

Weather

# Goals

1. Know the use, look, and purpose of 6 common instruments used with weather: barometer, anemometer, thermometer, rain gauge, weather vane, and hygrometer
2. Know the definition, use, and context of the weather vocabulary words
3. Know how weather is defined by scientist; Know the properties of air
4. Know the factors that affects climate zones
5. Know the four types of weather fronts
6. Describe the air pressure, fronts, and how all this information is used to describe and forecast weather
7. Know some basic Cloud types and their influence on weather

# Weather Words Used

- air masses
- air pressure
- anemometer
- atmosphere
- barometer
- blizzard
- climate
- climate zones
- cold front
- cyclone
- drought
- elevation
- front
- heat wave
- high pressure
- humidity
- hurricane
- hygrometer
- low pressure
- occluded front
- rain gauge
- stationary front
- temperate
- temperature
- thermometer
- tornado
- tsunami
- typhoons
- warm front
- weather
- weather vane
- wind

# What is weather?

- condition of the air at a specific and particular time and place
- It is the temperature – how hot or cold it feels to us
- how the air moves (wind)
- describes anything the air is carrying such as rain, snow or clouds
- thunder, lightning, rainbows, haze, and fog are all a part of weather

# So how do scientist describe weather?

They describe weather through the **four properties of air:**

1. They measure the air temperature
  - How cold / hot
2. They measure at the humidity
  - How wet / dry
3. They measure the air pressure
  - How heavy
4. They look at wind
  - How fast and direction - from where it is blowing

# 1. Air Temperature

- Use a thermometer to measure temperature
- Expressed in degrees ( #°)
- Measured in Celsius or Fahrenheit
- Cooler days have lower temperature
- Warmer days have higher temperature
- *Temperature is the measurement of heat or the absence of heat*
- **Warmer Air will rise, while Cool air will fall.**

## 2. Humidity

- Amount of moisture in the air
  - **Measurement of water vapor in the air**
- Humidity is higher when
  - Closer to large bodies of water
- In high temperatures, humidity makes us FEEL warmer than it actually may be
  - In cooler temperatures, high humidity makes us feel cooler
  - This has to do with the moisture in the air, how much moisture is on our skin, and how our body perspires / evaporates the moisture off our skin

# 3. Air Pressure

- Air has pressure
- Air molecules have weight and will push against other objects
- High Air Pressure = more push, more weight
- Low Air Pressure = less push, less weight
- **Air in High Pressure areas will always move into Low Pressure areas**
  - *Moving air is wind!*
- High Pressure areas normally associated with fair (*happy*) weather
- Low Pressure areas normally associated with storms



# 4. Wind

- Air in motion
- We can measure wind speed
  - How fast the air can move objects
- Caused by uneven heating of the earth
  - Warm air tends to rise because it is *lighter* than cool air
  - Cool air tends to fall because it is more dense (*heavier*) than warm air

# 4. Wind

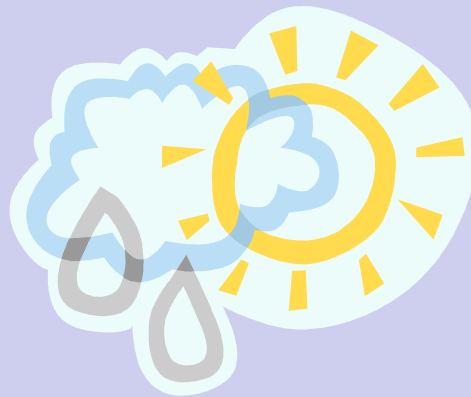
- Caused by uneven heating of the earth
  - Sun warms up different surfaces at different rates
  - Light reflects heat, darkness absorbs heat
  - As items heat up / hold heat, it warms the air around the item...
  - Warm air rises, pushes the cold air down when it rises to take the place...
  - Some surfaces hold heat longer – large bodies of water
    - Longer to warm, but is warmer longer
  - Some surfaces reflect heat and heat the air above faster

# Summary

- Scientist describe weather with the 4 properties of air
  - Air Temperature
  - Air Pressure
  - Humidity
  - Wind
- Wind, movement of air, is caused by the uneven heating of the earth

# Clouds

- What exactly happens when water vapors condense in the atmosphere? They make Clouds!
- Explain the weather associated with 4 different clouds types



# Cloud Types

- Depending on the temperature of the air and water droplets, determines the types of clouds that are formed.
- There are several types of clouds, we will be responsible for 4 main types:
  - Stratus
  - Cirrus
  - Cumulonimbus
  - Cumulus

# Cloud Types

- Each type of cloud has a different look and will also determine the type of weather that you can expect!
- The name of the cloud describes where in the atmosphere the cloud was formed and the shape of the cloud

# Cirrus



- Cirrus clouds are
  - thin, wispy clouds blown by high winds into long streamers
  - considered "high clouds" forming in the sky above 6000 m (20,000 ft)
  - Composed of ice
  - usually move across the sky from west to east
  - generally mean fair to pleasant weather.

# Stratus

- Stratus clouds are
  - uniform grayish clouds
  - made up of water droplets
  - often low and cover the entire sky.
  - resemble fog that does not reach the ground.
  - sometimes they may drizzle or very light rain
- When a thick fog "lifts," the resulting clouds are low stratus





# Cumulus

- **Cumulus clouds**
  - puffy clouds that sometimes look like pieces of floating cotton
  - base of each cloud is often flat and could be only 1000 m (330 ft) above the ground
  - top of the cloud has rounded towers
  - These clouds grow upward, and they can develop into a giant cumulonimbus, which is a thunderstorm cloud.







