

Liquid forms: drizzle, and rain

Solid forms: snow, ice pellets (sleet), and hail

Rain gauge is an instrument used to measure precipitation. It the units of measure is centimeter (cm) or millimeters.


cumulonimbus clouds
Water droplets and a few ice crystals form.
Ice crystals grow and combine to form snowflakes.
warm air
Water droplets form.
warm air
cold air
Water droplets collide and form drops.
Water drops collide and form larger drops.
cold surface
Wet Snow
Dry Snow
Ice Pellets (Sleet)
Ice pellets, also known as sleet, are a solid form of water. They form when snow falls through a warm layer of air, partially melting, and then falls through a layer of air below 0°C. The resulting beads of ice are hard enough to bounce off the cold ground when they strike it.
Drizzle
Drizzle is fine water droplets between about 40 µm and 0.5 mm in diameter. Depending on the intensity of precipitation, both rain and drizzle can be classified as light, moderate, and heavy.
Rain
Rain consists of falling water droplets between about 0.5 mm and 5 mm in diameter. If a larger drop forms, it breaks into pieces as it falls through the air.
Freezing Rain
When raindrops are close to freezing and strike a cold object on or near the ground, the drops freeze almost instantly.
Snow
Snow is formed when water vapour crystallizes on tiny particles of dust and other solid substances, such as smoke. Snow forms only when the air temperature, and therefore the water vapour, has cooled below 0°C.

All precipitation forms from water droplets or ice crystals in clouds. Some precipitation freezes or melts after it falls from the clouds.

5 **Hail** forms when ice pellets move up and down in clouds, growing larger as they gain layers of ice.

1 **Rain** and **drizzle** form from water droplets or ice crystals that melt as they fall.

2 **Freezing rain** is rain that freezes when it hits the ground or other surfaces.

3 **Sleet** is rain that freezes into ice pellets while falling through cold air.

4 **Snow** forms from ice crystals that merge in clouds.

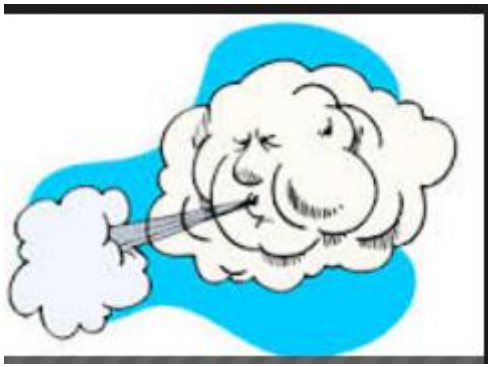
freezing rain

hail

SCIENCE 1206

- Topic 6:

  Wind



What is Wind

Atmosphere is the blanket of air and moisture that surrounds the earth.

Air refers to the invisible gaseous substance surrounding the earth, a mixture mainly of oxygen and nitrogen

Wind refers to the movement of air in the atmosphere

How is Wind Measured

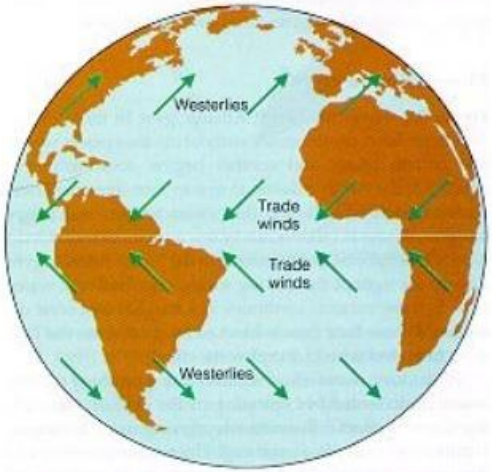
Anemometer is used to measure wind speed Km/hr is used to measure wind speed. .

Wind Vane or Wind Sock is used to measure direction. It indicates the direction of the wind is from the East, West, North or South .

The direction of the wind is expressed as the direction from which the wind is blowing. For example, easterly winds blow from east to west, while westerly winds blow from west to east.

Why is wind an important aspect of a weather forecast?

Knowledge of the winds has enabled man to sail the oceans and seas of the world.



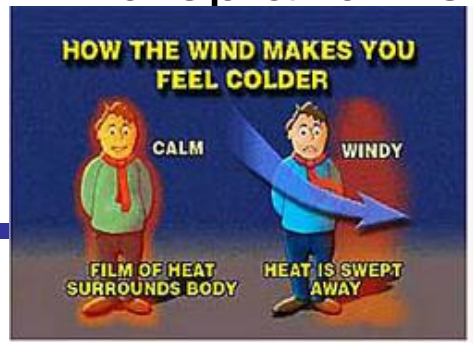
Airline pilots need information about wind speed and direction because the information it is important to safety during take-off and landing. Information regarding the wind direction and speed in the upper atmosphere is also important to save time and fuel.

How Does Wind Affect Temperature?

Anyone who has ever waited at a bus stop or taken a walk on a blustery winter day knows that you feel colder when the wind blows.

Wind Chill refers to a cooling sensation that is caused by the combined effect of temperature and wind.

On a calm day, our bodies insulate us somewhat from the outside temperature by warming up a thin layer of air close to our skin, known as the boundary layer. When the wind blows, it takes this protective layer away, exposing our skin to the outside air. It takes energy for our bodies to warm up a new layer and, if each layer keeps getting blown away, our skin temperature will drop and we will feel colder.



Estimating Wind Chill

Wind Speed (km/h)	What to Look for When Estimating Wind Speed	Temperature (˚C)									
		0	-5	-10	-15	-20	-25	-30	-35	-40	-45
10	Wind felt on face; wind vane begins to move.	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57
20	Small flags extended.	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62
30	Wind raises loose paper, large flags flap and small tree branches move.	-6	-13	-20	-26	-33	-39	-45	-52	-59	-65
40	Small trees begin to sway and large flags extend and flap strongly.	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68
50	Large branches of trees move, telephone wires whistle and it is hard to use an umbrella.	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69
60	Trees bend	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71

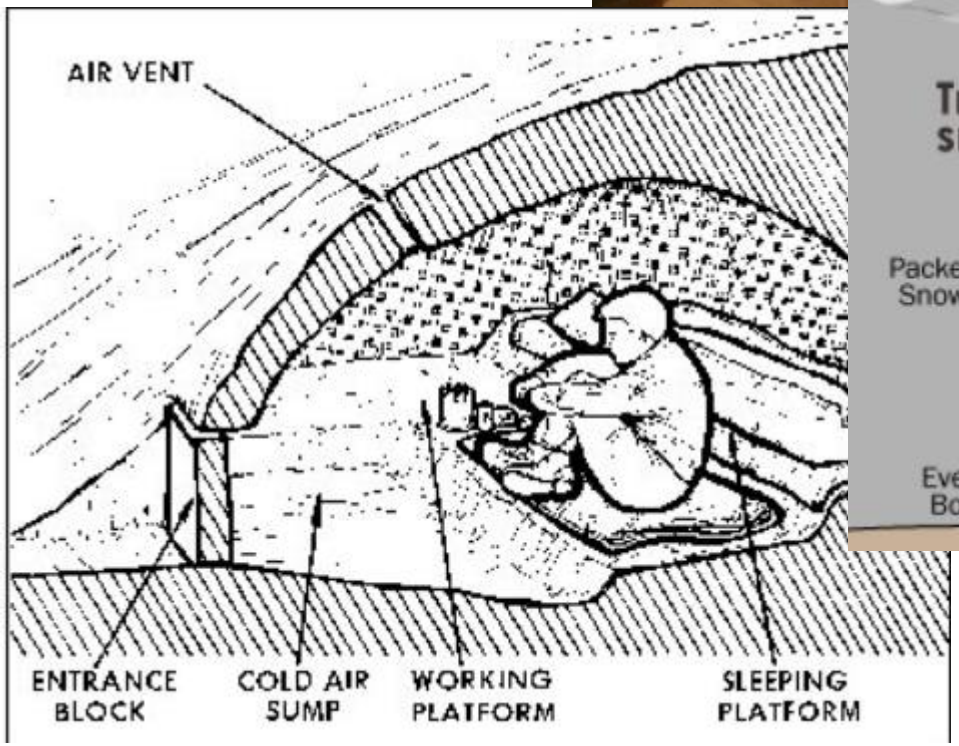
wind chill index is not actually a real temperature but rather, **represents the feeling of cold on your skin**

Wind Chill Hazards and What To Do

Wind Chill	Risk of Frostbite	Other Health Concerns	What to Do
0 to -9	**Low**	• Slight increase in discomfort	• Dress warmly • Stay dry
-10 to -27	**Low**	• Uncomfortable • Risk of hypothermia if outside for long periods without adequate protection.	• Dress in layers of warm clothing, with an outer layer that is wind-resistant. • Wear a hat, mittens or insulated gloves, a scarf and insulated, waterproof footwear. • Stay dry. • Keep active
-28 to -39	**Risk**: exposed skin can freeze in 10 to 30 minutes	• Risk of frostnip or frostbite: Check face and extremities for numbness or whiteness. • Risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.	• Dress in layers of warm clothing, with an outer layer that is wind-resistant • Cover exposed skin • Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and insulated, waterproof footwear • Stay dry • Keep active
-40 to -47	**High risk**: exposed skin can freeze in 5 to 10 minutes*	• High Risk of frostbite: Check face and extremities for numbness or whiteness. • Risk of hypothermia if outside for long periods without adequate clothing or shelter from wind and cold.	• Dress in layers of warm clothing, with an outer layer that is wind-resistant. • Cover all exposed skin. • Wear a hat, mittens or insulated gloves, a scarf, neck tube or face mask and insulated, waterproof footwear. • Stay dry • Keep active.

A simple way to avoid wind chill is to **get out of the wind**


Evergreen Boughs
Tree-pit snow shelter
Packed Snow
Packed Snow
Evergreen Boughs
Ground Level


AIR VENT
ENTRANCE BLOCK
COLD AIR SUMP
WORKING PLATFORM
SLEEPING PLATFORM

What caused Wind to Blow?

As the sun warms the Earth's surface, the atmosphere warms too.

Some parts of the Earth receive direct rays from the sun all year and are always warm. Other places receive indirect rays, so the climate is colder

.Warm air, which weighs less than cold air, rises. Then cool air moves in and replaces the rising warm air. This movement of air is what makes the wind blow

Where is the coldest wind chill in Canada?

Wind chills below -70 have been recorded in northern communities in Canada. On January 13, 1975 at Kugaaruk, Nunavut, the air temperature was -51˚C and the winds were 56 km/h, producing a bone-chilling wind chill of -78!

Kugaaruk, NU

Set Kugaaruk as default location

Current Conditions Thu Dec 05, 13 at 7:00 PM MST

°C | °F

n/a

-26 °C

Feels like: -38

Wind: WSW 19 km/h
Humidity: 76%
Pressure: 103.2 kPa

Visibility: n/a
Sunrise: 12:00 AM
Sunset: 12:00 AM

SCIENCE 1206

- Topic 7:

  Atmospheric Pressure

Keeping an Atmosphere

- Atmosphere is *kept* by the world's gravity
  - **Low mass (small) worlds= low gravity**
    =almost no atm.
  - **High mass (large) worlds = high gravity**
    = thick atm.

