Weather & Climate

Introduction
Dimensions of the Earth
Rocks & Minerals
Earthquakes
Weathering
History
Weather
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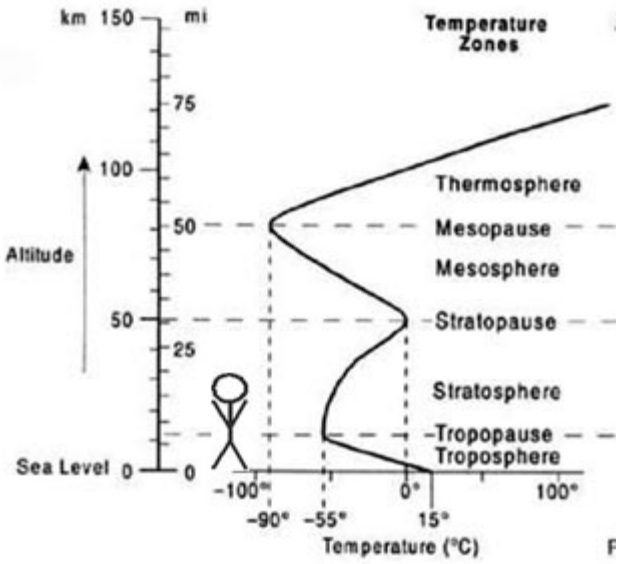
Structure of the Atmosphere

Meteorology is the study of the atmosphere- including weather.

Weather is the condition of the atmosphere. It can change from time to time and place to place.

Climate is the type of weather an area has over a long period of time.

Layers of the atmosphere: separated by the variation of temperature patterns.



In these two models, you can see how most of the atmosphere is concentrated near the surface due to the pull of gravity.

Speed Links

Storms

Fronts

Water Cycle

Land/Sea Breeze

Orographic Effect

Time-Temp Lag

Worksheets & Downloads

Vocabulary

States of Matter

Fronts

Gradients

Drawing Isotherms

Station Model Code

Station Models 1

Station Models 2

Pressure Conversions

Isobars

Rel Hum/DPT

Rel Humidity 1

Rel Humidity 2

Dew Point Temperature

Temperature Conversions

Temp/Rel Hum/DPT

Weather Review

Contrails DBQ

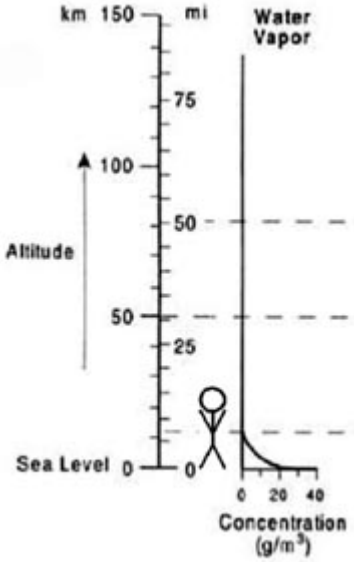
Perfect Storm DBQ

Hurricane of 1938 DBQ

Long Island Groundwater Map

Troposphere

- We live in the troposphere.
- 0-18 km
- Gets colder as you go up.
- All weather occurs here
- "The Troublesphere"
- All water vapor in the atmosphere is here



Stratosphere

- Temperatures get warmer as you go up.
- Home of the Ozone layer.

Mesosphere & Thermosphere

- Upper layers of the atmosphere.
- The air is very thin here.

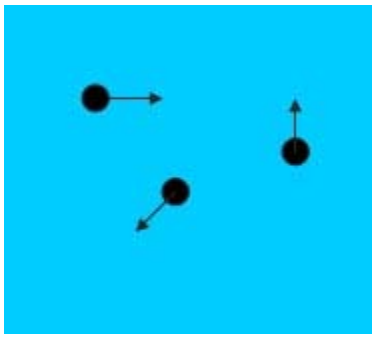
Atmospheric Variables- things that can be measured and change from moment to moment.
(Click the link to go down to that section)

- Temperature
- Air Pressure
- Wind Speed and Direction
- Water Content & Humidity
- Cloud Cover
- Precipitation
- Others (dust, transparency, pollen, etc)

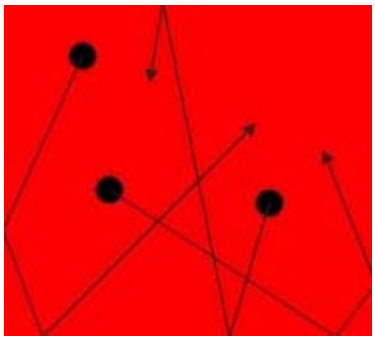
Temperature
Measures the average kinetic energy of molecules.

Heat enters the atmosphere from the sun as solar radiation.

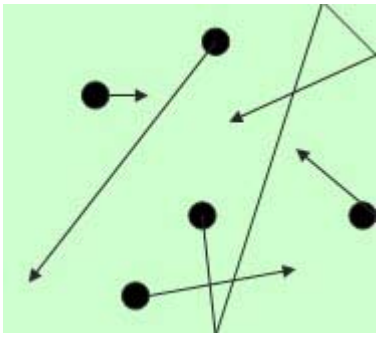
Average Kinetic Energy- kinetic energy is the energy of motion.



The slower the molecules vibrate, the colder the material.



If they vibrate fast, it is hot.



Mix hot & cold and you get warm.
The hot molecules still move fast and the cold move slow.

But the temperature averages to warm.

The temperature of any material is an average of all of the kinetic energies- hence *Average Kinetic Energy*.

3 ways to Measure temperature:
Fahrenheit

- Water freezes at 32°
- Water boils at 212 °

Celsius

- AKA Centigrade (100 levels)
- Water freezes at 0 °
- Water boils at 100 °
- Makes more sense and is easier to make a thermometer

Kelvin

- Same scale as Celsius but 0 means zero energy
- No degrees mark for Kelvin
- 0K means that all atomic vibrations stop.

Converting Temperature

To convert °C into °F: °F = °C x1.8 + 32

To convert °F into °C: °C = (°F - 32) ÷ 1.8

To convert °C into Kelvin K = °C + 273.15

To convert K into °C: °C = K -273.15

Energy always go from high to low.
There is no such thing as “cold”.
Cold is just an absence of heat.
Ice doesn’t add cold to something.
It sucks the heat into it.
Heat flows from hot to cold
(source to sink).

Heat Transfers:
Radiation -the transfer of heat in the form of light.