# Cumulonimbus

- Cumulonimbus clouds are
  - tall, dense clouds shaped like a block or anvil
  - signal thunderstorms and also start tornadoes, as well as other violent weather effects such as hail and lightning
  - dark bases may be no more than 300 m (1000 ft) above the Earth's surface
  - tops may extend upward to over 12,000 m (39,000 ft)
  - tremendous amounts of energy are released by the condensation of water vapor within a cumulonimbus



# Cloud Summary

Cirrus		Thin, wispy, high in sky; made of ice particles	Fair Weather
Cumulonimbus		Large, tall, billowy, dark at the bottom, storm clouds	Stormy, can be violent storms
Cumulus		Fluffy, billow, white	Fair Weather
Stratus		Low lying, foggy, hazy, covers a large area	Humid, slight sprinkle, foggy, or drizzly rain

# Scientist look at the properties of air to describe weather

- Temperature
  - Humidity
  - Air Pressure
  - Wind
- 
- How do they figure out these properties?
    - They use special equipment...

# Instruments of Weather

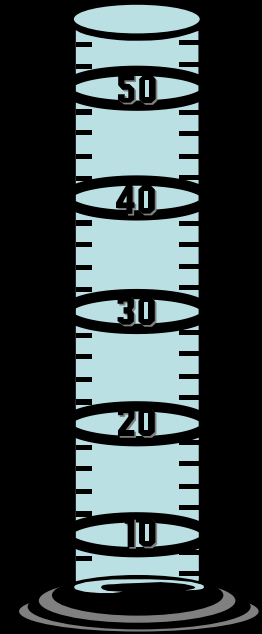
- **Thermometer**

- measures the air temperature
- most are closed glass tubes containing liquids such as alcohol or mercury
- air around the tube heats the liquid, the liquid expands and moves up the tube
  - scale then shows what the actual temperature is.



- **Rain Gauge**

- amount of rain (precipitation) that has fallen over a specific time period.



Source: <http://www.weatherwizkids.com/wxinstruments.htm>

<http://schoolscience.rice.edu/duker/winstruments.html>

# Instruments of Weather

- **Hygrometer**

- the water vapor content of air

- measures the humidity



Source: <http://www.weatherwizkids.com/wxinstruments.htm>

<http://physics.kenyon.edu/EarlyApparatus/Thermodynamics/Hygrometer/Hygrometer.html>

# Instruments of Weather

- Barometer

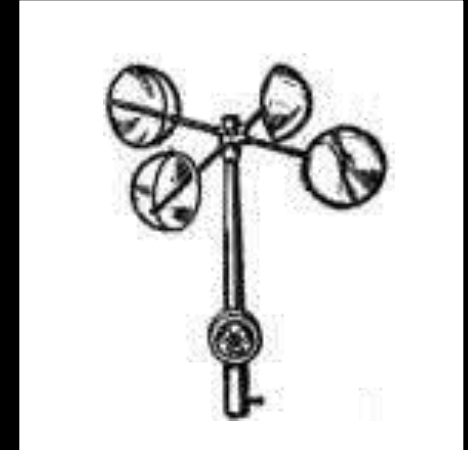
- Used to measure air pressure
- tells you whether or not the pressure is rising or falling
- A rising barometer means sunny and dry conditions
- a falling barometer means stormy and wet conditions
- An Italian scientist named Torricelli built the first barometer in 1643.



# Instruments of Weather

- **Anemometer**

- measures wind speed
- cups catch the wind, turning a dial attached to the instrument
- dial shows the wind speed



- **Weather Vane**

- determines the direction from which the wind is blowing





# Summary

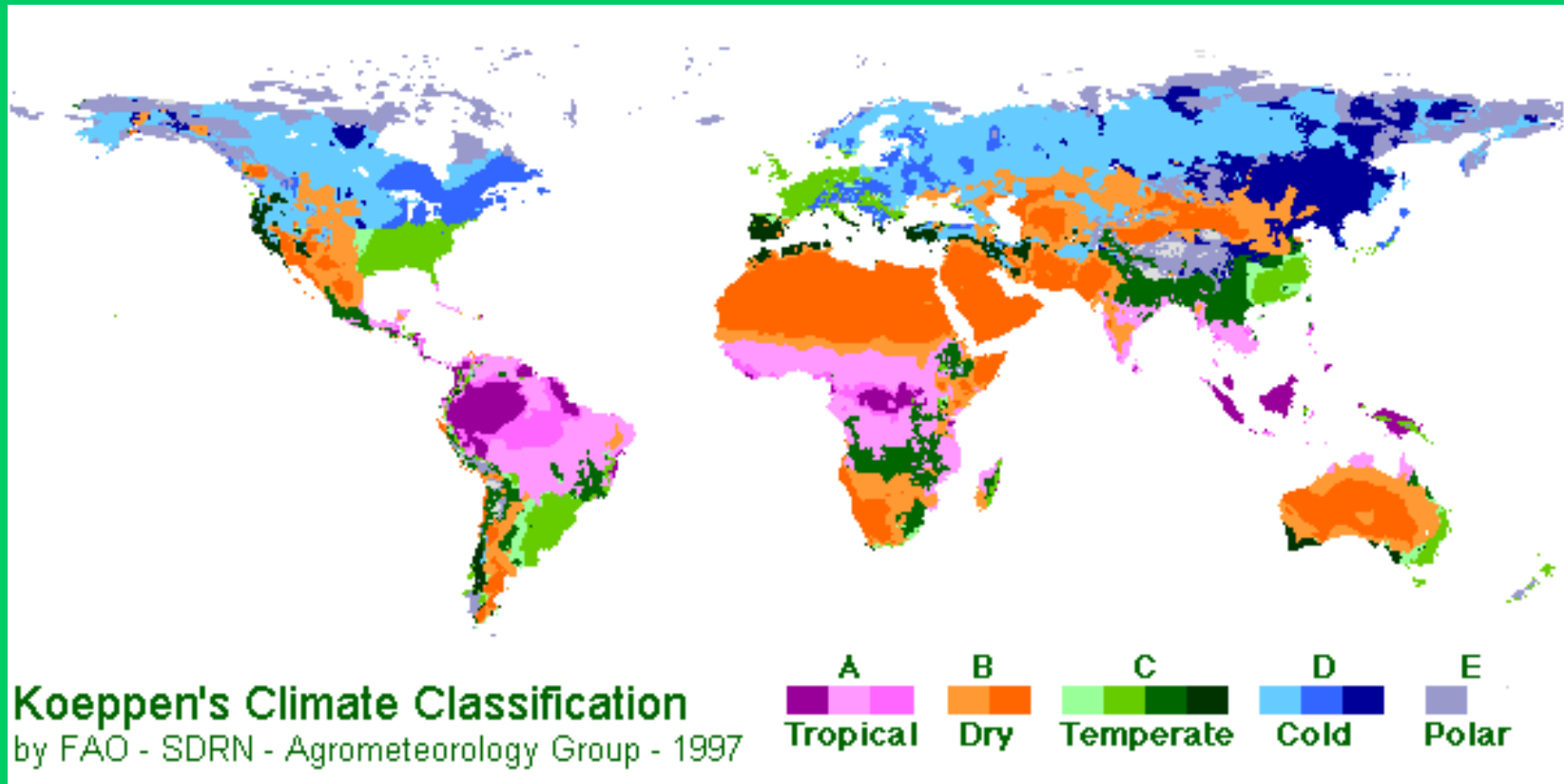
- Instruments used
  - Thermometer
  - Barometer
  - Anemometer
  - Weather Vane
  - Rain Gauge
  - Hygrometer