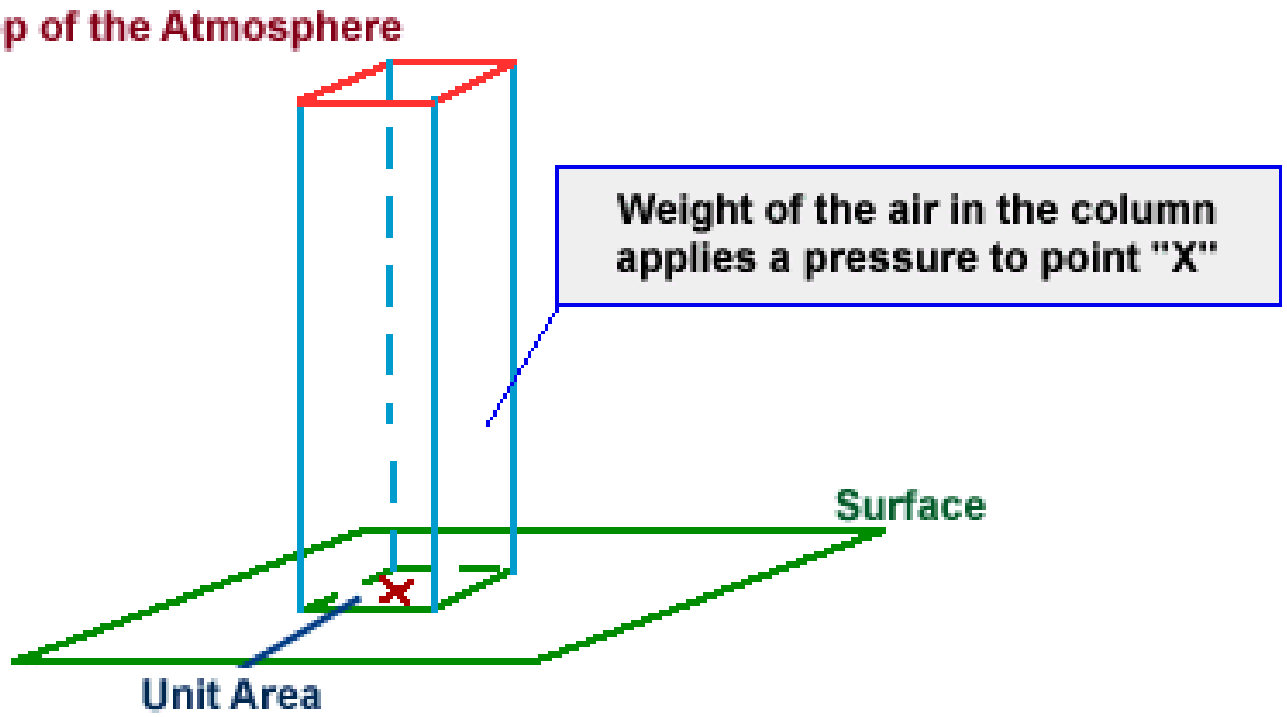
- Gravity and pressure
  - **Air pressure depends on how much gas there is i.e. The atmospheric thickness.**

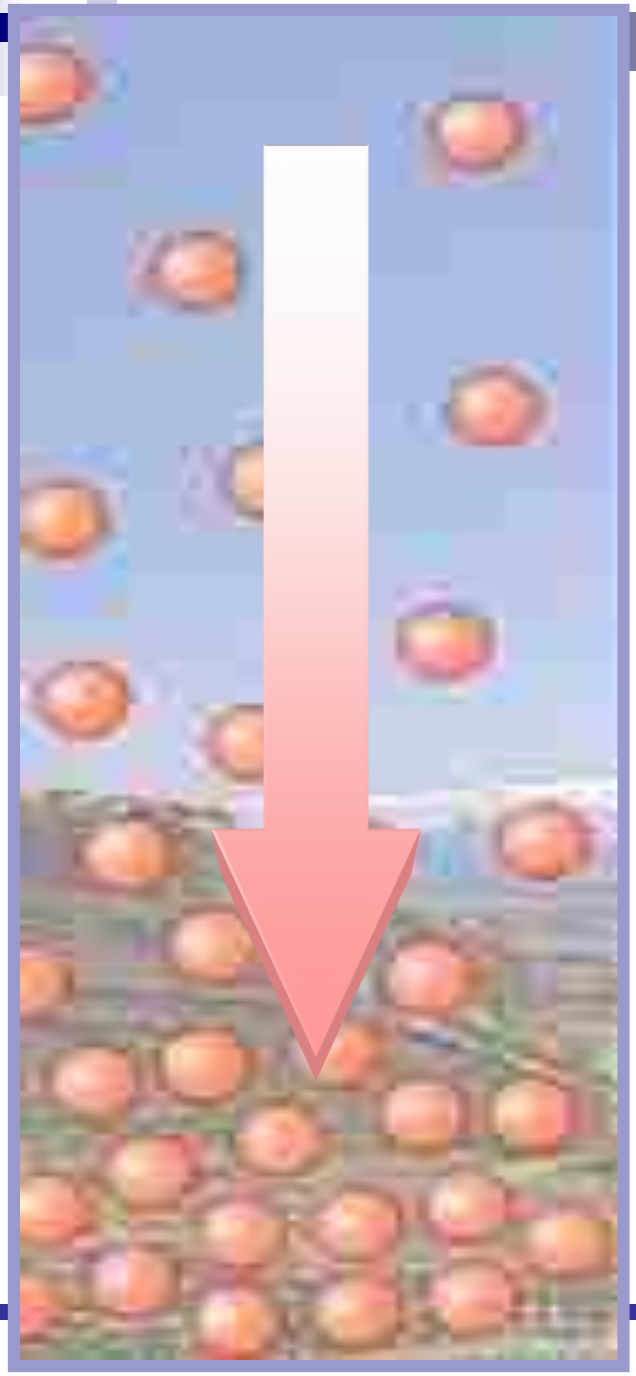
Earth's Atmosphere

- About 10 km thick
- Consists mostly of molecular nitrogen (N_2) and oxygen (O_2)

Atmospheric Pressure

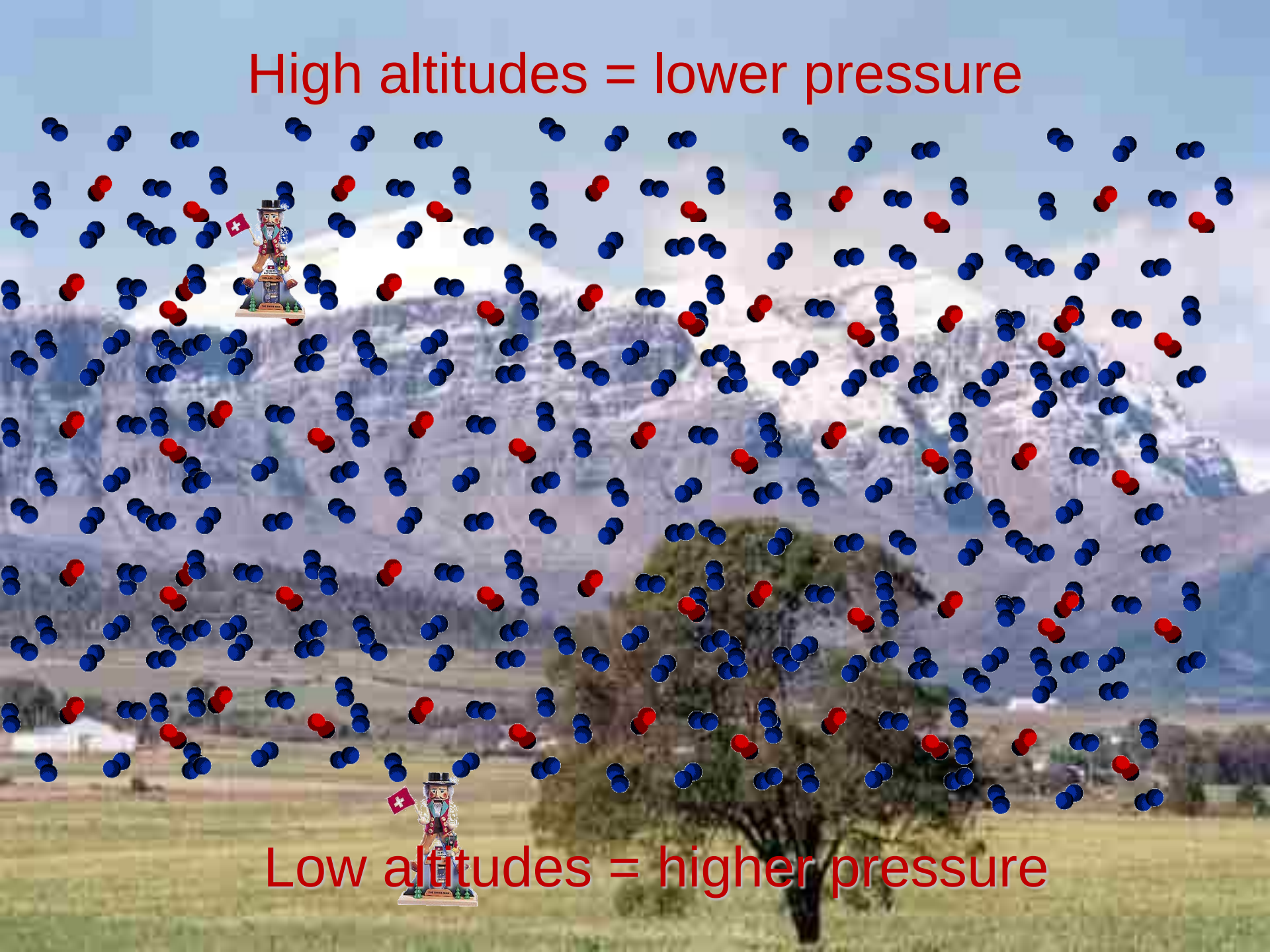
- Atmospheric pressure is a measure of the force exerted on us by the weight of the air column above us.



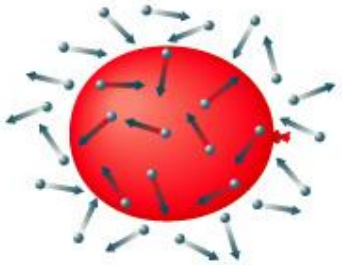


Gravity pulls the air molecules toward the earth, giving them weight. **Air pressure** refers to the weight of the air molecules all around us.

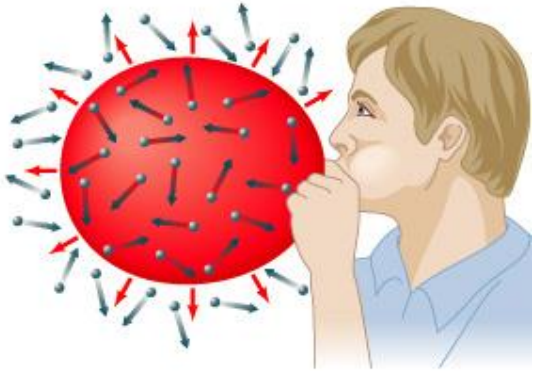
Pressure gradient is a measure of the amount atmospheric pressure changes across a set distance . Pressure gradient can be vertical or horizontal


High altitudes = lower pressure
Low altitudes = higher pressure

Atmospheric Pressure



Gas pressure depends on both density and temperature.



Adding air molecules increases the pressure in a balloon.

Heating the air also increases the pressure.

As elevation goes up

air pressure goes down.

