Thunderstorms and Severe Weather

- 13.1 and 13.2

Thunderstorms

- The intensity and duration of thunderstorms depend on local conditions that create them.

Thunderstorm facts

- At any given time there are 2000, thunderstorms occurring around the world!
- Most storms are harmless , but storms are responsible for great destruction.

How do thunderstorms form?

- In order for a thunderstorm to form three conditions must exist.
- A source of moisture.
- Lifting of the air mass.
- An unstable atmosphere.

Moisture

- In order for storms to form there must be an abundance of moisture in the lower atmosphere.
- The humid air is less dense than the dry air and is lifted.
- The humid air cools and forms water droplets or clouds

Lifting

- A mechanism is needed to lift air into cooler regions in the atmosphere.
- Examples cold fronts push up warmer air, cities or bodies of water can create a heat source to push up air.
- Only when the water vapor condenses can it release latent heat and keep the cloud rising.

Stability

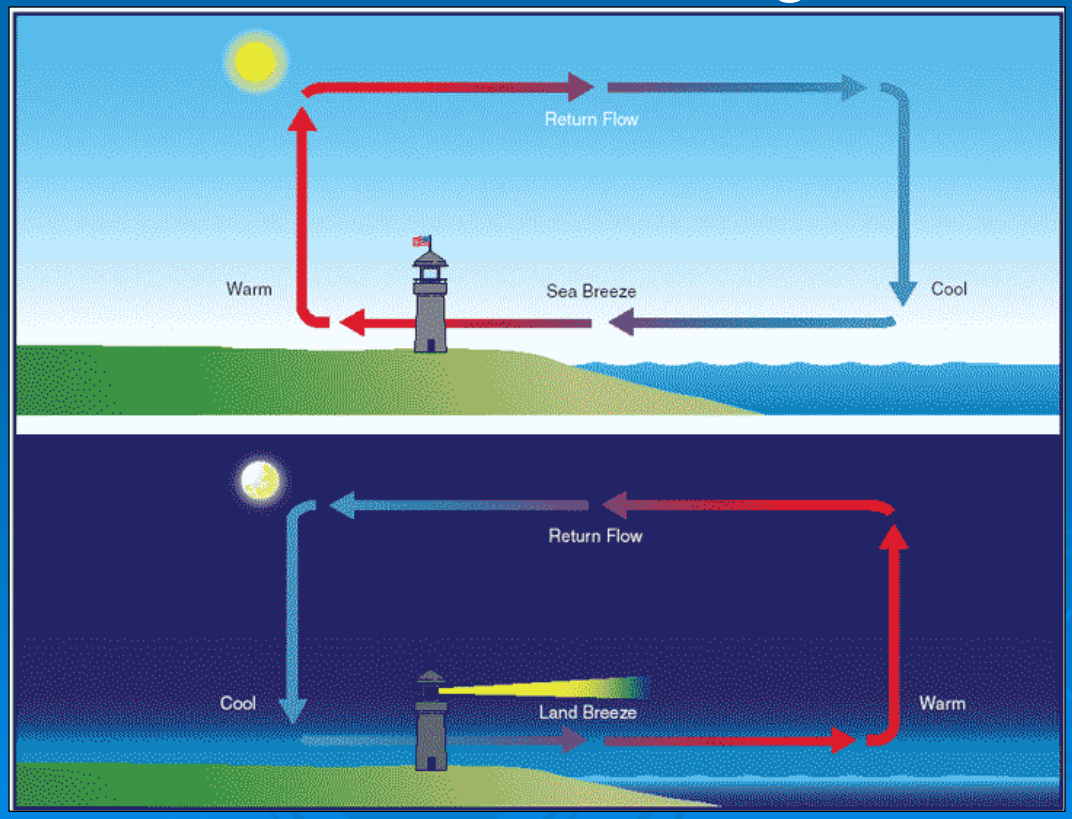
- If the air remains cooler than the rising air mass, the unstable conditions can produce clouds that grow upwards.
- When the density of the rising air mass and the surrounding air are nearly the same, clouds stop growing.

Types of Thunderstorms

- 2 major types of Thunderstorms are
- 1. Air-Mass Thunderstorms
- 2. Frontal Thunderstorms.

Air-Mass Thunderstorms:

- A type of thunderstorm in which air rises because of unequal heating of Earth's surface with in a single air mass and is most common during the afternoon and evening.