# Weather vs. Climate

- Weather is the conditions of the air at a very specific time and place
- **Climate** is the general or average condition of the air (weather) for an area
  - Sometimes specified by season or other time period
  - *Georgia has generally mild winter and hot summers; also known for high humidity*
  - *Alaska has very cold winters and cool summers*
  - *Arizona is very arid and hardly any humidity*

# Climate Zones

- Climates: General weather experienced
- Climate Zones: particular region with similar climates
  - South is generally warmer than the Northern states



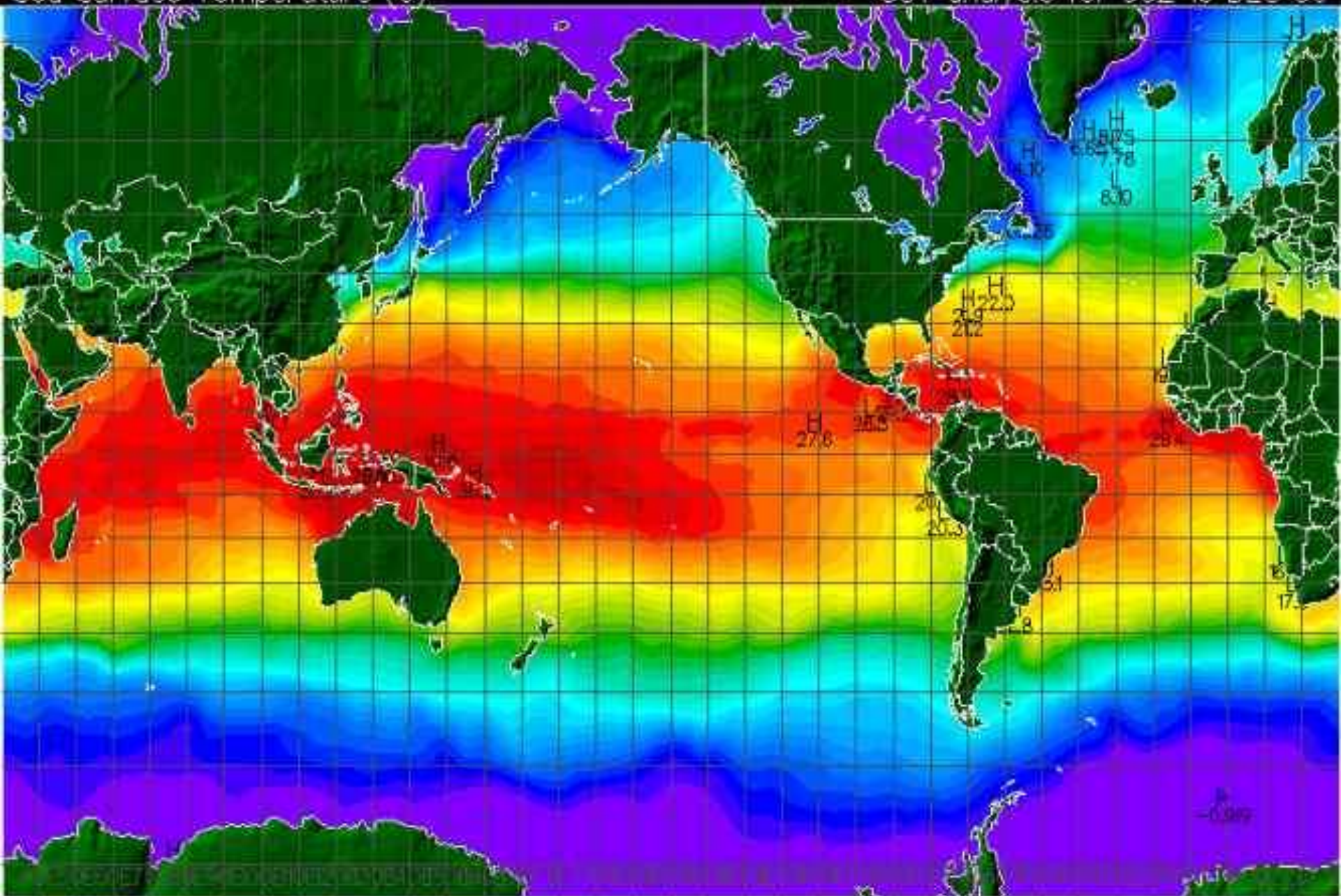
# What Affects Climates?