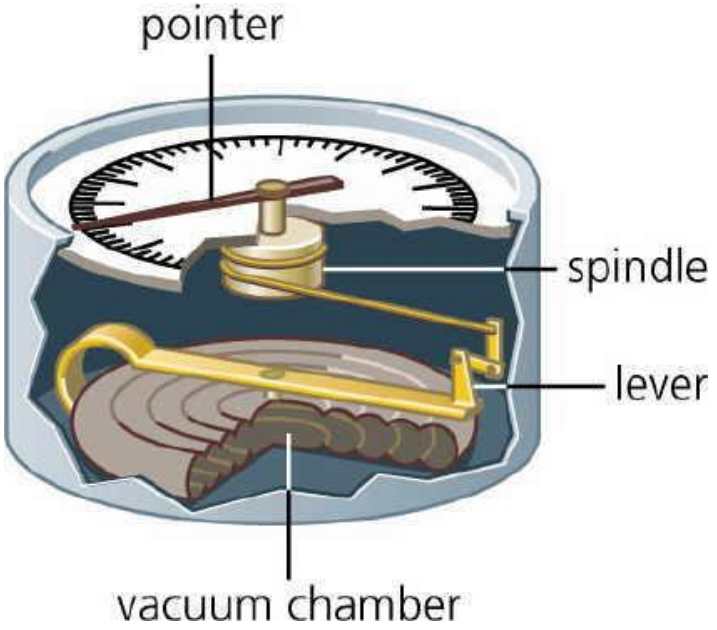
This is an inverse relationship.

Measuring Air Pressure

- **Aneroid Barometer** is used to measure air pressure.

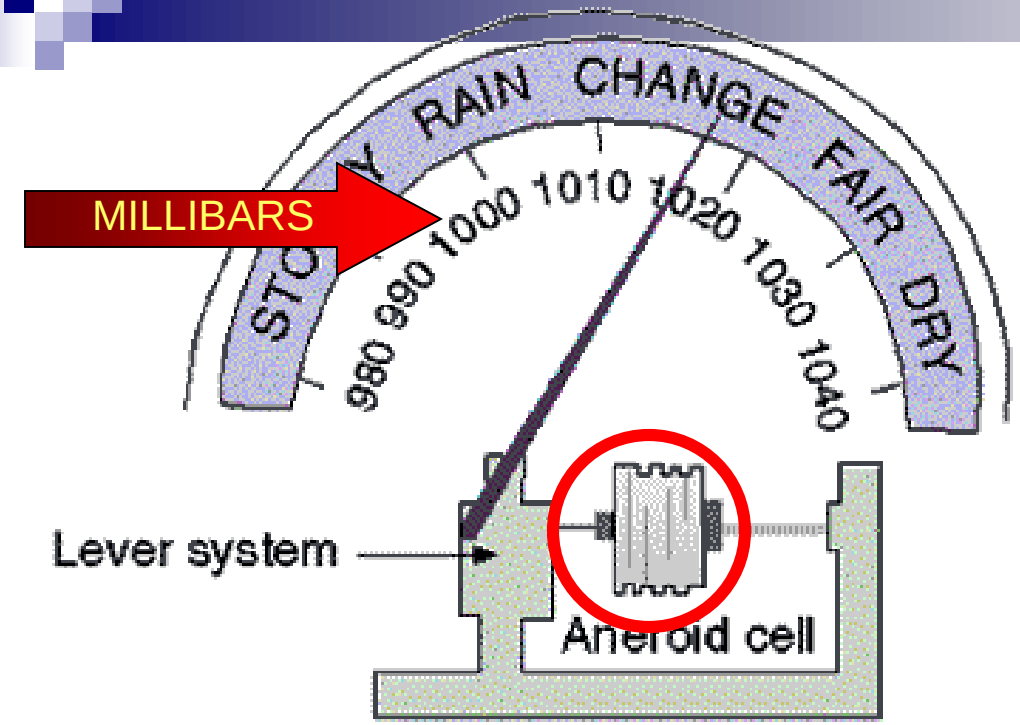
Unit of measure is Kilopascal (kPa), Millibars (mb) and inches of Mercury

At ground level, the average atmospheric pressure is 100 kPa



The *Aneroid* Barometer

- No fragile tubes!
- No toxic chemicals!
- No batteries!
- Never needs winding!



An aneroid barometer uses a cell which has had most of the air removed.

As the air pressure around the cell increases, it presses on the cell, which causes the needle to move.

Television weather forecasters usually give barometric pressure in inches of mercury. However, meteorologists measure atmospheric pressure in *millibars.*

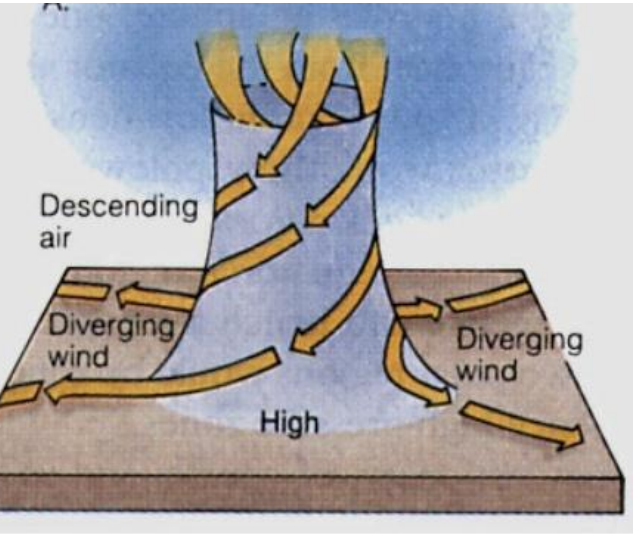
Most aneroid barometers have a needle which can be set to remember the previous reading.

Changing Pressure

A *rising barometer* = increasing air pressure.

This usually means:

Rising barometer readings indicate that a high pressure system is approaching. Higher atmospheric pressure is usually associated with fair weather and clearing skies.



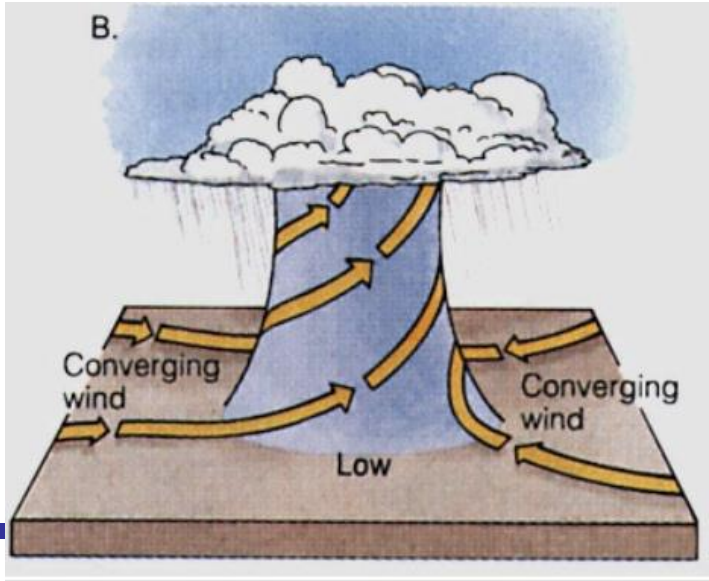
The high pressure means that the gases in the air are being forced downwards and squished closer together. This causes them to heat up (warm weather) and prevents condensation (no clouds, more sun).

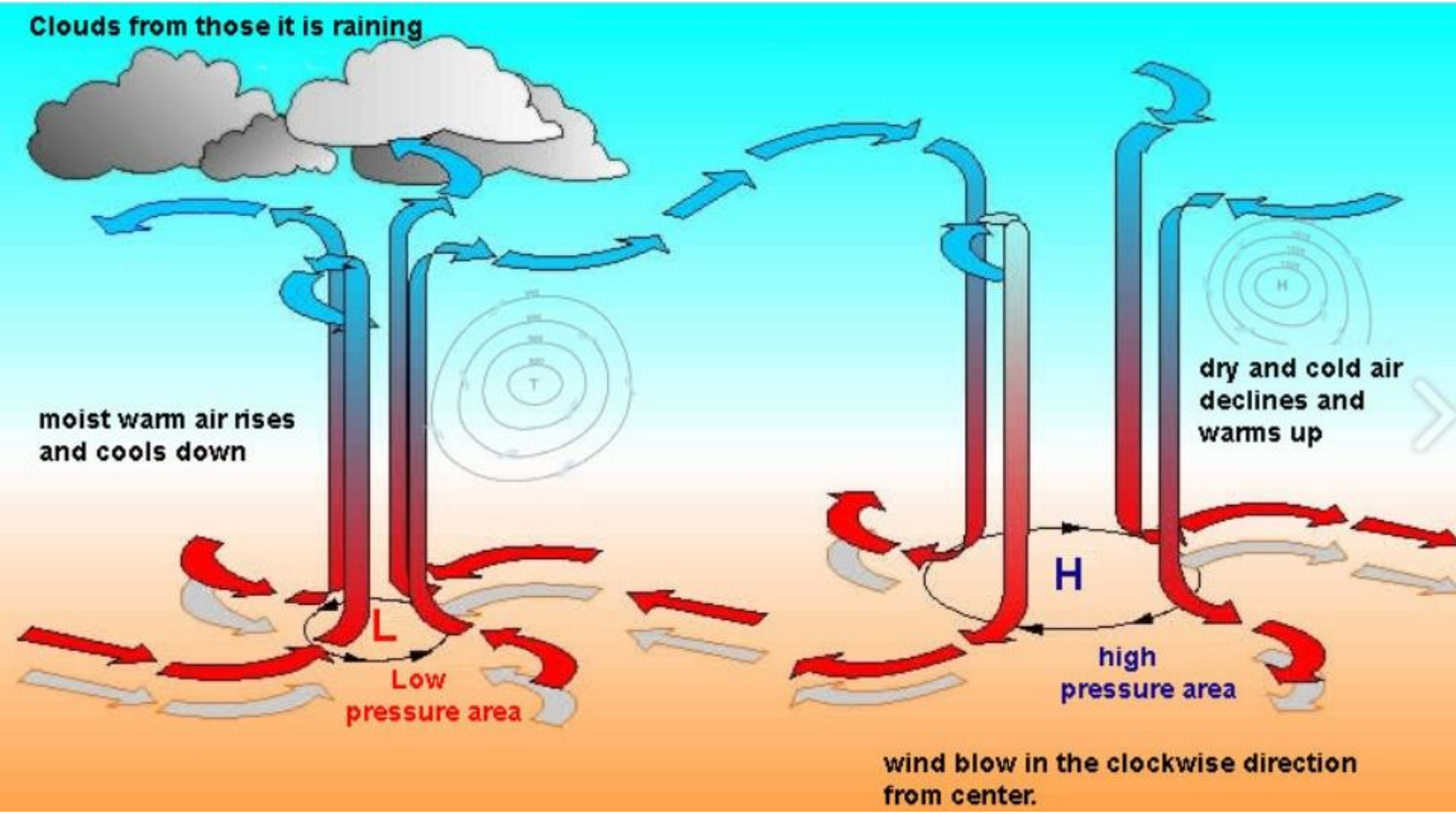
A *falling barometer* = decreasing air pressure.