The Greenhouse Effect

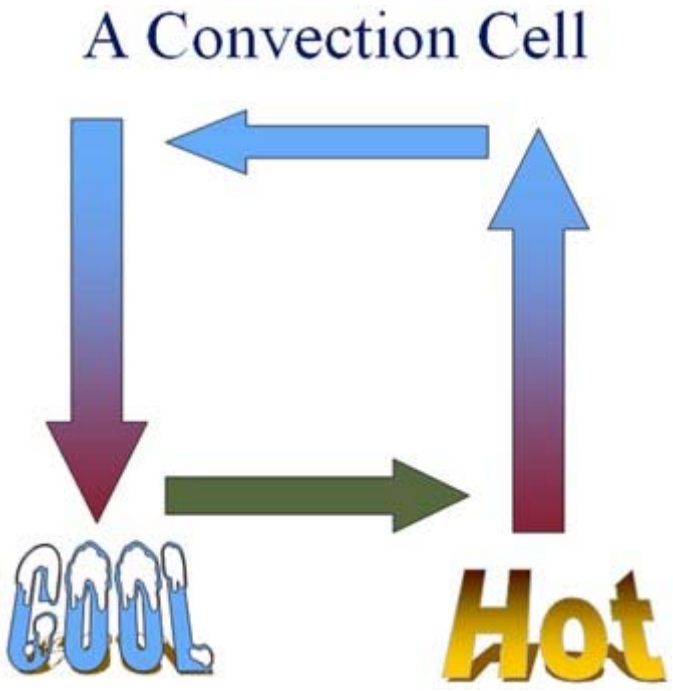
- IR (infrared) light that is re-radiated from the ground is stopped from reaching space by extra “greenhouse gasses” in the air.
- CO2 from burning fossil fuels.
- Clearing of trees.
- Fart gas from cows (methane).

Conduction- Heat transfers from one object to another through touch.

Convection

Hot Rises
Cold Sinks

- Caused by density differences:
  Hot air expands and gets less dense.
  Cold air contracts and gets more dense.



Air Pressure

- The weight of the air above you. The more air that is above you the more pressure you will feel.
- Sinking air pushes down more- cold air is usually high pressure.
- Rising air pushes down less- hot air is usually low pressure.

When converting from millibars to station model code, use only the last three digits and throw out the decimal point.

When converting from station model code to millibars:

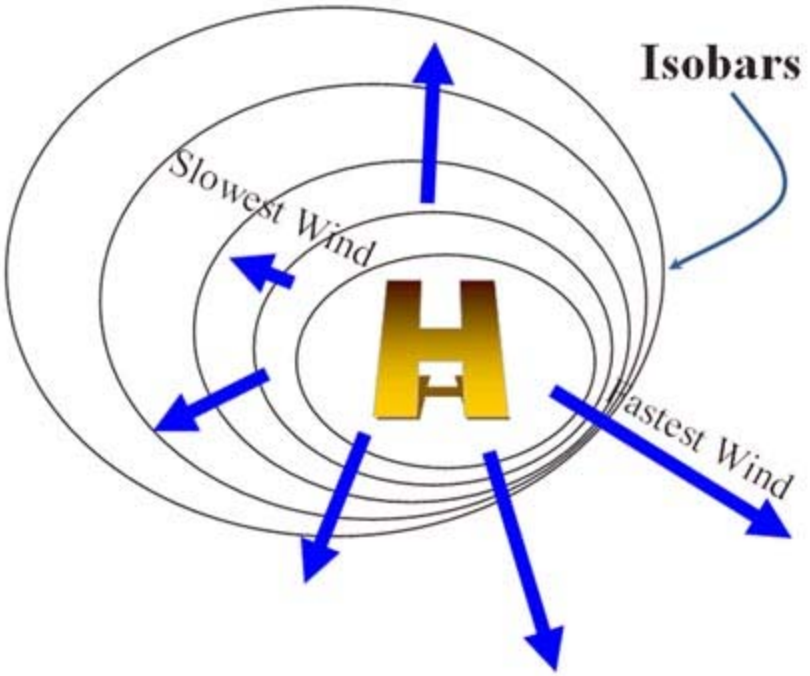
1. Write your code twice
2. Write a 10 in front of one
3. and a 9 in front of the other
4. Insert the decimal point between the last two numbers
5. Look on the reference Tables so see which one is possible

(Short Method: if the code is 500 or higher put a 9 in front, therwise put a 10)

Wind

- Wind travels from high pressure to low.
- The gradient between isobars determines the wind speed.

Big Difference in Pressure
(Steep Gradient) = fast wind



Small Difference in Pressure
(Gentle Gradient) = gentle winds

The Coriolis Effect

- The Coriolis Effect deflects things to their right in the Northern Hemisphere.
- Caused by the rotation of the Earth.
- High Pressure flows outward and clockwise (cw) (in the N. Hemisphere)
- Low Pressure flows inward and counterclockwise (ccw)(in the N. Hemisphere)

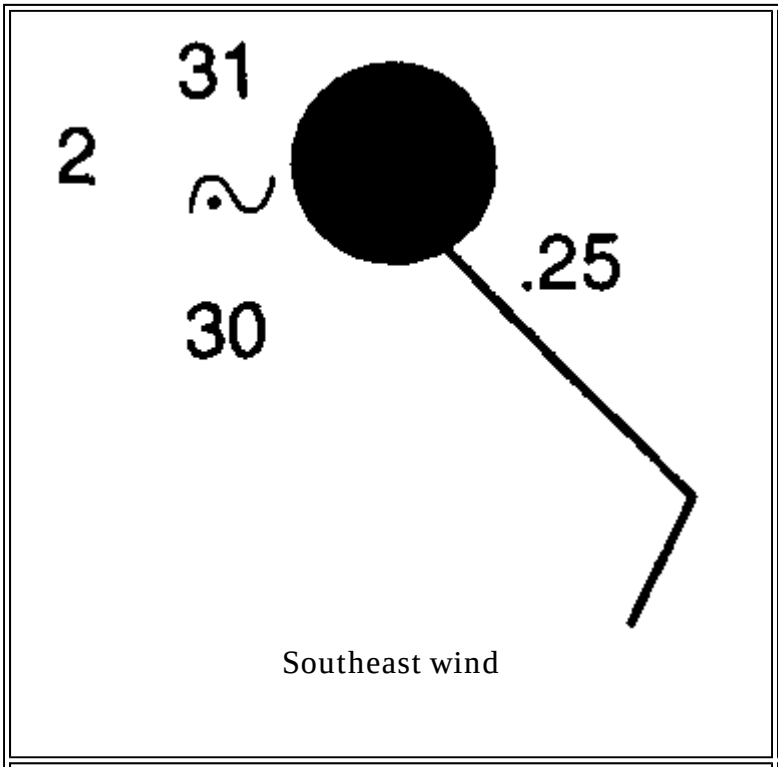
The Right Hand Rule

- Your thumb (of your right hand) represents the rising or sinking of low or high

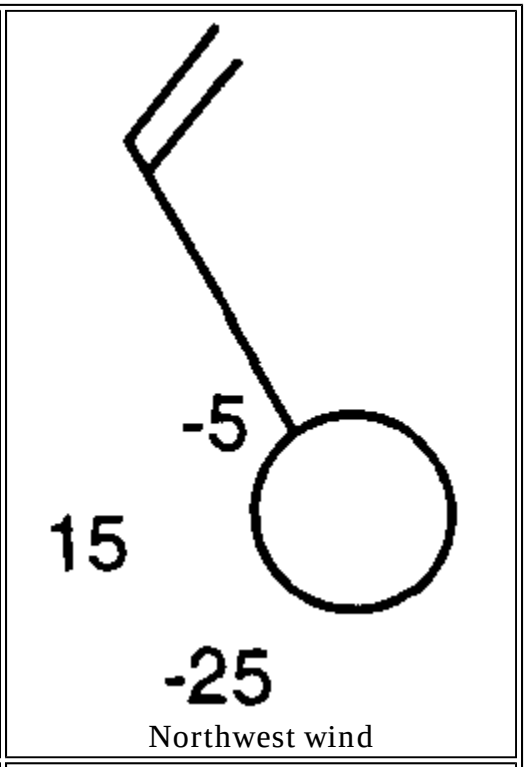
pressure.
- Your fingers wrap around your palm the way that the wind spirals around the pressure system.
- Low Pressure sucks so low has inward flow while highs are outward.