- Latitude
  - How far north or south an area is from the equator
  - Areas around the equator are generally warmer because they have more of the sun's direct rays



Sea Surface Temperature (C)

SST analysis for 00Z 19 DEC 06



# What Affects Climates?

- Large bodies of water
  - ✓ Water holds heat longer, causing the area around the water to be warmer (during the summer)
  - ✓ Warmer air holds more humidity, helping to hold heat longer
  - ✓ Larger bodies of water take longer to heat up, causing the area around the water to be cooler (during the winter)
  - ✓ Increased humidity around the water causes our skin to feel cooler when cooler wind blows
- coastal areas have more moderate temperatures than inland areas, and are generally warmer in the winter and cooler in the summer

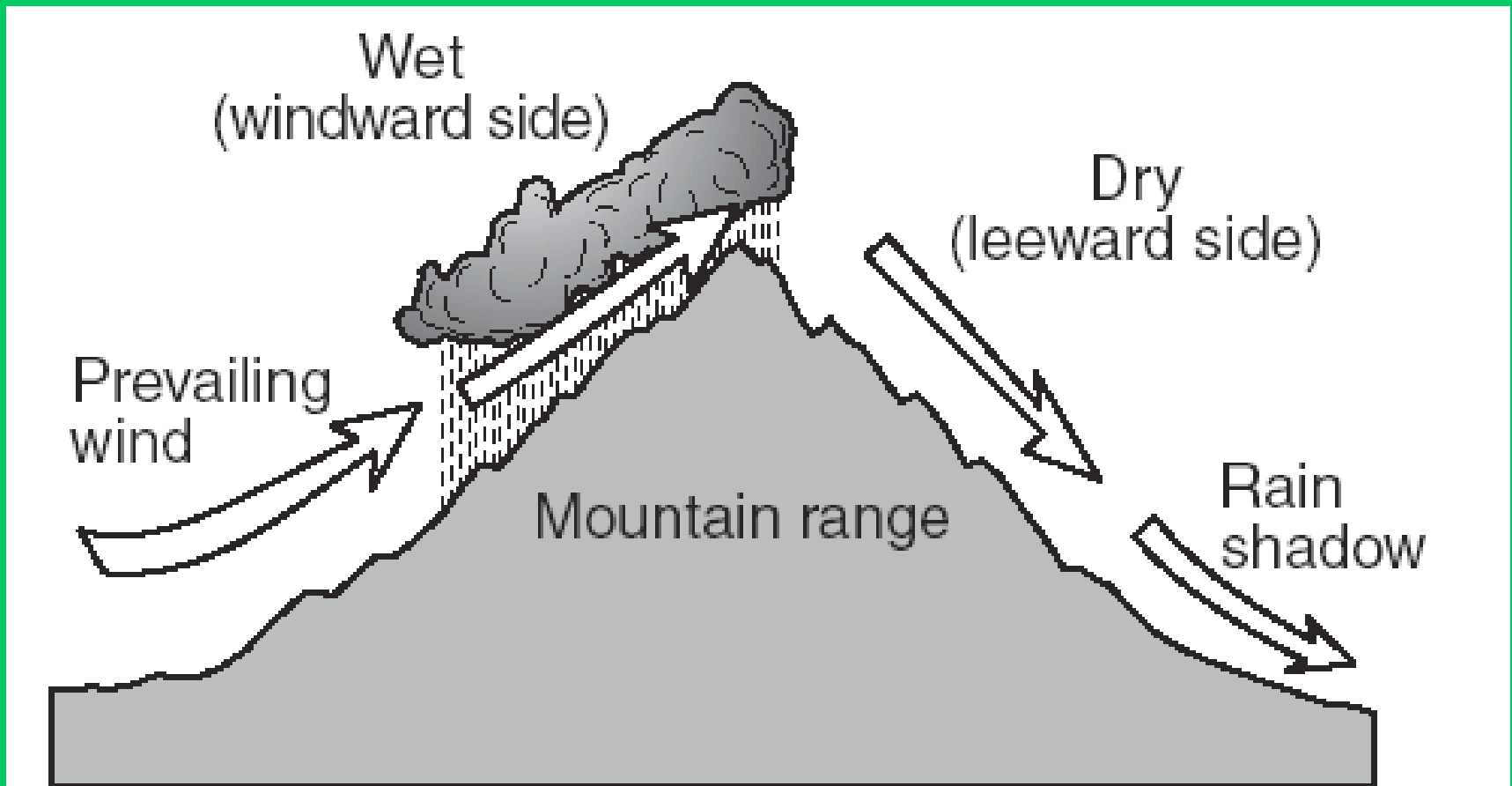
# What Affects Climates?



- Elevation
  - Higher the place, usually cooler the climate
  - Less atmosphere to hold heat, less air pressure
- Mountains and other land forms
  - Mountains receive more rainfall. Cold air rushes around the land, when they hit a mountain, the cool air must rise, or they can't get through. The cool air cools more as it rises producing precipitations