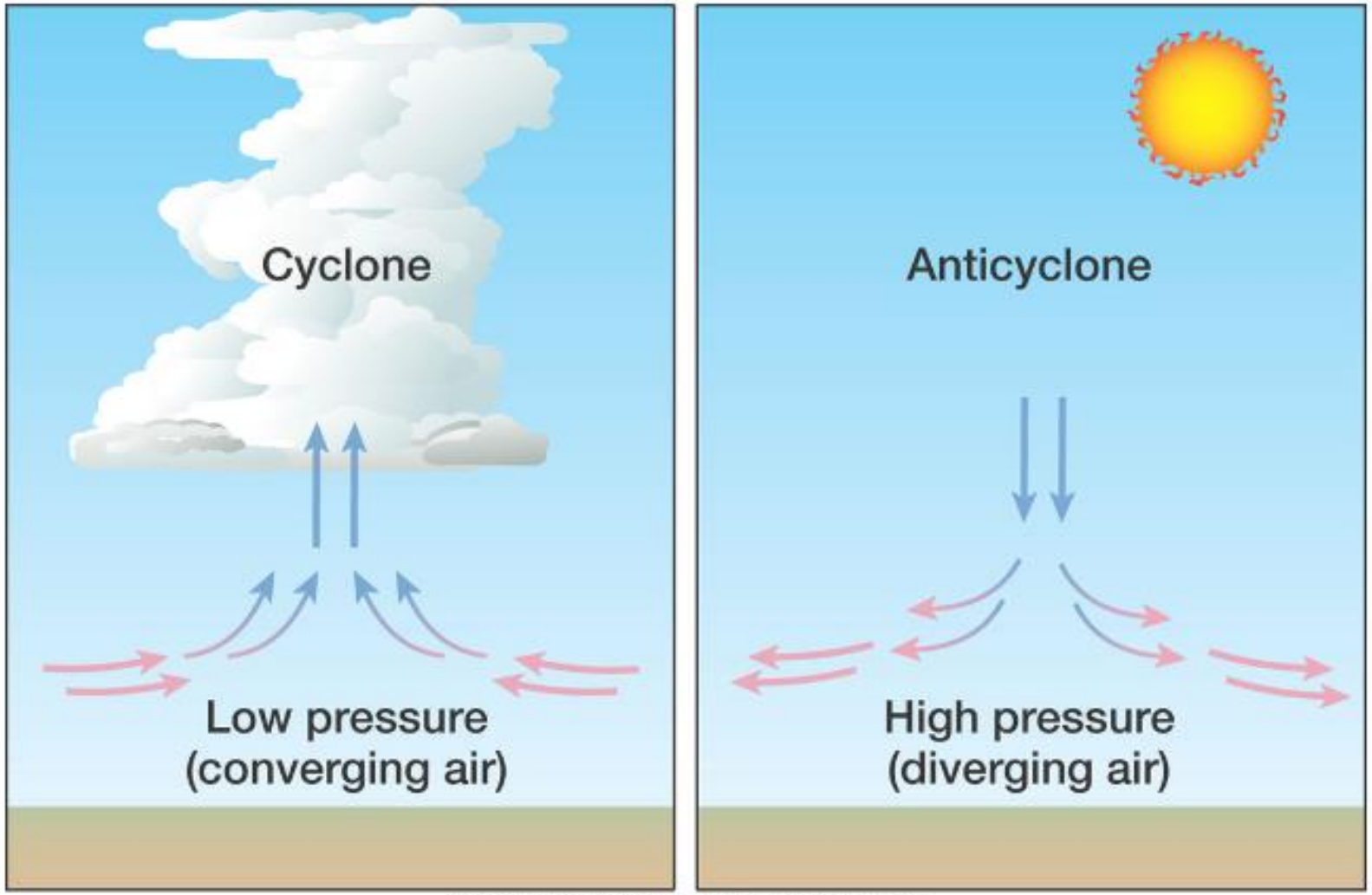
This usually means:

Falling barometer readings usually indicate the approach of an area of low pressure. Low pressure readings are usually associated with storm systems. Tornadoes and hurricanes can produce very low barometric readings.

low pressure means less compression of the molecules of gas which make up the air. This means that there is less of a heating effect and more chance of Condensation and cloud formation

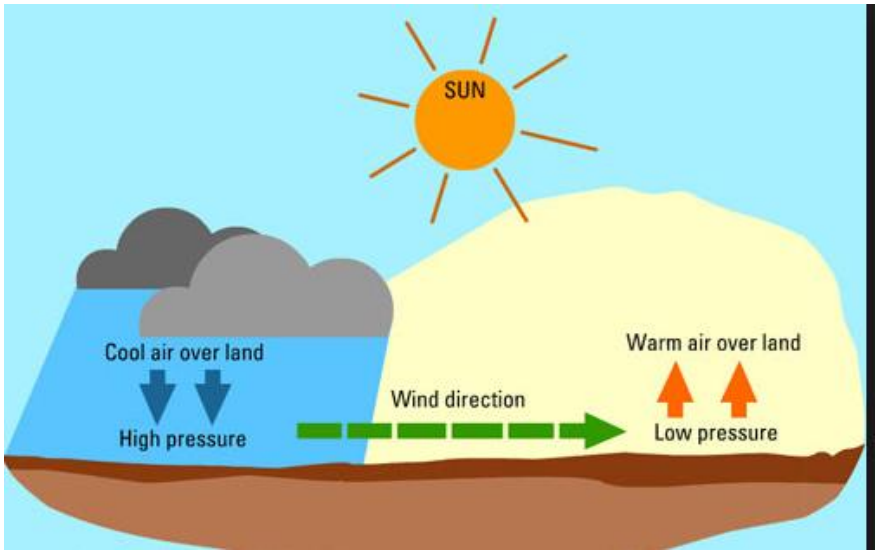



Clouds from those it is raining
moist warm air rises
and cools down
L
Low
pressure area
H
high
pressure area
dry and cold air
declines and
warms up
wind blow in the clockwise direction
from center.



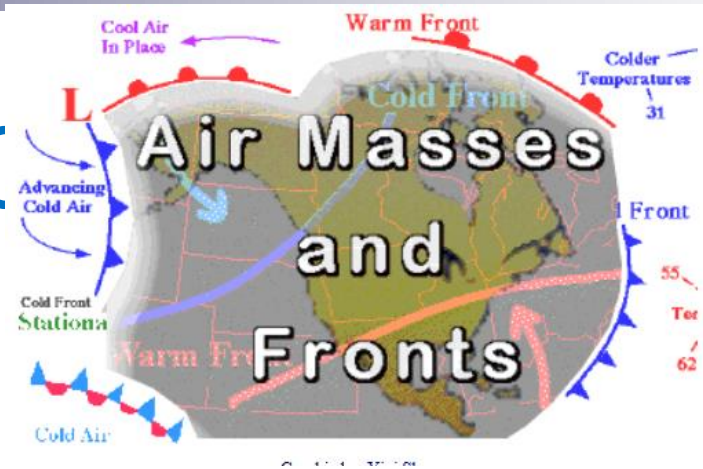
AIR PRESSURE - WIND

Air moves because of pressure systems - it travels from areas of high pressure to areas of low pressure.



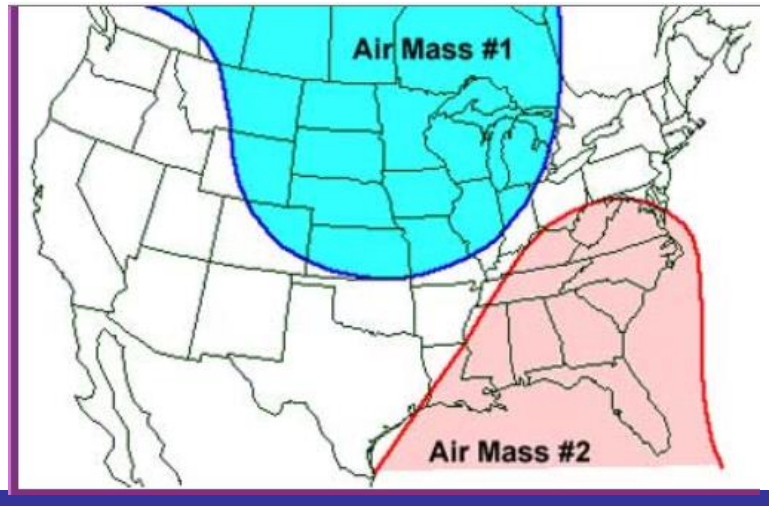
Air near the earth's surface is heated by the sun. Warm air is less dense and rises and low pressure areas are created below. Air in high pressure areas then rushes to fill in the gap. If there's a big difference between the pressure, the flow of air between the two points will be stronger.

SCIENCE 12(



- **Topic 8:**

  North America Weather System

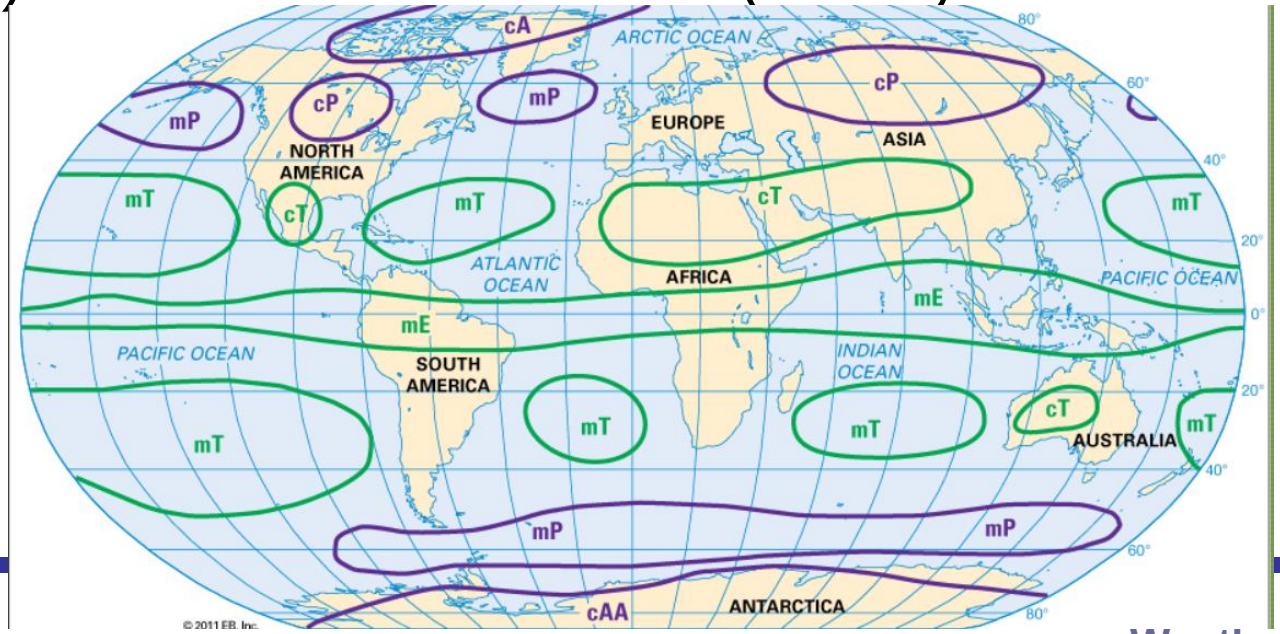


Weather System

- **Weather System:** a set of temperature, wind, pressure and moisture conditions for a certain region, that moves as a unit over a period of days

NORTH AMERICAN WEATHER SYSTEMS (p. 546 – 549)

- In the mid-latitude regions of North America weather is difficult to forecast because it changes so often (because in this region cold air form the north meets warm air from the south)
- • It's easier to forecast near the equator (usually hot and humid) and near the North Pole (usually cool and dry).



Air Masses

The bases of weather systems in N.A.