Wind Direction

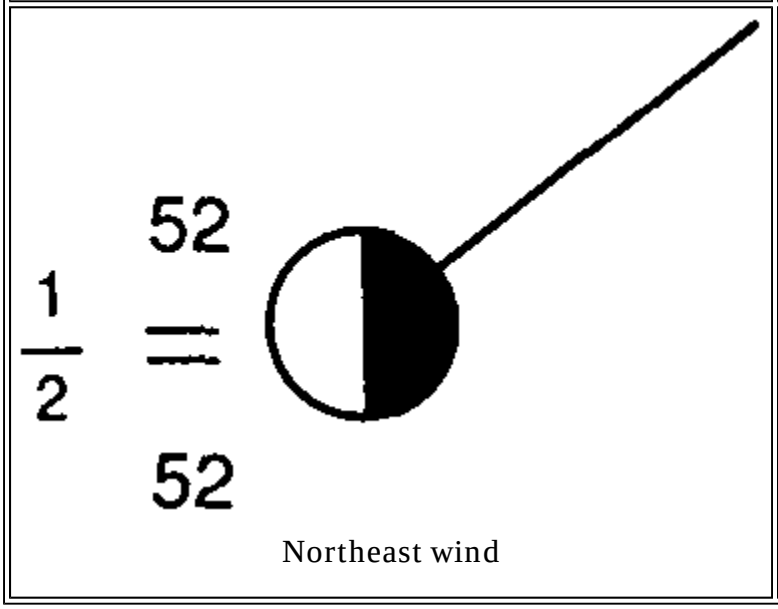
- Winds are named for the direction that they come **<u>from</u>**
- On a map direction is shown with a line showing where it came from.



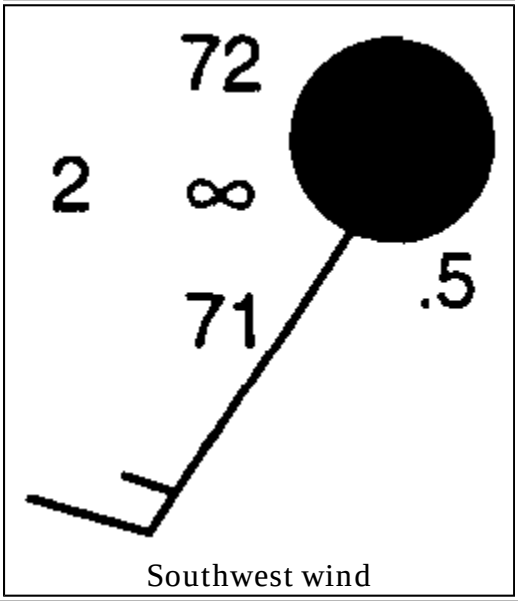
Southeast wind



Northwest wind

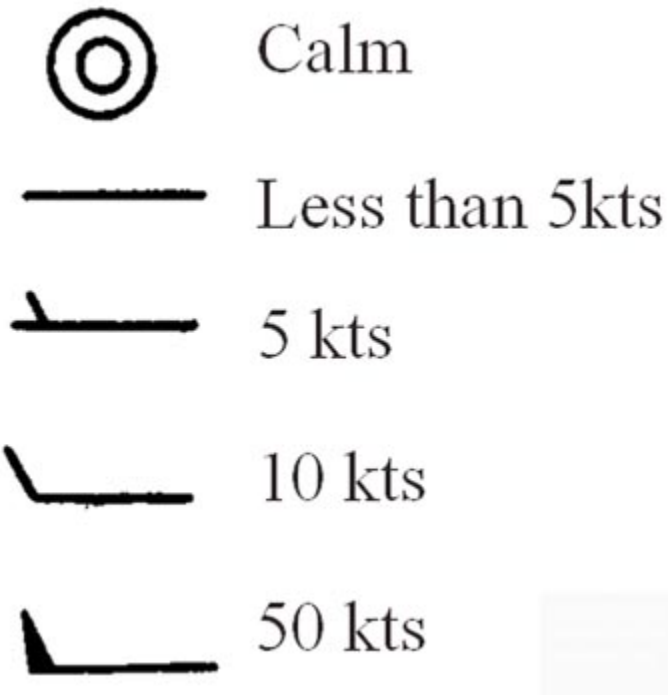


Northeast wind



Southwest wind

Wind Speed



Water Content & Humidity

The amount of water in the air is called **humidity**. The actual amount of water vapor in the air is the **absolute humidity**.

- The ability of air to hold water changes depending on the temperature.
- Relative humidity tells "how full" the air is with water.
- It is expressed in %.
- 100% is full and can't hold any more.
- It is **saturated**.
- Water gets into the air by evaporation or sublimation.
- **Evaporation** is changing from a liquid to a gas.
- **Sublimation** is changing from a solid (snow or ice) to a gas. (sublime means to skip a step)
- To get the water out of the air it either condenses or sublimes.
- **condense**-changing from gas to liquid.- dew
- **Condensation nucleus** – a small piece of dust, smoke, or salt that acts as a surface for codensation.
- **precipitation**- water that condenses in the atmosphere falls to the surface.
- Precipitation cleans out the atmosphere by pulling down the condensation nuclei (pollution)

Measuring Relative Humidity

The “Dry Bulb”

- Don’t let it fool you. It is just a thermometer.

- It measures the air temperature.
- Duh!

The “Wet Bulb”

- Has a little wet booty tied to the bottom.
- Gets cool when water evaporates.

On A Dry Day...

- A lot of moisture will evaporate.
- The wet bulb will be a lot cooler than the dry bulb.

On A Humid Day...

- A little bit of moisture will evaporate.
- The wet bulb will not be much cooler than the dry bulb.

Storms

Cyclone- any inward and counterclockwise air circulation around a low pressure center.