**Windward Side:** cool, moist

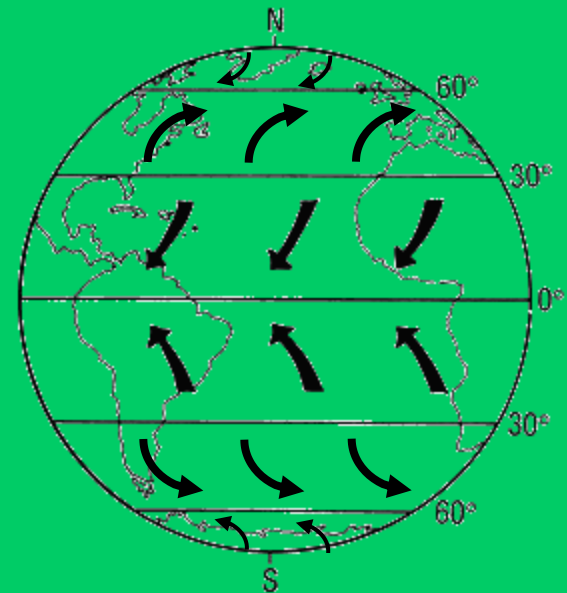
**Leeward Side:** warm, dry





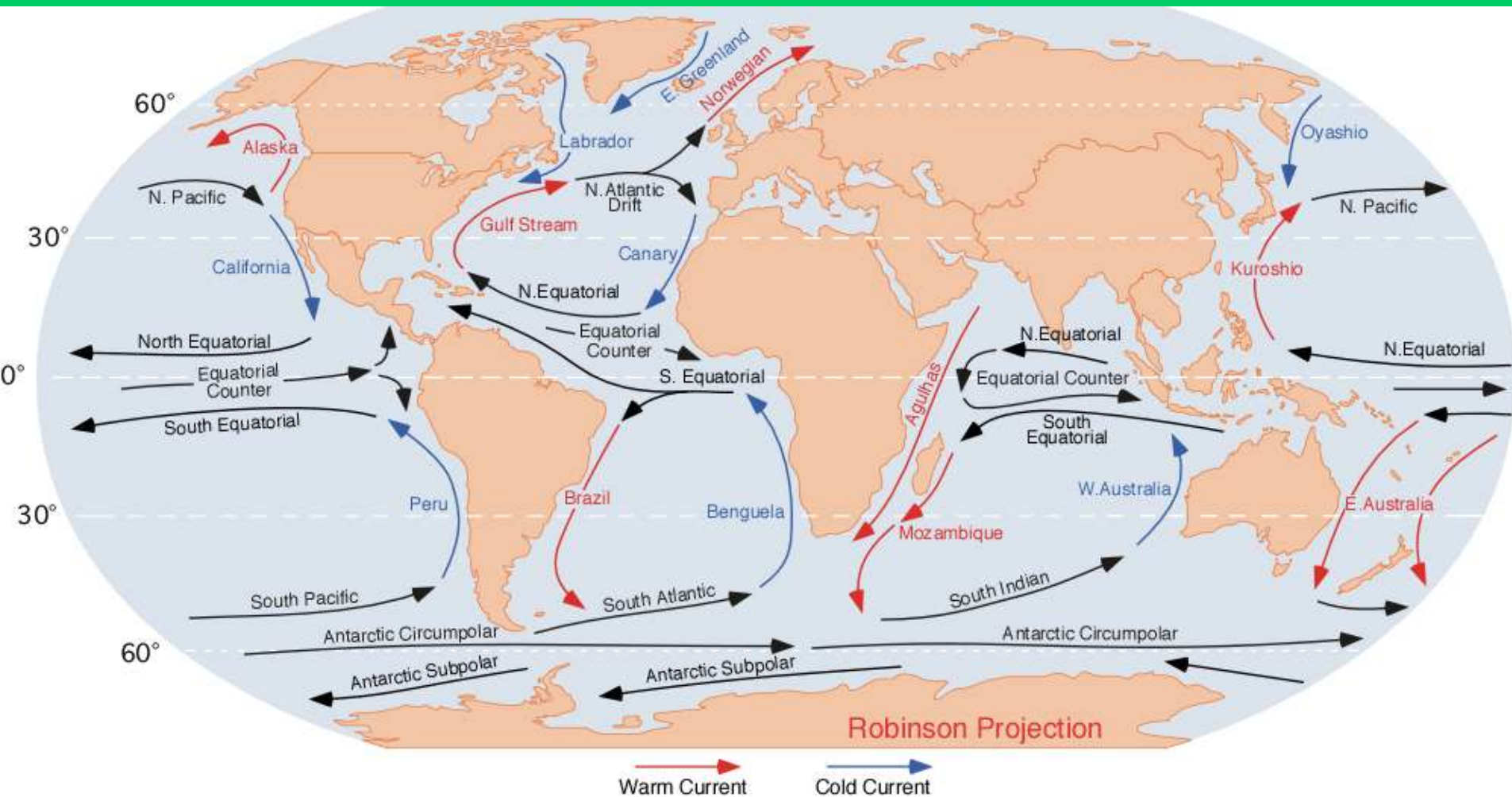
# What Affects Climates?

- Winds
  - The earth has certain patterns that the wind (and ocean currents) blow/go
    - Caused by uneven heating of the earth
- Ocean Currents
  - Water in the ocean moves in certain patterns.
  - Cooler waters from the earth's poles cause cooler climates.