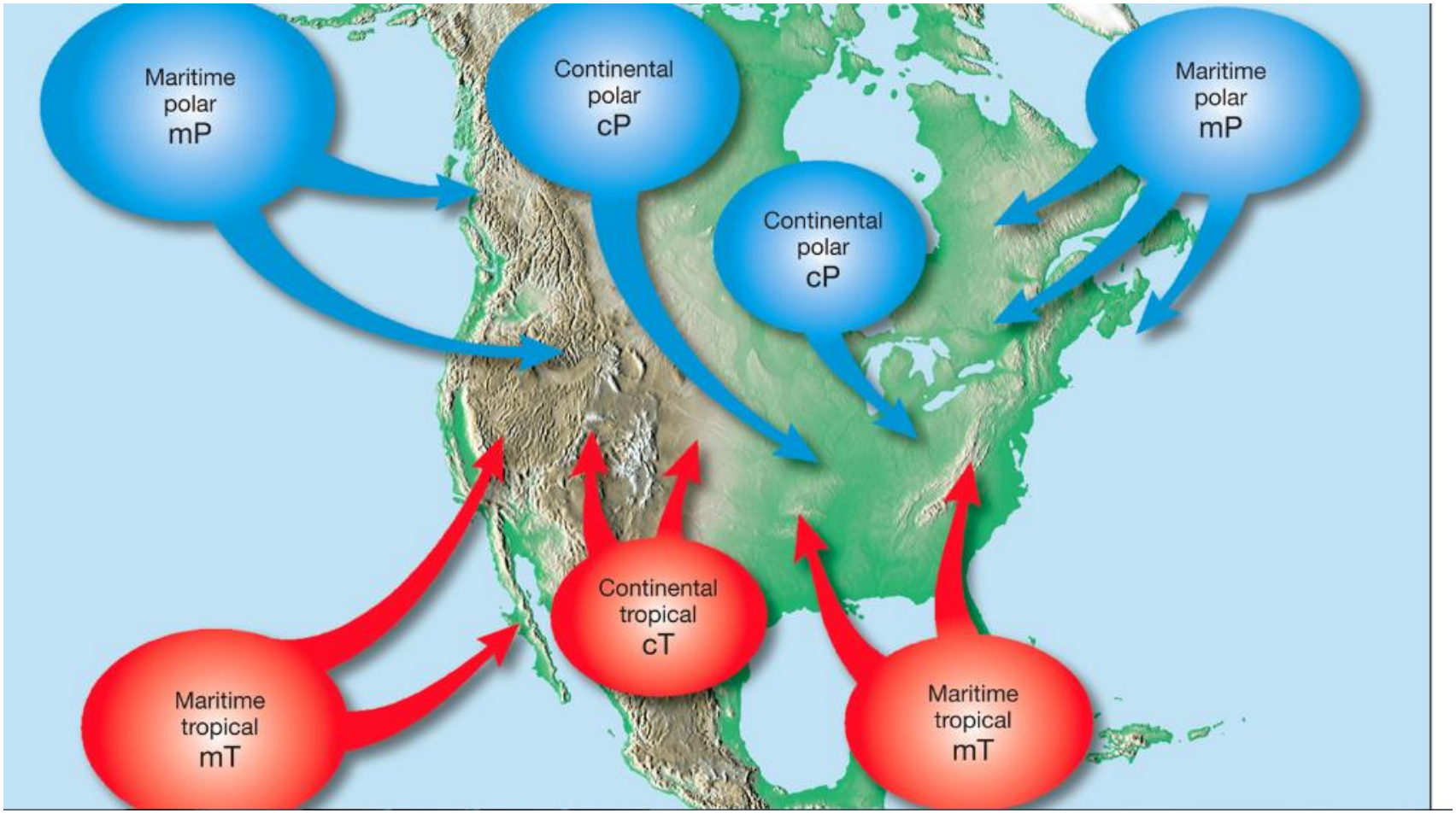
Large bodies of air in which temperature and moisture content at a specific altitude are fairly uniform

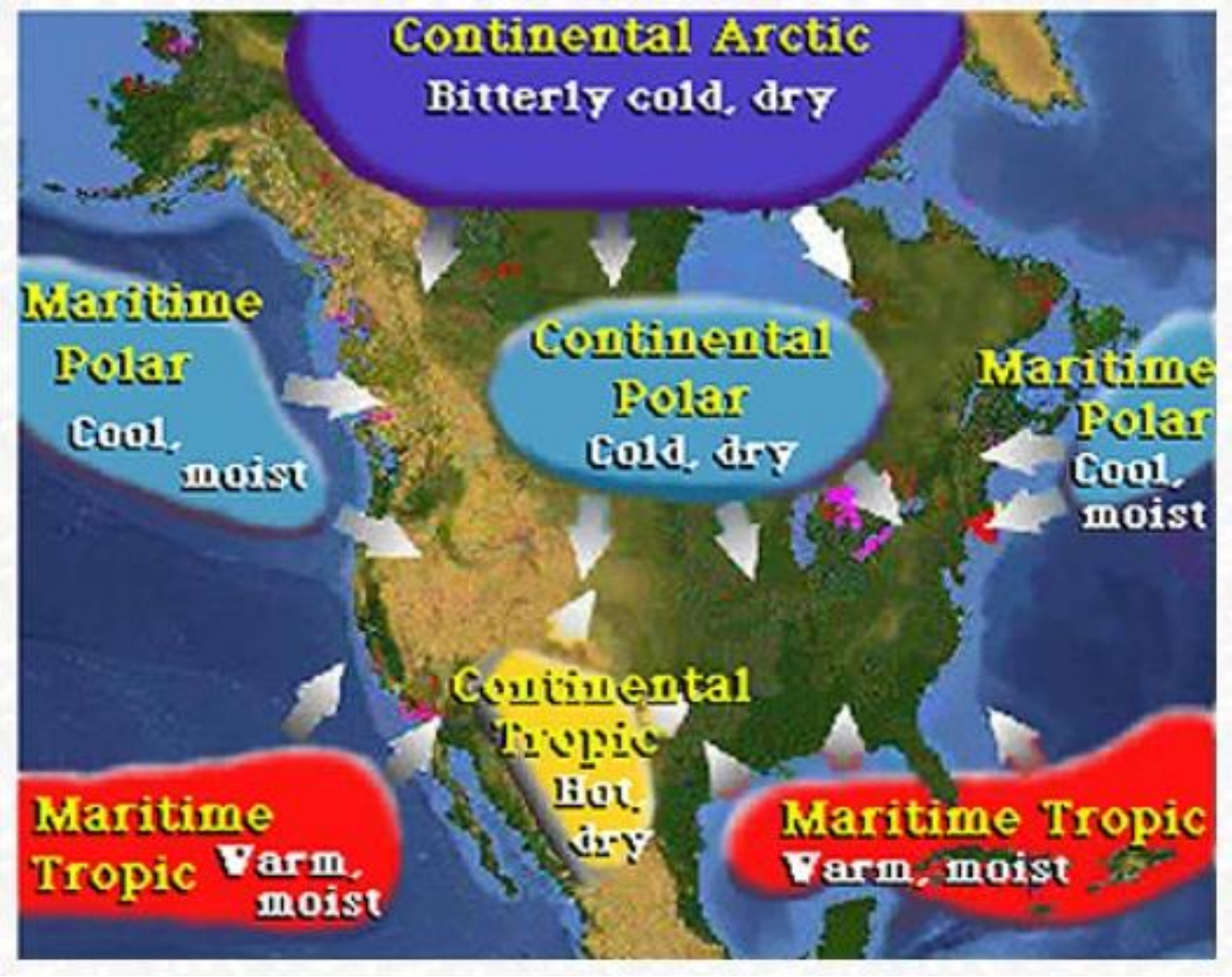
Vary in size, from 100 km across to 1000 km across

Most form where air above surface is fairly still for days or weeks and air takes on the moisture and temperature properties of the surface

Help maintain Earth's energy balance ie. Convection and prevailing winds move warm, tropical air northward and cold, polar air southward.

NORTH AMERICAN AIR MASSES




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
Maritime Tropic
Warm, moist

THE 6 NORTH AMERICAN AIR MASSES

Air Masses	Temperature	Moisture Content	Where they form	Direction they move
Maritime Polar (West Coast)	Cool	moist	Over North Pacific Ocean	Northwest to southeast
Maritime Polar (East Coast)	Cool	moist	Over North Atlantic Ocean	Northeast to southwest
Continental Polar	Cold	dry	Over mid-polar Regions of N.A.	North to south
Maritime Tropical (West Coast)	warm	moist	Over South Pacific Ocean	Southwest to northeast
Maritime Tropical (East Coast)	warm	moist	Over South Atlantic Ocean	Southeast to northwest
Continental Tropical	warm	dry	Over mid-southern U.S. & northern Mexico	South to north

Front

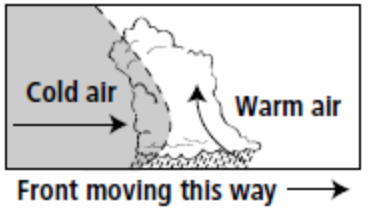
Front: the leading edge of a moving air mass; air masses with difference properties don't blend easy, so a boundary, or front, develops as they meet.

When a front passes, the weather changes.

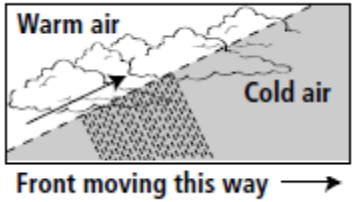
Types of Fronts

The four main types of fronts:

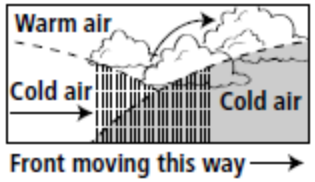
Cold front: the leading edge of a cold air mass



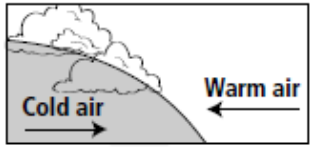
Warm front: the leading edge of a warm air mass



Occluded front: forms when a cold front catches up with a warm front; the warm air is lifted above the earth's surface and is cut off (occluded) from the cooler air below



Stationary front: occurs when the boundary between warm and cold air masses remains still for some time