Types of Cyclones:

Tornado

- a small, compact storm with strong winds.
- AKA:
  - Twister
  - Willy-Willy (Australia)
- Extremely localized low pressure center.
- 99.9% in Northern Hemisphere spin ccw.
- Come from strong thunderstorms.
- Can be predicted a few minutes early with Doppler radar.
- Fujita Scale is based on the width and wind speed of the funnel.
- For more info on the Fujita Scale.

Hurricane

- A large, organized storm with strong winds and heavy rain.
- AKA
  - Typhoon- in the Pacific
- Massive storms with a size that can be more than 300 miles in diameter.
- Feed on warm water.
- Biggest danger is the storm surge in coastal areas.

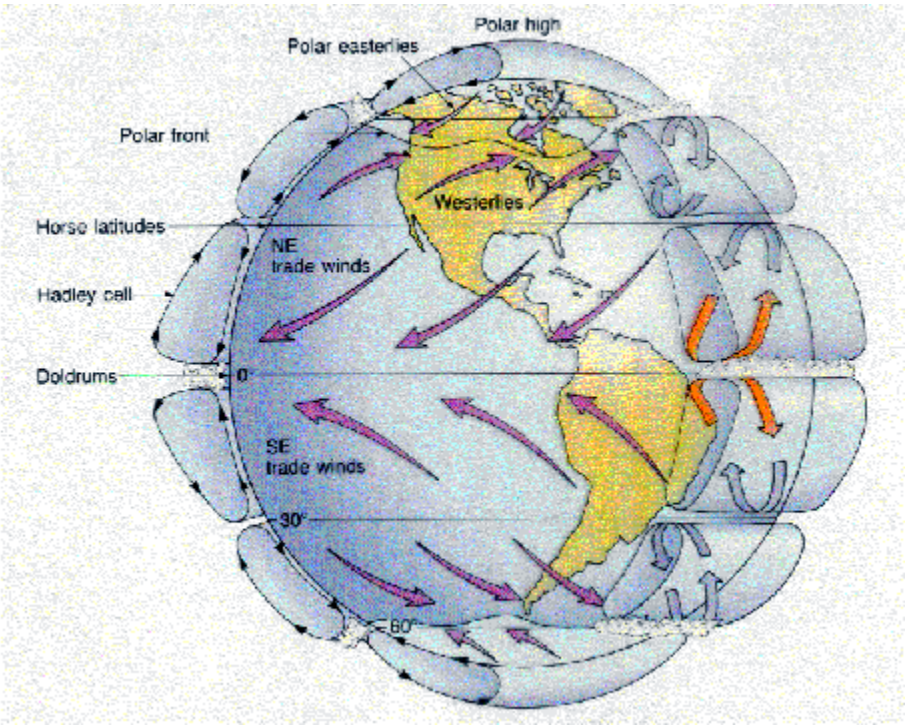
Mid Lattitude Low

- a low pressure system in the middle latitudes.

- We live in the middle latitudes.
- Comma-shaped ,
- AKA
    - Nor' Easter (North Easter)
    - Alberta Clipper

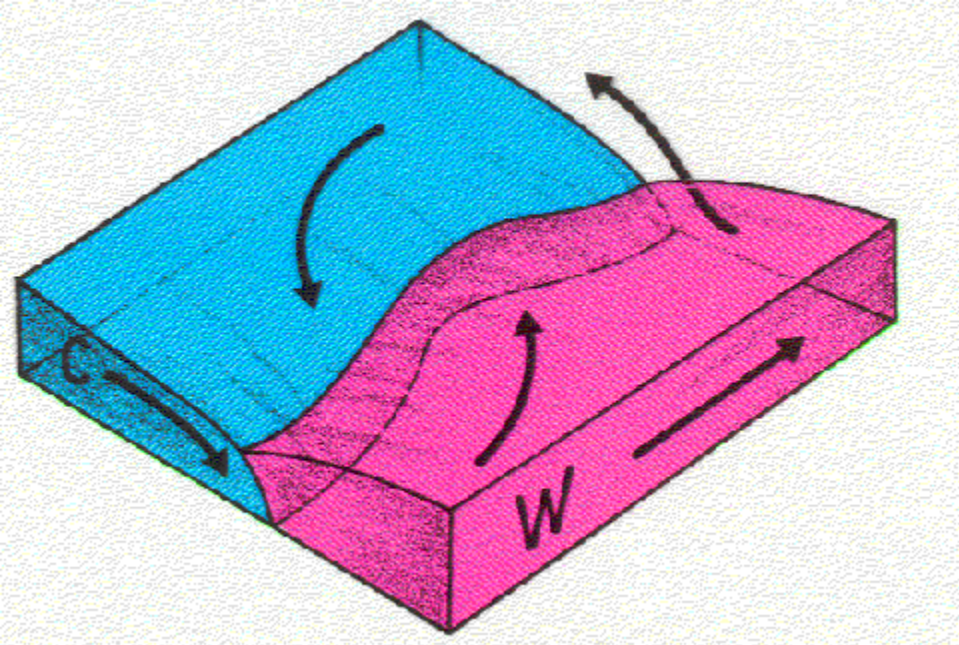
Prevailing Winds

- Push weather around
- On LI, the prevailing winds come from the west.
- Most of the time our winds come from the west.
- Therefore our weather will usually come from the west.
- Prevailing Westerlies- the typical west wind in most of the United States.