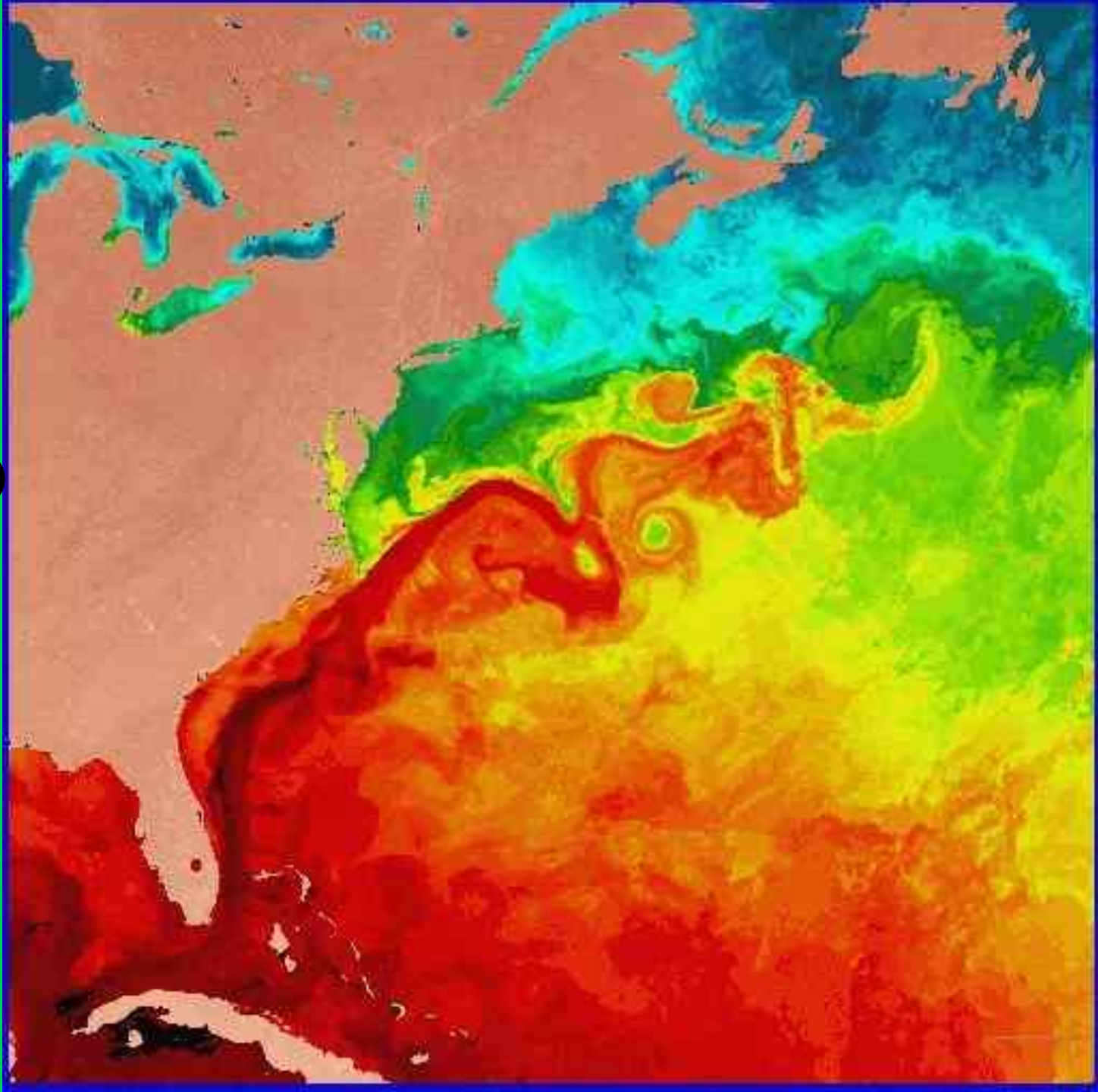


# Warm Currents: warmer climate

## Cold Currents: cooler climate



# The Gulf of Mexico



# What Affects Climates?

- Vegetation (Plants)
  - More humidity – transpiration
  - Reflection / absorption of sun
  - Covering of ground
- People
  - Global warming
    - Green house effect
    - Melting Polar ice caps
  - Pollution
    - Air, Water



# Summary

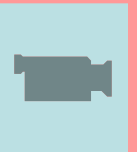
- Climate is affected by
  - Latitude
  - Proximity to large bodies of water
  - Landforms (Mountains)
  - Elevation
  - Wind patterns
  - Ocean Currents
  - *Vegetation*
  - *People / pollution*

# What are the different forms of Extreme Weather?

- Extreme weather occurs all over the world.
- Examples:
  - Drought
  - Floods
  - Blizzards
  - Hurricanes/ Typhoons/Cyclones
  - Heat wave
  - Tsunami
  - Tornado

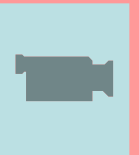
# Drought and Heat Wave

- Drought: when there is continued dry weather – no rain
- Heat Wave: hotter than usual temperatures for a region
- no one reason... everyone has an opinion
  - Global warming
- If areas not use to the heat has uncommonly high temperatures, it can cause other disasters...



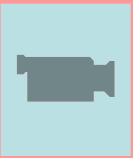
# Floods

- Too much rain
  - Causes rivers, lakes, ponds, or any body of water to overflow





# Tsunami



- Extreme ocean wave
- An ocean wave with a long period that is formed by an underwater earthquake or landslide, or volcanic eruption
- may travel unnoticed across the ocean for thousands of miles from its point of origin and builds up to great heights over shallower water
- also known as a seismic sea wave, and incorrectly, as a tidal wave.

# Blizzards

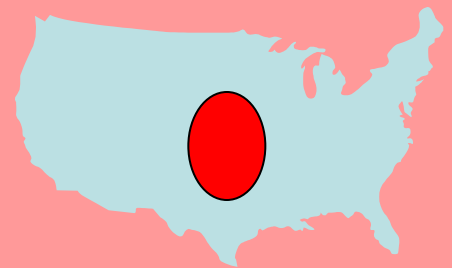
- Gigantic snow storm
- Warmer, humid air from south travels north; it causes more precipitation, but in the form of snow / ice in addition to the colder air causing more condensation
- The U.S. Weather Bureau definition:
  - A snowstorm with winds of at least 35 mph, temperatures 20 degrees F or lower over the period of the storm is a plain "blizzard."
  - A severe blizzard has 45 mph or greater winds, blowing snow and temperatures at 10 degrees F or below.

# Tornadoes

- most destructive of all storm-scale atmospheric phenomena
- occur anywhere in the world given the right conditions,
  - frequent in the United States in an area bounded by the Rockies on the west and the Appalachians in the east.

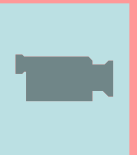


Photo: NOAA



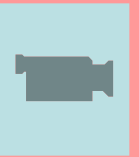
# Tornadoes

- violently rotating column of air
- caused by the rapid rotation of warm, humid air rising and cool, dry air falling
- Watch: conditions good for a tornado to form
- Warning: tornado has been spotted