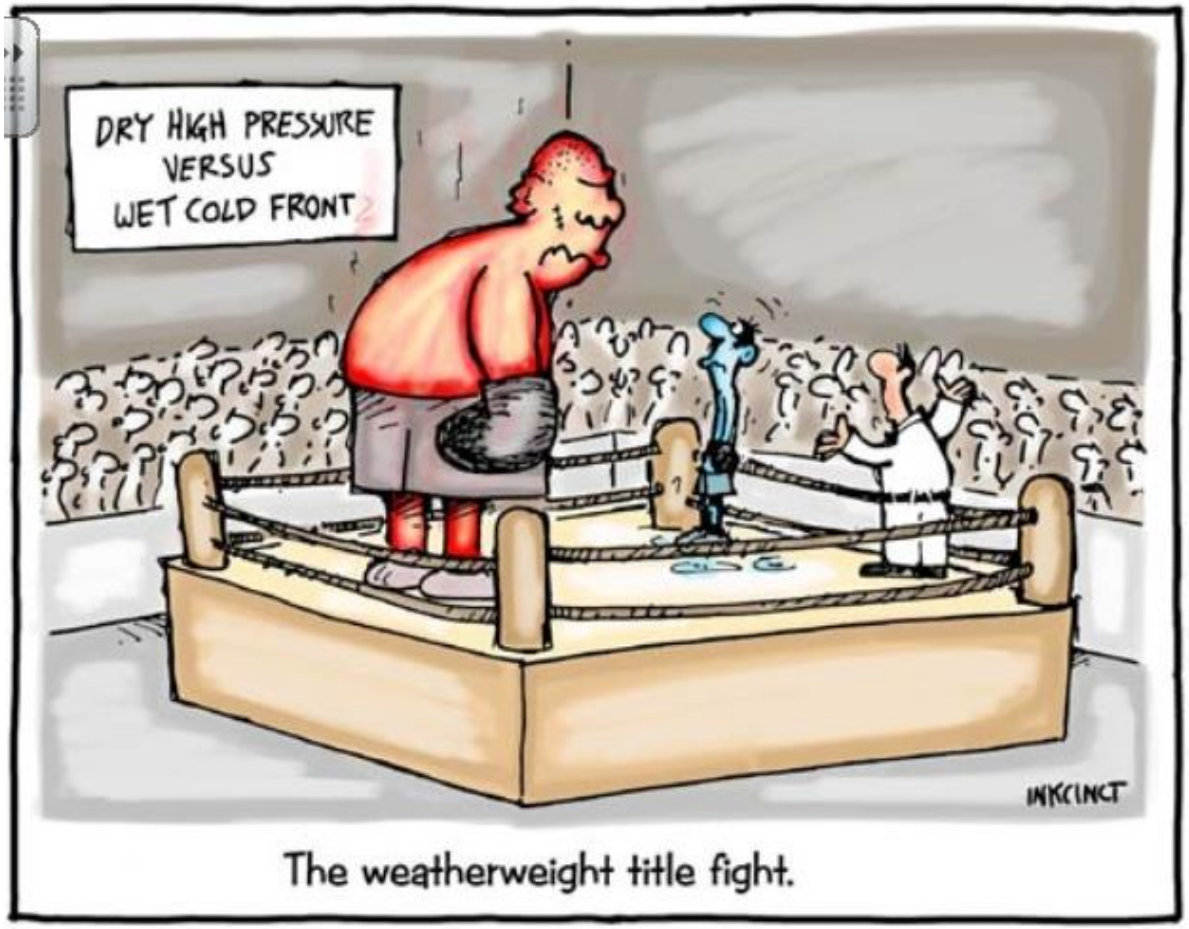
Low Pressure System

Low Pressure System

is a region where the atmospheric pressure is lower than that of surrounding locations. It tends to bring cloudy skies and stormy weather.

It may be referred to as a **low pressure trough** or simply **trough**

When viewed from above, winds spiral into a low-pressure center in a counterclockwise rotation in the Northern Hemisphere.

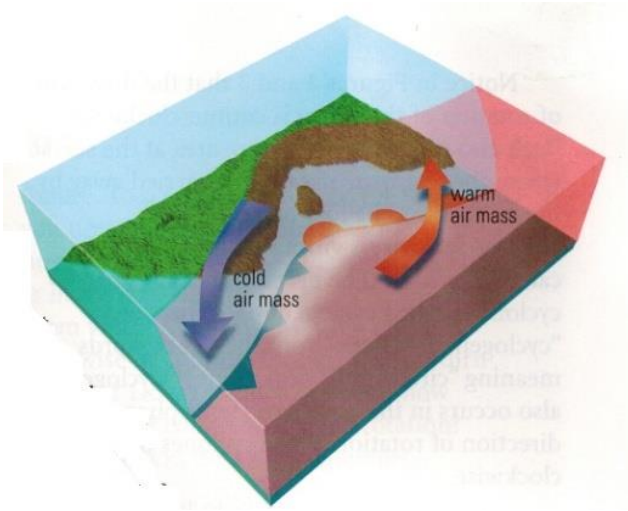


A low pressure system occurs when a cold front (leading edge of a cold air mass) meets a warm front (leading edge of a cold air mass)

FORMATION OF A LOW-PRESSURE SYSTEM (STORM)

- A front forms between a cold air mass and a warm air mass

- Fast-flowing air in the jet stream pulls air up out of both air masses, creating a low-pressure system near the ground.

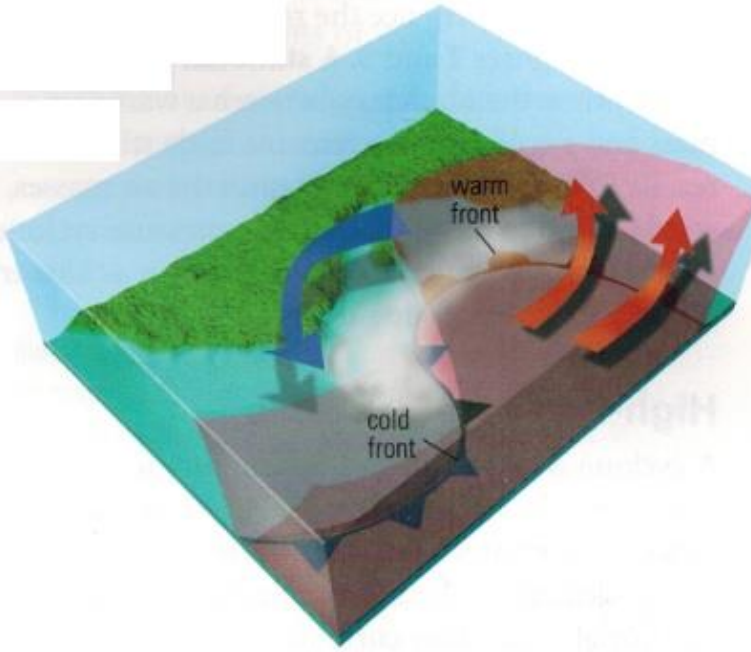


- The low-pressure area pulls in air near the surface

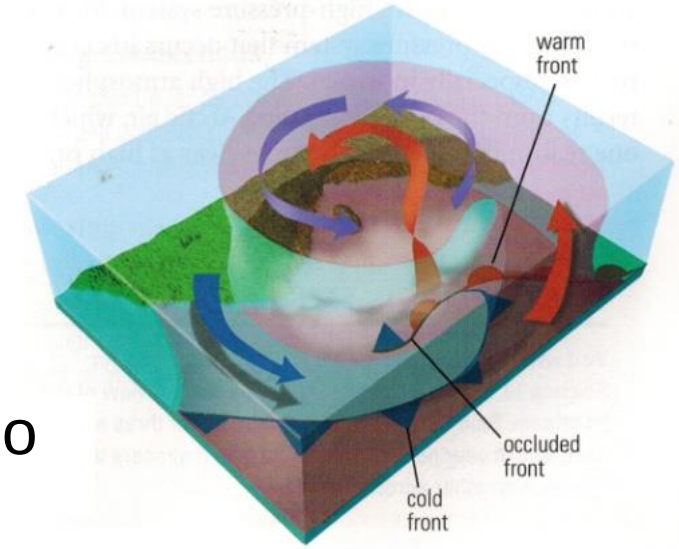
- The rising air swirls in a counter-clockwise direction (Coriolis effect)

- The warm front rises over the cold air mass, carrying moisture with it and the cold front pushes under the warm air mass, causing warm, moist air to rise steeply.

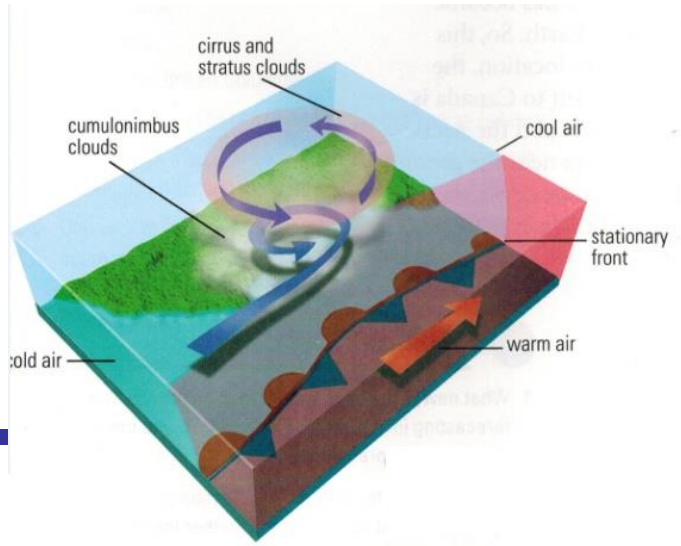
- A region of precipitation forms in front of the warm front as the jet stream continues to pull air away. Cumulonimbus clouds form and bring precipitation



- An occluded front forms as the warm front is caught by the cold front, cutting it off from the cooler air below (in the low-pressure system)



- The storm ends as upper air flow no longer pulls air away from the low-pressure area and a stationary front forms



High Pressure

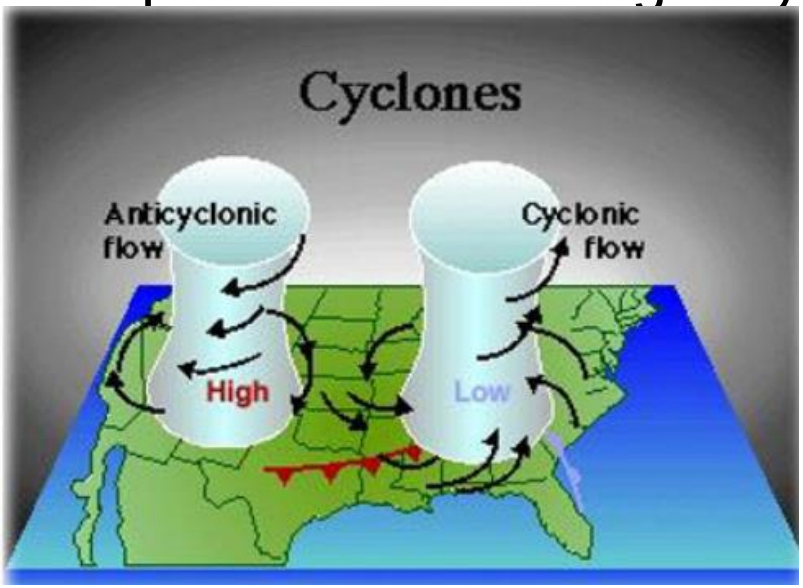
High pressure system

is a region where the atmospheric pressure is higher than that of surrounding locations . It is a whirling mass of cool, dry air that generally brings fair weather and light winds.

When viewed from above, winds spiral out of a high-pressure center in a clockwise rotation in the Northern Hemisphere.