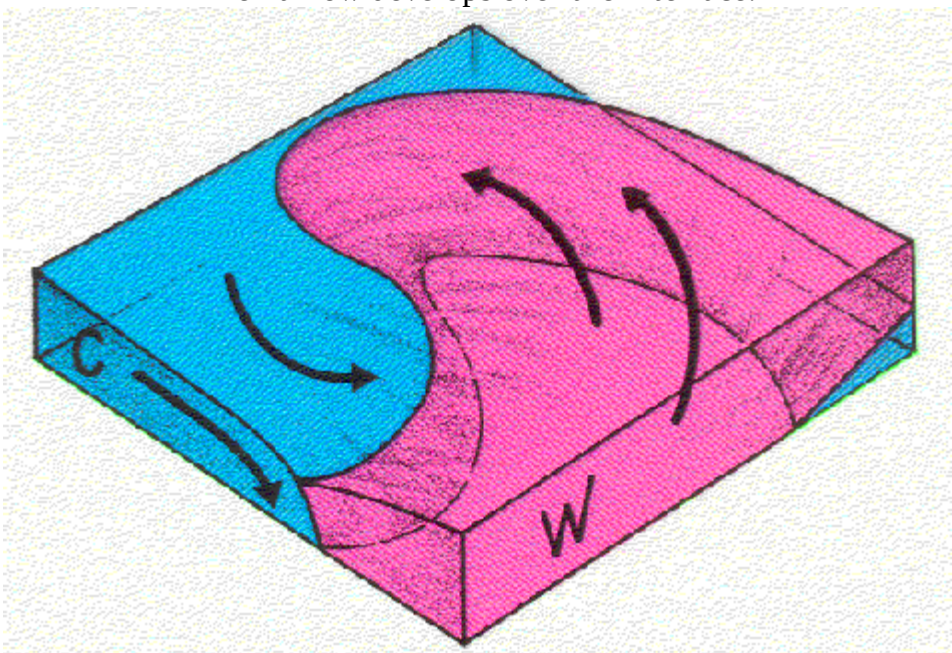


Development of The Mid Latitude Low

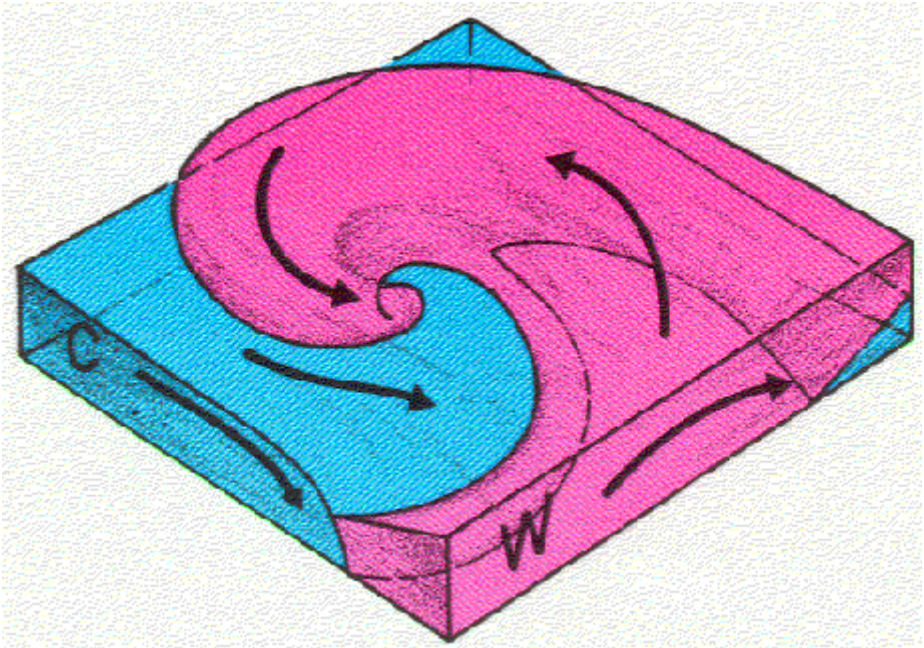
This weather system starts when cool and warm air masses meet.



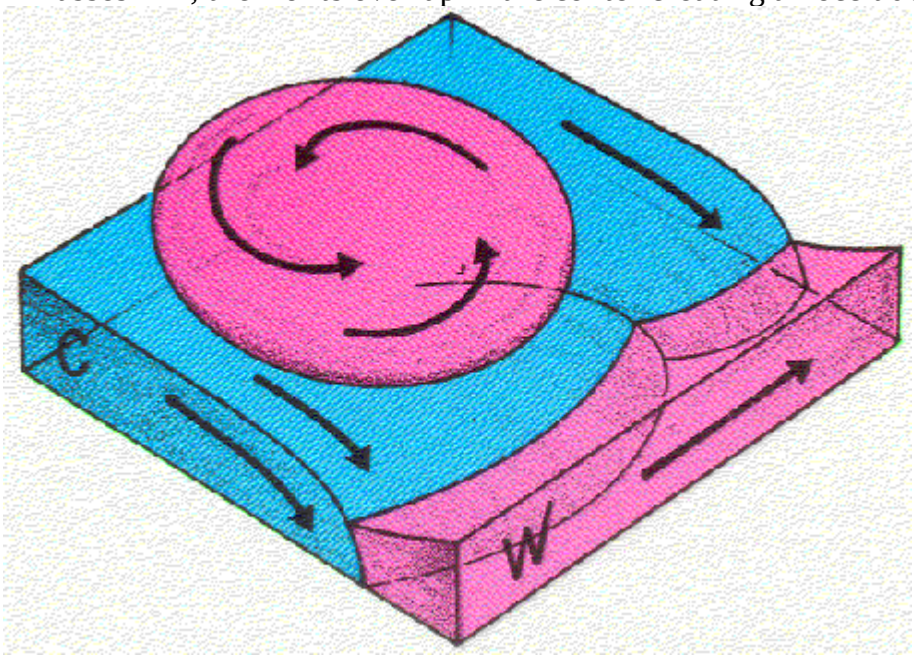
Then a Low develops over the interface.



The Low continues to spin, creating a warm front and a cold front.

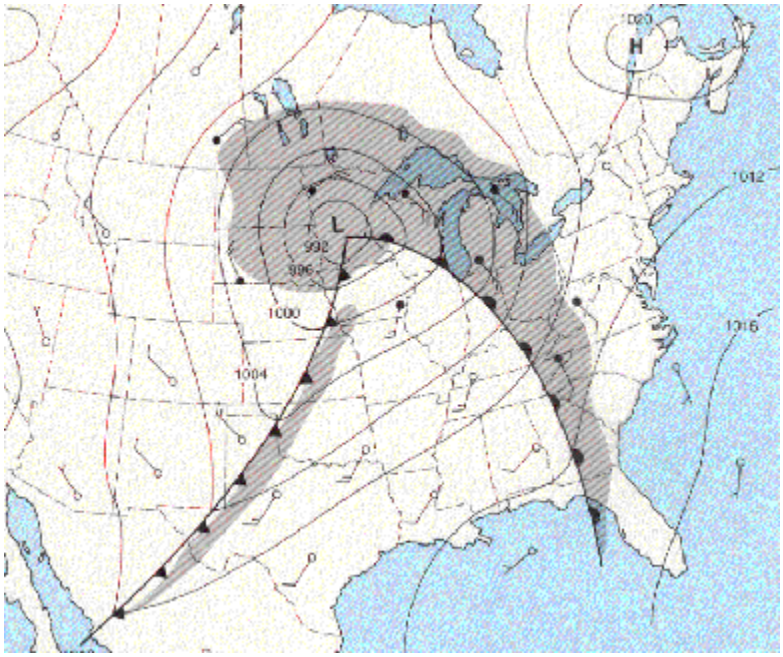


As the air masses mix, the fronts overlap in the center creating an occluded front.



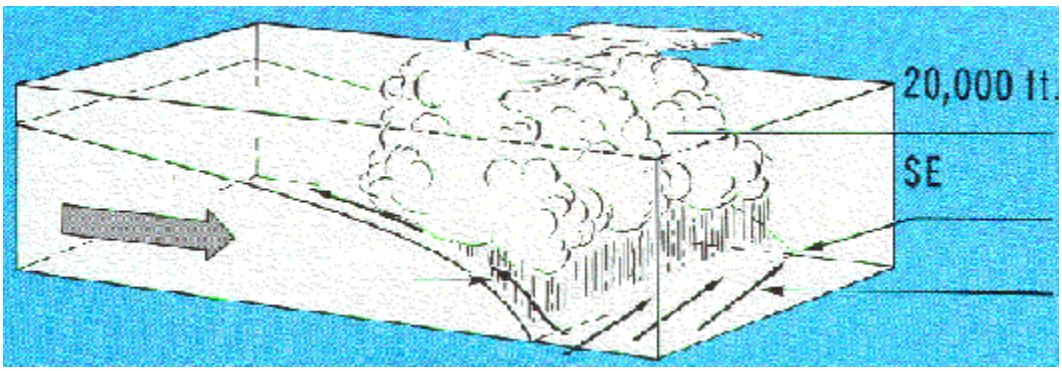
In the end, the air mixes and the system breaks down.
Rain will fall in front of the warm front and right on top of the cold front.