# Cyclones = Hurricanes = Typhoons

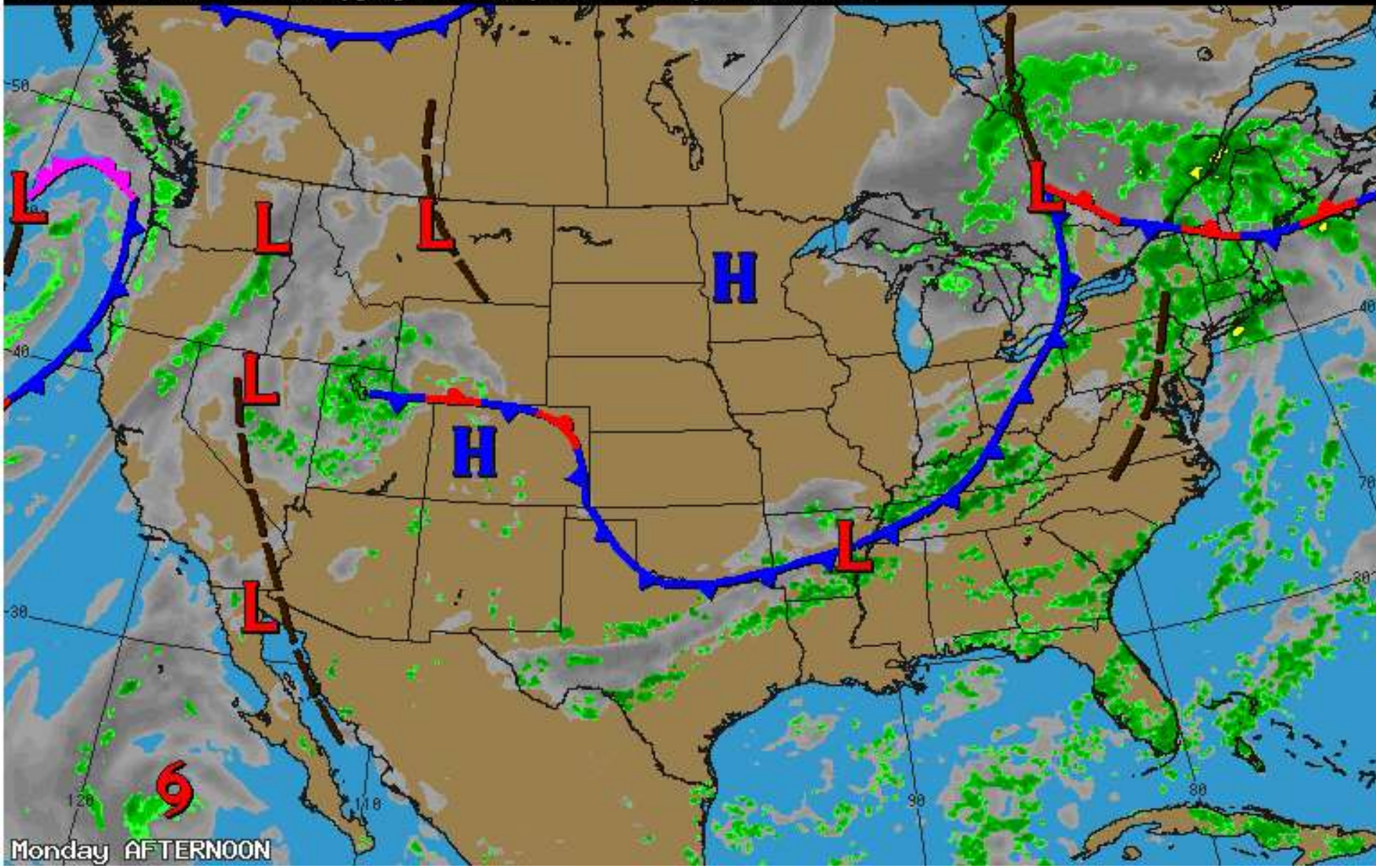
- Hurricane: East Pacific or Atlantic Ocean
- Typhoons: Northwest Pacific Ocean
- Cyclones: Everywhere else in the world
- most storm starting in the ocean with rotating winds over 75 mph
- “Tornado” starting over the ocean
- If the winds do not get you, the accompanying floods, water, and destruction will ☹️



# Forecasting Weather

# Three Main Goals

- What are the symbols on a Weather Map and what kind of weather do they forecast?
- How do you read a Weather Map?
- How / What is the weather forecasted?



Monday AFTERNOON



# First: Vocabulary

- Air Masses - large volume of air with the same temperature and humidity
- Fronts – area where air masses meet
- Air Pressure – pressure or weight of air

# The Symbols

Warm front



Cold front



Stationary front



Occluded front



# Cold front

- The cold front is colored blue. The triangles show you which way it is moving.
- The cold front is the front of a mass of cold air
- This mass has lower temperatures and lower humidity
- It is fast moving and bad storms are in front of the cold front.
- The weather **generally** clears once the front has passed, and leaves behind colder air.



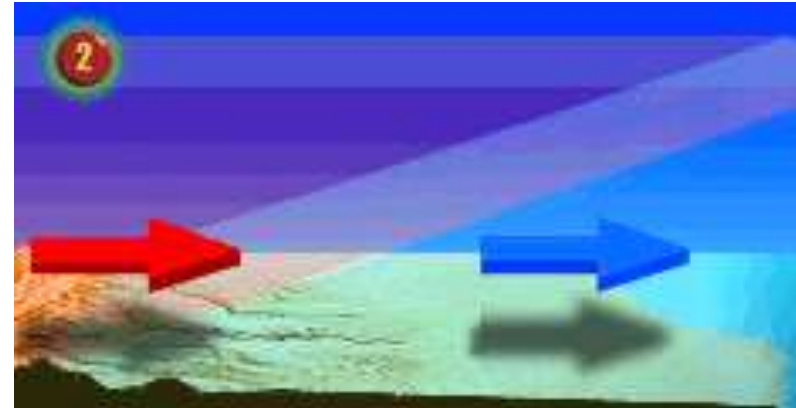
## 2 Like a bulldozer

A typical cold front plows into warmer, lighter air forming towering clouds, rain and often thunderstorms.



# Warm front

- The warm front is colored red. The half-circles show you which way it is moving.
- The warm front is the front of a mass of warmer and moist air
- This mass has higher temperatures and higher humidity
- It is slower moving and rain is in front of the warm front.
- The weather **generally** clears once the front has passed, and leaves behind warmer air.



## 2 Gold air still the boss

Heavier, denser cold air retreats slowly as warm air rides up and over cold air and spawns widespread clouds, precipitation

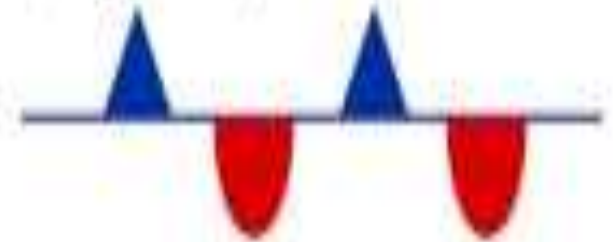




# Stationary Front

- Two air masses that have met and are not moving are called a stationary front.
- Bad, Stormy weather hangs around with the stationary front!