Movement of Pressure Systems

Cyclogenesis: the process of forming a cyclone



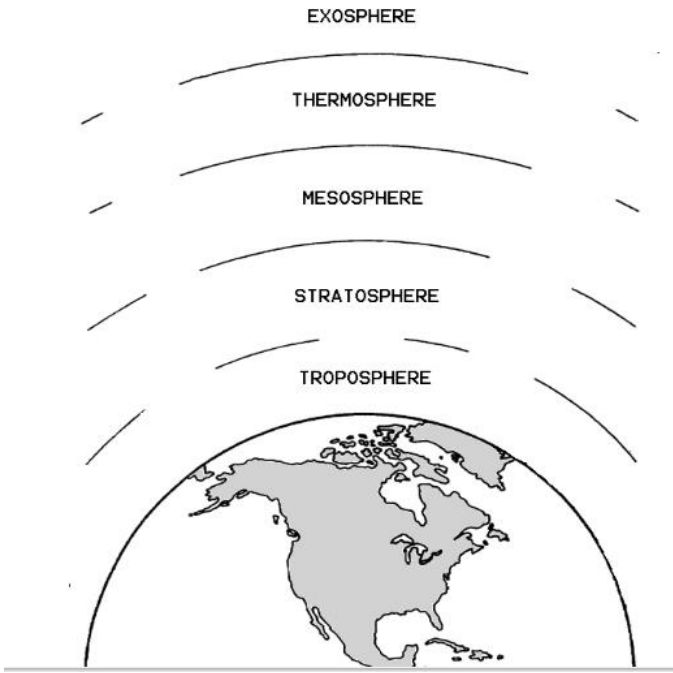
Cyclone: a low-pressure system that rotates counterclockwise (in the Northern Hemisphere) and usually brings cloudy, stormy weather

Anticyclone: a high-pressure system that rotates clockwise (in the Northern Hemisphere) and usually brings clear skies

SCIENCE 1206

- **Topic 9:**

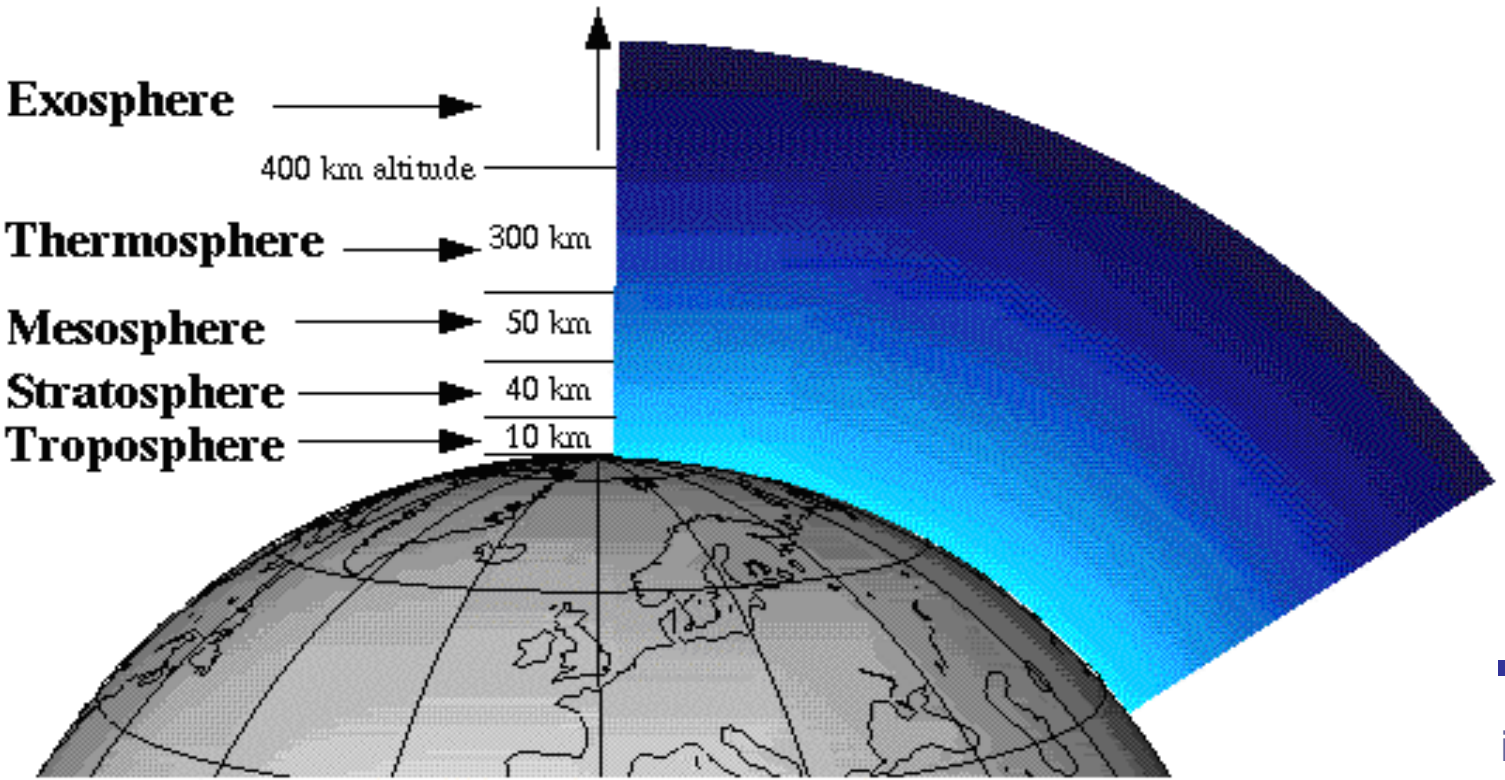
  Layers Of The Atmosphere



In order to better understand our atmosphere, scientists have divided it into several layers.

These layers are divided based on the characteristics of air temperature that height.

Each layer in our atmosphere is referred to as a **sphere**.



Layers of the Atmosphere

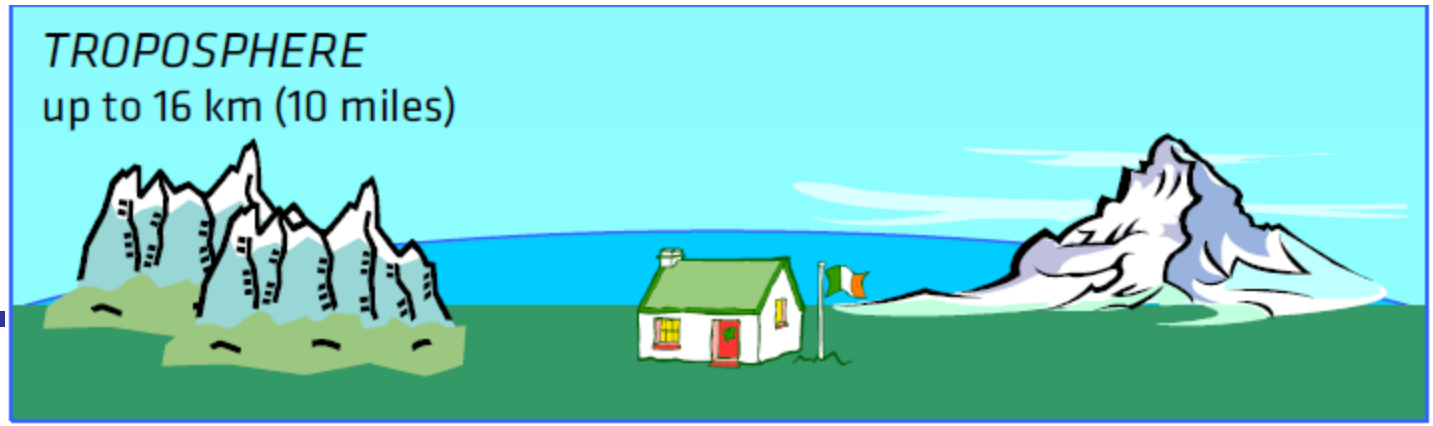
1. Troposphere

-Layer closest to the Earth's surface.

-Altitude of 8 km at the poles and up to 16 km at the equator..

-Most of our weather occurs in this layer.

- The upper part of this layer is colder than the lower part.



2. Stratosphere

-located between 12 km and 50 km above the Earth's surface.

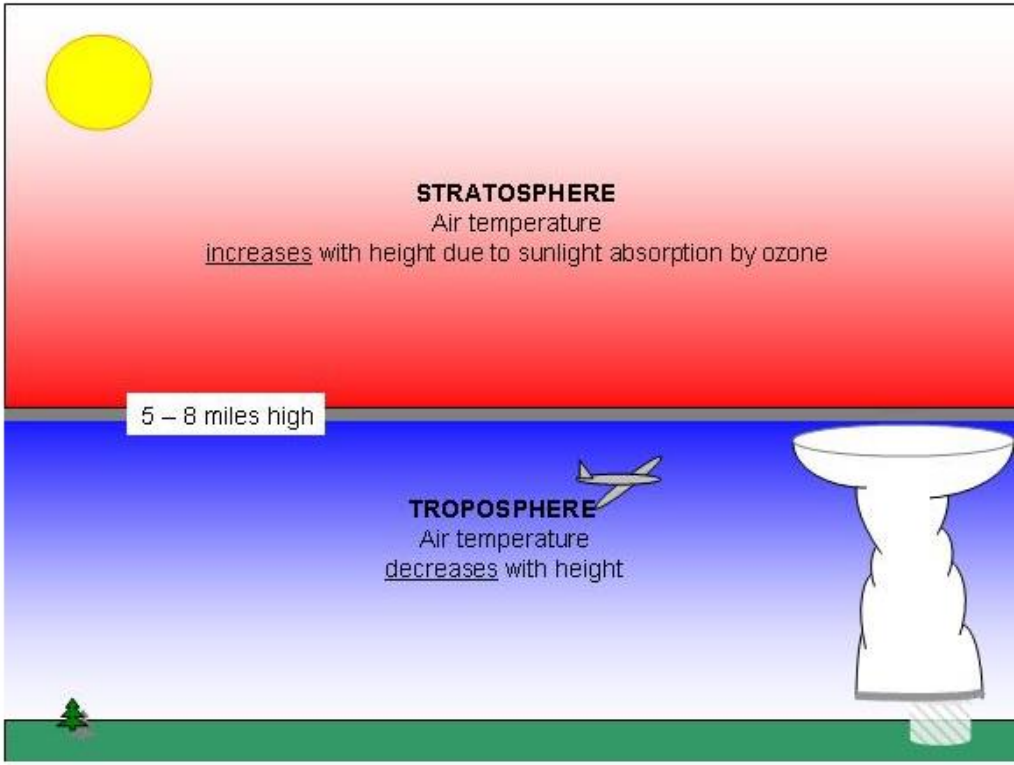
-This layer contains high concentrations of ozone.

-Ozone protects the Earth from harmful doses of ultraviolet given off by the sun

-The ozone also cause the stratosphere to be warmer.

-Tropopause refers to transitior Layer between the troposphere and stratosphere

No weather occurs here



Jet fly in the stratosphere

3. Mesosphere

- the middle layer extends from 50 km to 80 km.

-This layer has low concentrations of gases and low temperatures

-Most meteors burn up in the mesosphere.

mesosphere

4. Thermosphere

- extends from 80 km to 500 km.

- It is in this layer that X-rays (from the sun) are absorbed. This absorption by the few air molecules in this layer gives the molecules energy producing higher temperatures.

-The sun's radiation cause the particles in this layer to become electrically charged to produce the northern and southern lights (auroras).

It is also where the space shuttle orbits.

5. Exosphere

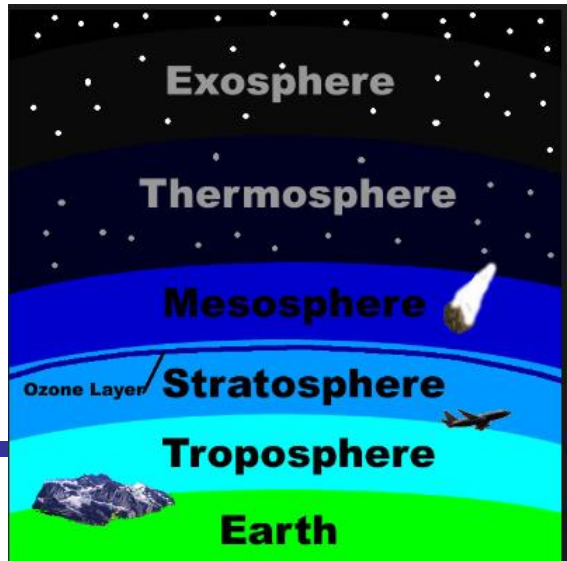
-extends from 500 km to 1000 km

-thin outer part of our atmosphere.