A well-developed Mid-Latitude Low



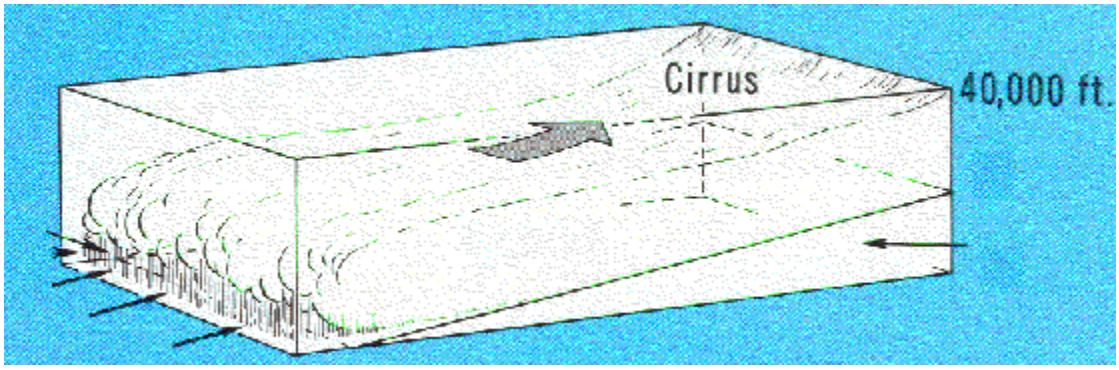
Fronts

The Cold Front



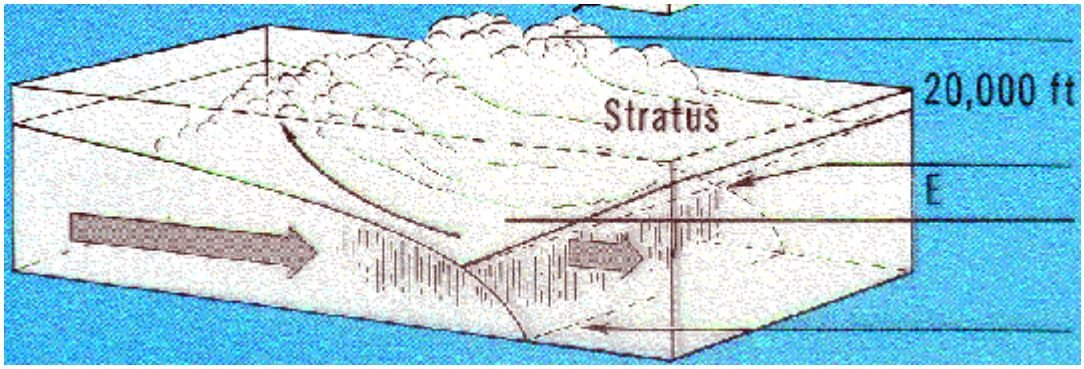
- Moves faster than the warm.
- Rain falls on top of the front.
- Short period of heavy rain & maybe thunder

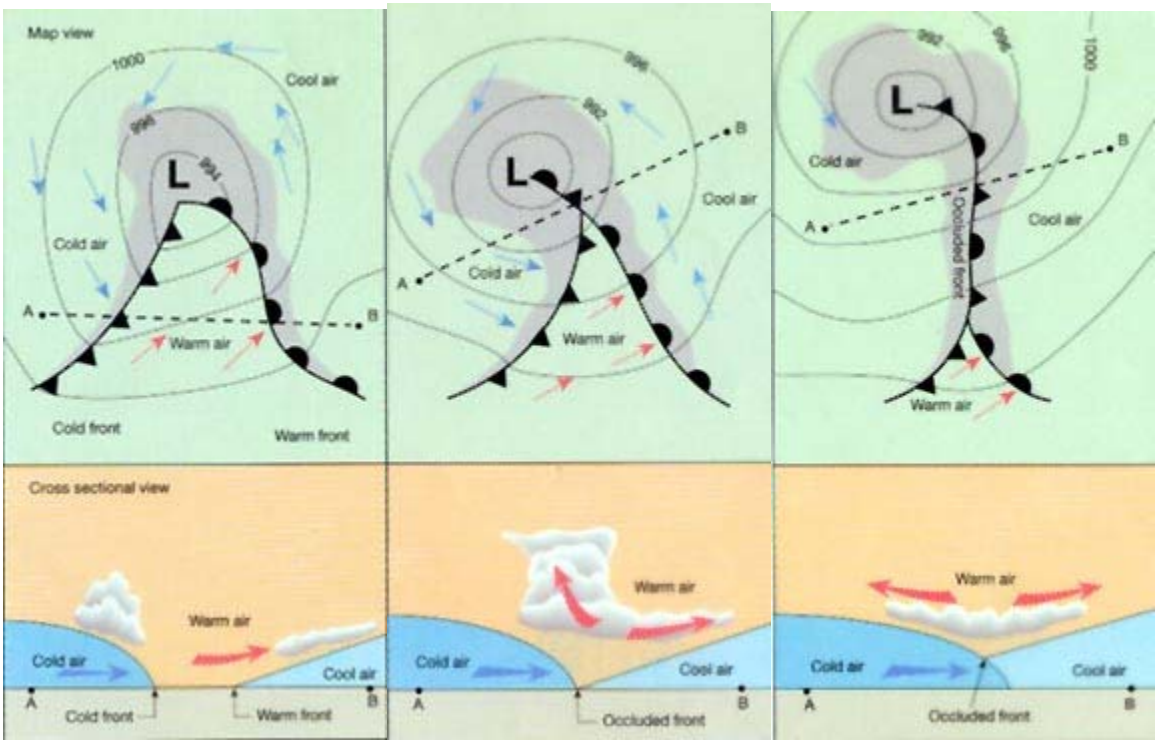
The Warm Front



- Moves slower
- The rain falls in front of the front
- Gentle rain for a long period of time.

The Occluded Front





- Combination of warm front and then cold front
- A long period of gentle rain followed by heavy rain & possibly a t-storm

Fronts

- A front is the leading edge of an air mass.
- If it is the front of a cooler air mass, it will be a COLD FRONT.
- If it is the front of a warmer air mass, it will be a WARM FRONT.

How to tell where a front belongs on a map.