## Stationary Front



# Occluded front



- The occluded front symbol is colored purple. The half-circles and triangles point to the way it is moving.
- An occluded front forms when a cold front and warm front meet, but the cold front overtakes the warm front.
- The weather on an occluded front, like all the other fronts is rainy. How stormy it gets depends on how fast the cold front is moving.
- **Generally** once the front clears it leaves clear, drier weather.



**1**  
**Cold occlusion:**  
Colder air behind front plows into cool air ahead of it similar to cold front.



**2**  
**Warm occlusion:**  
Cool air behind front rises up and over colder air ahead.



# High Pressure

- High pressure has wind that blows around it in clockwise. It is colored blue and usually means dry, clear weather.
- Air is more dense (higher pressure, more weight) and tends to fall and go into Low pressure areas



# Low Pressure

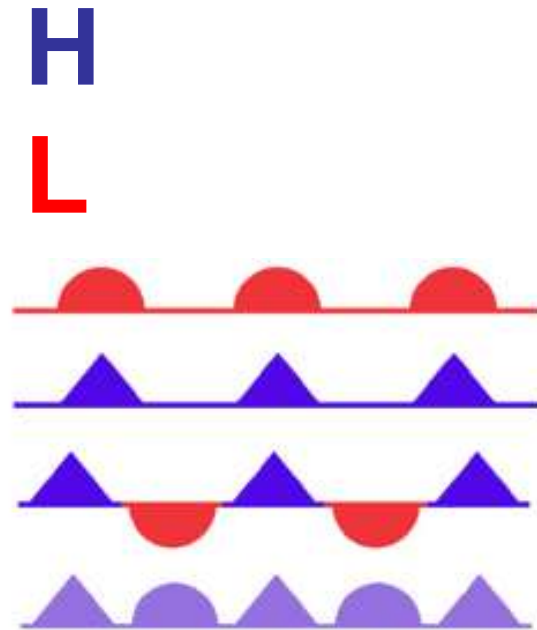
- Low pressure is colored red and it has wind that blows around counterclockwise.  
*(High Pressure air blows into Lower Pressure areas)*
- It usually brings cloudy, wet, or stormy weather.











# Summary

- Large moving air masses have a huge impact on the weather
  - Weathermen uses this as one factor in forecasting
- High Pressure Area
- Low Pressure Area
- Warm Front
- Cold Front
- Stationary Front
- Occluded Front







# Summary

	Before	During	After
Warm Front 	Cooler Temp. Light showers	Warm Temp. <b>Drizzle or none</b>	<b>Warmer Temp.</b> usually Fair weather
Cold Front 	Warmer Temp. Light showers	Cooler Temp. <b>Stormy weather</b>	<b>Colder Temp.</b> showers clearing
Stationary Front 	<i>Existing weather</i>	<b>Varies depending on which front is pushing</b>	<i>Depends on air mass that pushed</i>
Occluded Front* 	<i>Existing weather</i>	<b>showers</b>	<i>Depends on air mass that pushed</i>
High Pressure Area 	<b>Sunny, fair weather</b> – air sinks reducing clouds. Air is moving in clockwise direction – cooler northern air is moving south and warmer southern air is moving north		
Low Pressure Area 	<b>Stormy cloudy weather</b> – air rises increasing clouds & precipitation. Air is moving in counter clockwise direction		

# Summary: Properties of Air

- Scientist describe weather with the 4 properties of air
  - Air Temperature
  - Air Pressure
  - Humidity
  - Wind
- Wind, movement of air, is caused by the uneven heating of the earth

# Summary: Clouds

Cirrus		Thin, wispy, high in sky; made of ice particles	Fair Weather
Cumulonimbus		Large, tall, billowy, dark at the bottom, storm clouds	Stormy, can be violent storms
Cumulus		Fluffy, billow, white	Fair Weather
Stratus		Low lying, foggy, hazy, covers a large area	Humid, slight sprinkle, foggy, or drizzly rain

# Summary: Instruments Used

- Instruments used
  - Thermometer
  - Barometer
  - Anemometer
  - Weather Vane
  - Rain Gauge
  - Hygrometer

# Summary: Climate

- Climate is affected by
  - Latitude
  - Proximity to large bodies of water
  - Landforms (Mountains)
  - Elevation
  - Wind patterns
  - Ocean Currents
  - *Vegetation*
  - *People / pollution*

# Summary: Extreme Weather

- Types of Extreme Weather
  - Drought
  - Blizzard
  - Tornado
  - Hurricane / Cyclone / Typhoon
  - Tsunami
  - Floods

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# Some Vocabulary

- **Weather vs. Climate**

- Weather = state of the atmosphere right at this moment in a specific place
- Climate = general average weather for an area

- **Weather:**

- condition of the air at a particular time and place
- how the air moves (wind)
- describes anything the air is carrying such as rain, snow or clouds
- thunder, lightning, rainbows, haze are all part of weather.

- **Climate**

- Average temperature for a place during a general time
- Average rainfall, humidity, and weather conditions

# Review Vocabulary

- **Air Mass**

- large body of air with the same amount of moisture (Humidity) and temperature

- **Humidity**

- amount of water vapor in the air
- Did you know – temperature affects humidity: warmer air can hold more water vapor than colder air

- **Air Pressure**

- weight of air pressing down on earth
- can change from place to place, and cause air to move
- flowing from areas of high pressure toward areas of low pressure
- It's the same as barometric pressure.

- **Wind Speed**

- Measurement of how much the wind is blowing

# Review Vocabulary

- **Front**

- boundary between two different air masses
- resulting in stormy weather
- usually is a line of separation between warm and cold air masses.

- **Stationary Front**

- a warm air mass and a cold air mass meet and do not move; rain or drizzle may happen for several days..

- **Cold Front**

- boundary between two air masses, one cold and the other warm, moving so that the colder air replaces the warmer air

- **Warm Front**

- boundary between two air masses, one cold and the other warm, moving so that the warmer air replaces the cooler air

# Review Vocabulary

- Climate Zones

- General regions grouped together based on similar climates

- Temperate

- Moderate temperatures.... Not too hot or cold