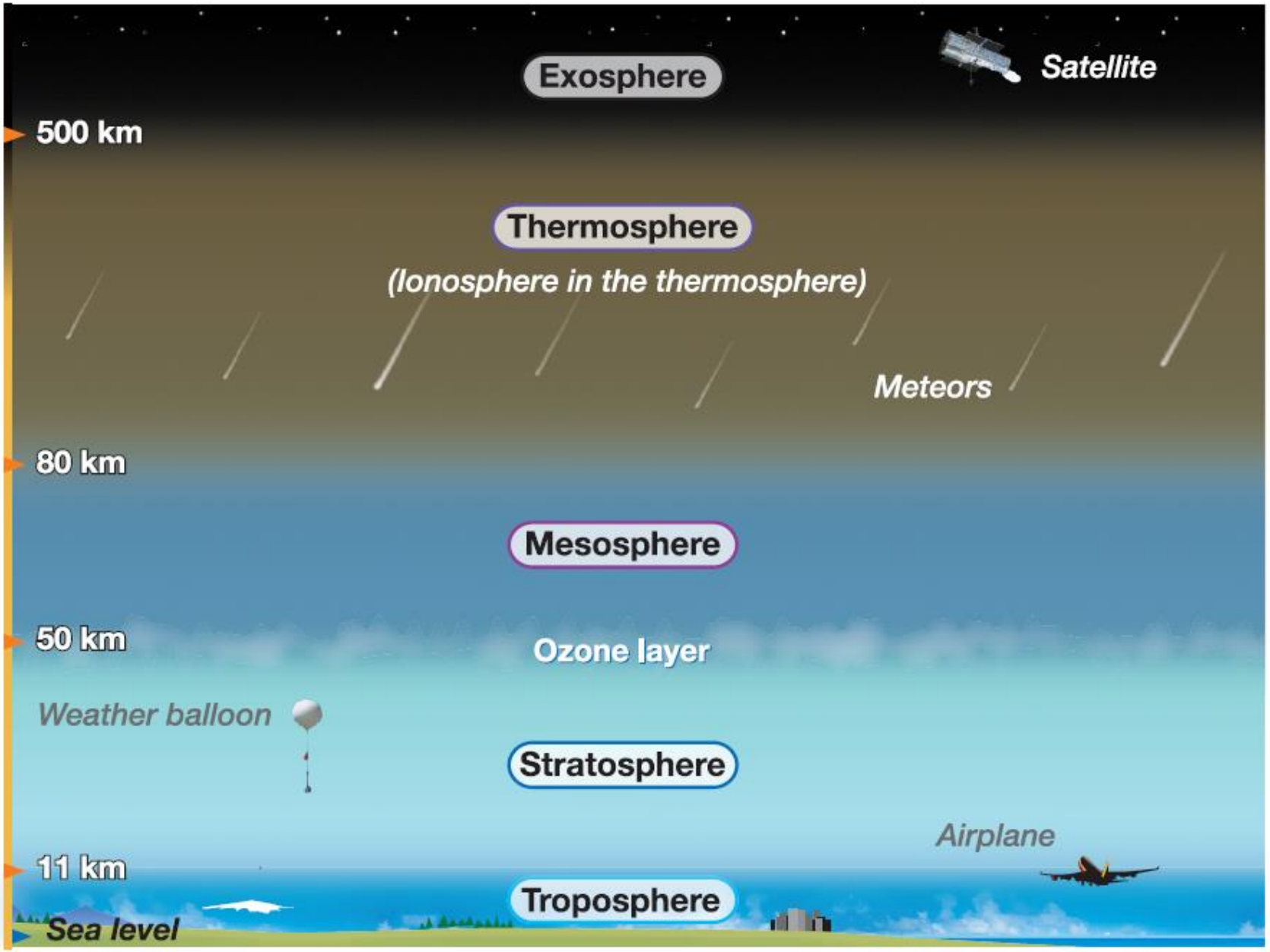
-There are very few particles (mainly hydrogen) in this layer.

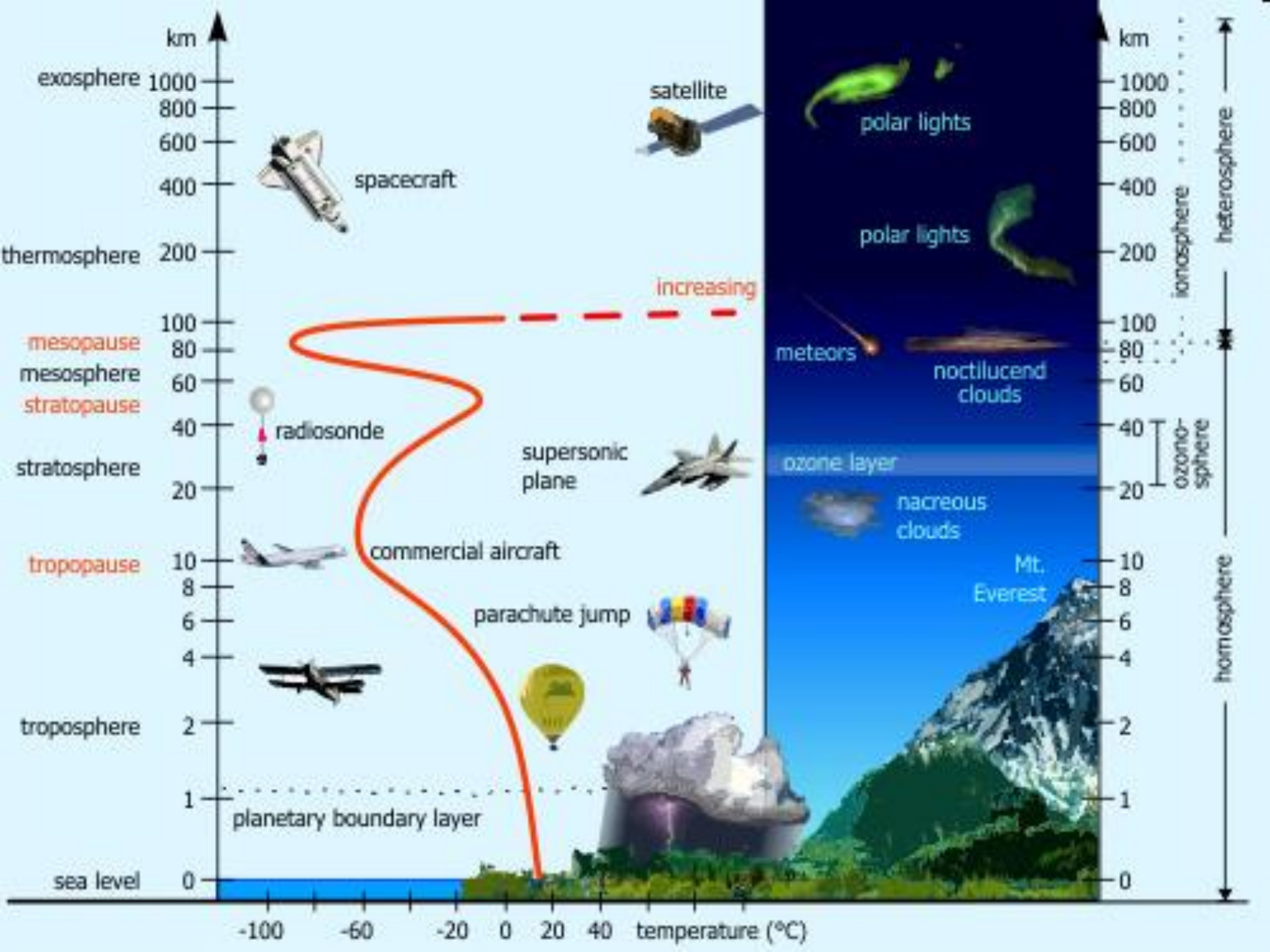
-The upper part of this layer is the beginning of true space.

-Some manmade satellites orbit the Earth within this layer.



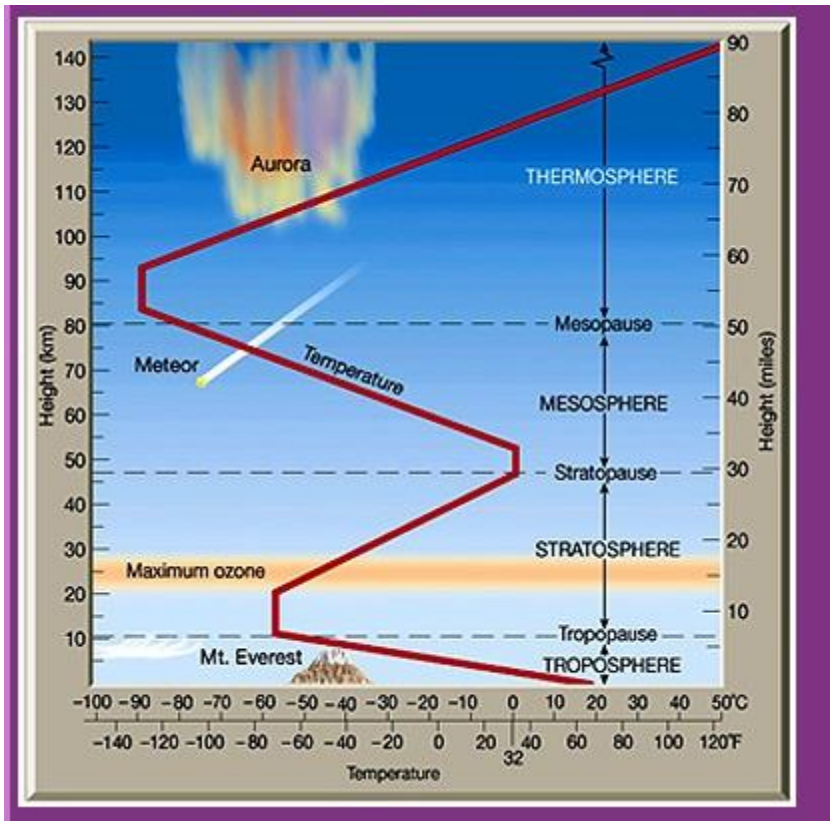
Layers in the Atmosphere




km
exosphere
1000
800
600
400
thermosphere
200
100
mesopause
80
mesosphere
60
stratopause
40
stratosphere
20
tropopause
10
8
6
4
troposphere
2
1
sea level
0
satellite
spacecraft
increasing
radiosonde
supersonic plane
commercial aircraft
parachute jump
planetary boundary layer
-100
-60
-20
0
20
40
temperature (°C)
polar lights
polar lights
meteors
noctilucend clouds
ozone layer
nacreous clouds
Mt. Everest
ionosphere
heterosphere
ozono-sphere
homosphere

TEMPERATUE OF THE LAYERS

as you continue traveling outward through the atmosphere, you will find that as you approach the tropopause the temperature will stop decreasing, and for several miles will remain constant. It will then actually begin to increase again as you travel through the upper stratosphere. As you enter the mesosphere, the temperature will once again begin to drop, getting cooler and cooler. Then, as you travel up through the thermosphere, the temperature again begins to increase, eventually becoming even warmer than the temperature on the surface of the Earth. Finally, as you continue to travel outward leaving the atmosphere via the exosphere, the temperature drops again, becoming very cold.



Acronym for the Layers of the Atmosphere

- Top
- Students
- Make
- Test
- easy

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere
5. Exosphere