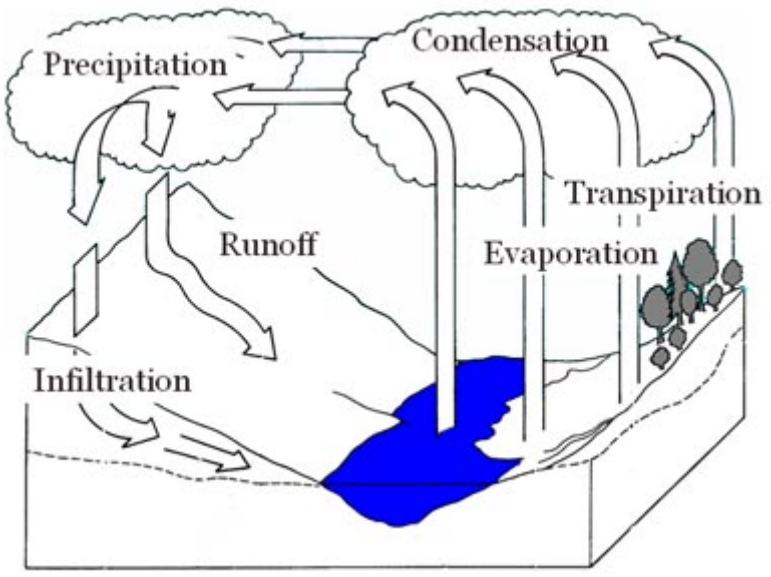
- A front will be located where the temperature changes rapidly in a short distance.
- Isotherms will be close together.

How to tell what kind of front it is.

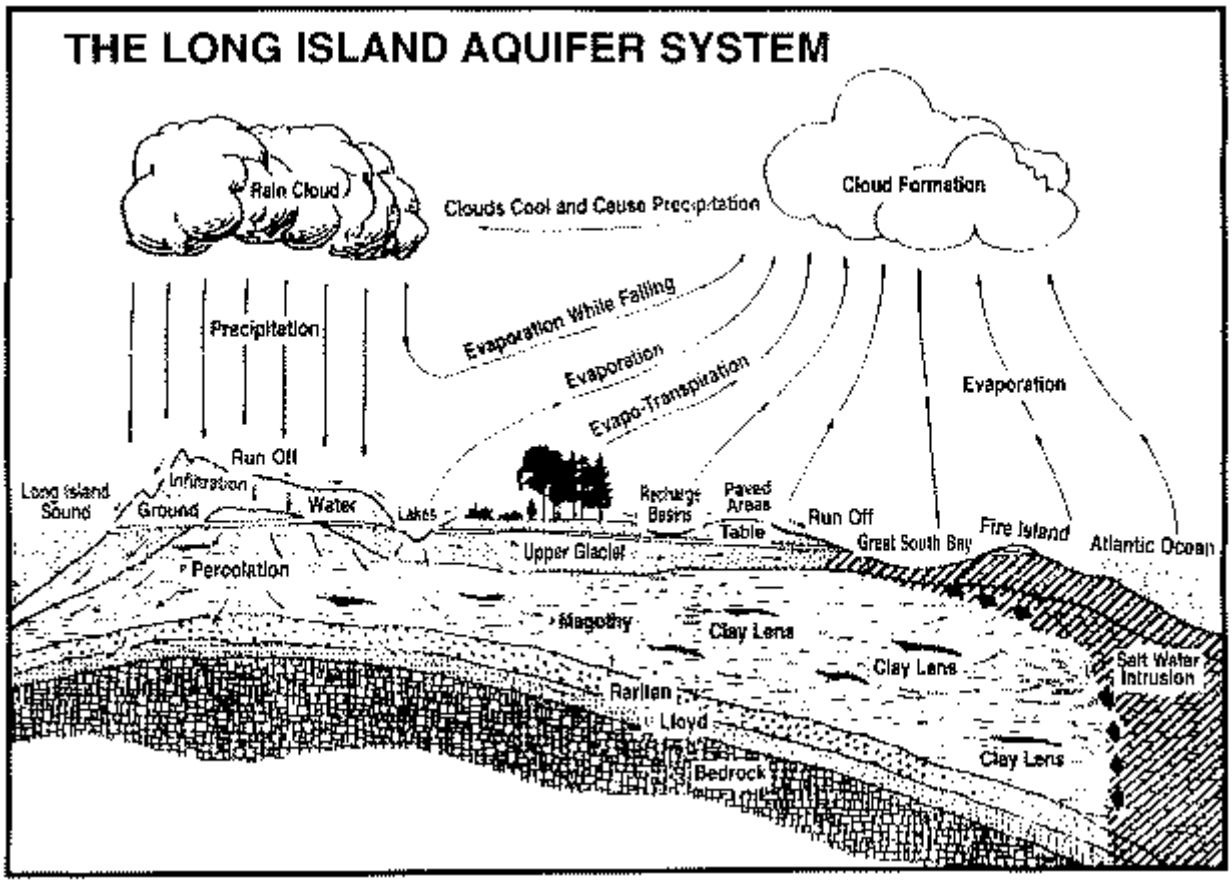
- It depends on which direction the front is moving...Look at the winds on both sides of the front.
  - On one side, the winds will be “pushing” the front.
  - On the other side, the winds will be retreating from the front.
- If colder air is coming in, it is a cold front.
- If warmer air is coming in, it is a warm front.

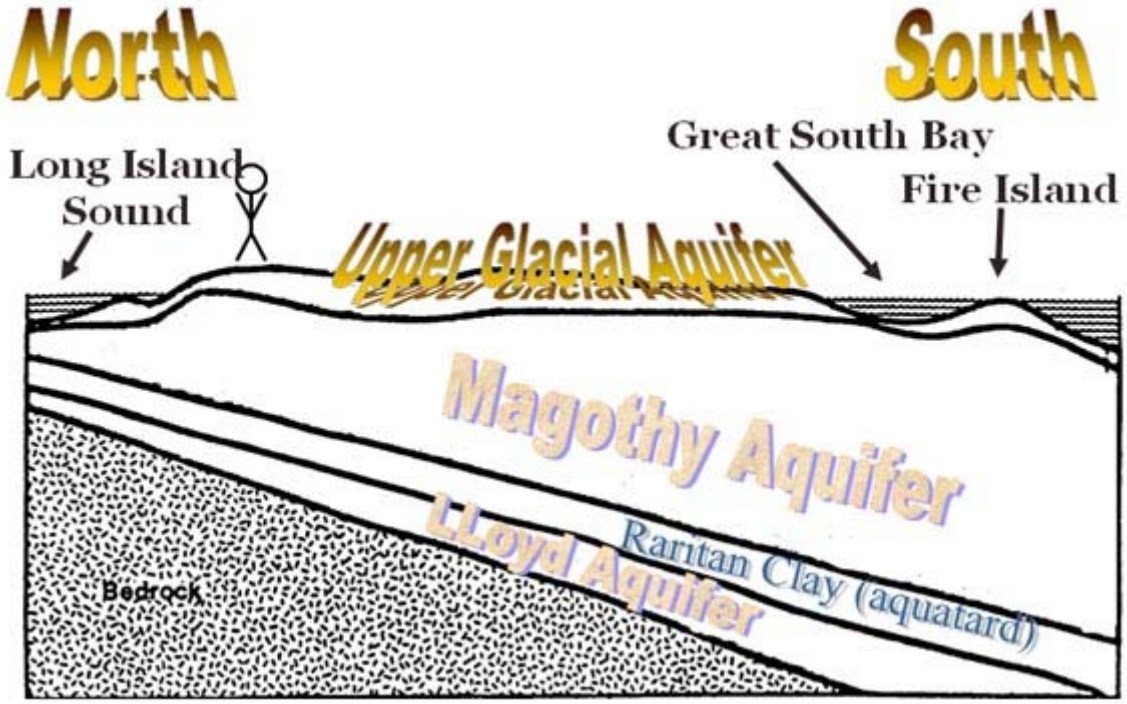
Climate Factors

The Water Cycle



On Long Island, this is how it all comes together:

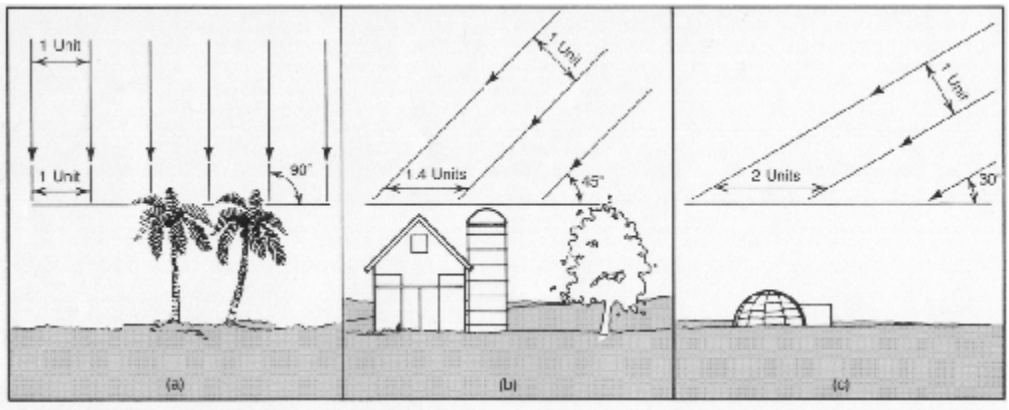




Angle of Insolation

Insolation is energy from sunlight. **In**coming **Sol**ar Radi**ation**. The strength of insolation

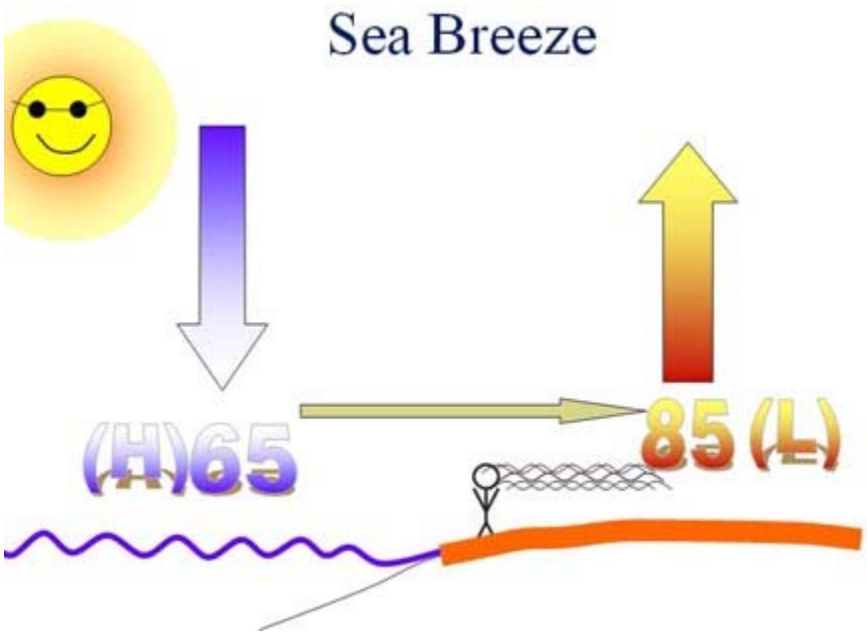
depends on the angle at which the light hits the ground.



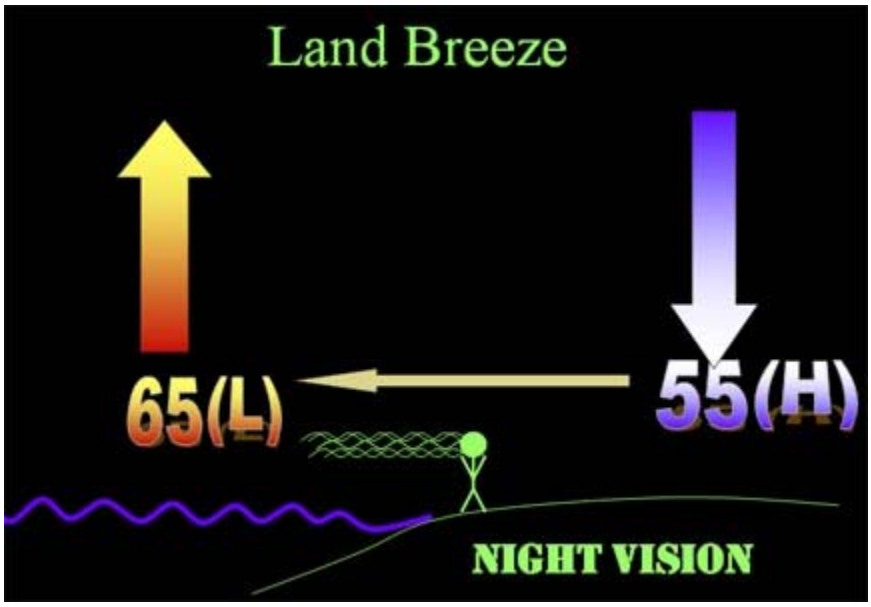
Land Breeze-Sea Breeze

Water is stubborn.
It does not want to change its temperature.
It has a high specific heat.

During the day, the land will heat up more than the water and will create a convection current.



At night , the land will coll down faster than the water and will create a convection current in the opposite direction.



Orographic Effect (Mountian Barrier)

- When air is forced to rise because it hits mountains, it will cool and condense.
- On the Windward side of the mountains it will have a moist climate.
- On the Leeward side, there will be a dry climate that is usually warmer than the windward
- (Caused by the release of heat during the condensation on the windward)

Temperature Time Lag

- Since it takes a little time for the atmosphere to heat up, the hottest time of the day is around 2 pm.
- Since it takes so long for the oceans to heat up, the hottest time of the year is

July/August.

Fifteen years of
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1994-2009
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