2 Types of Air-mass Thunderstorms

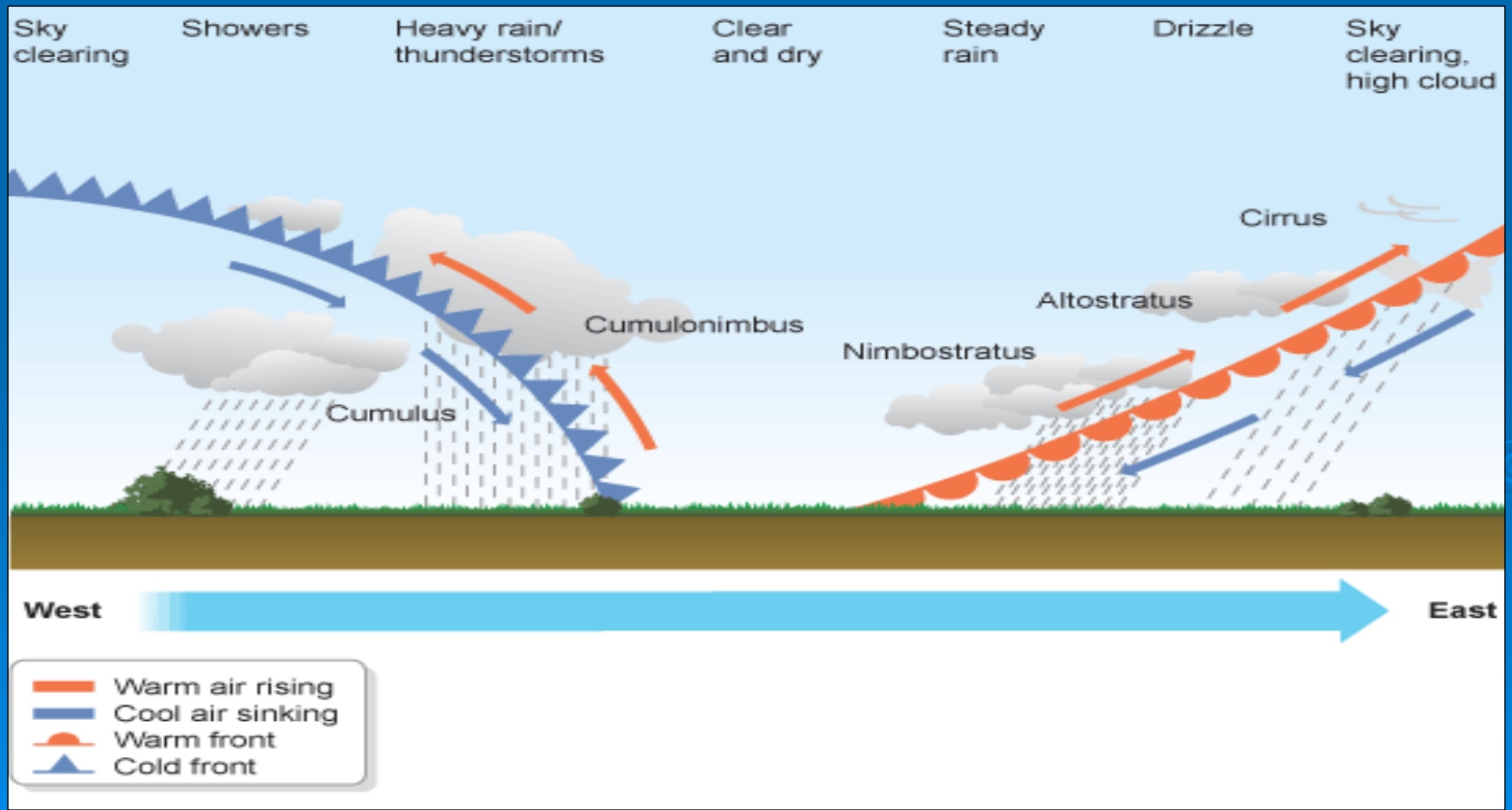
- Mountain Thunderstorms: occurs when an air mass rises from low elevation to a high elevation, which involves air moving up the side of a mountain.

(Mountain barrier)

2. Sea- breeze Thunderstorm: Local air-mass thunderstorm that commonly occurs along a coastal area because land and water store and release thermal energy differently.

Frontal thunderstorms

- A type of thunderstorm usually produced by an advancing cold-front, which can result in a line of thunderstorms hundreds of kms long or more rarely an advancing warm front, which can result in a relatively mild thunderstorm.

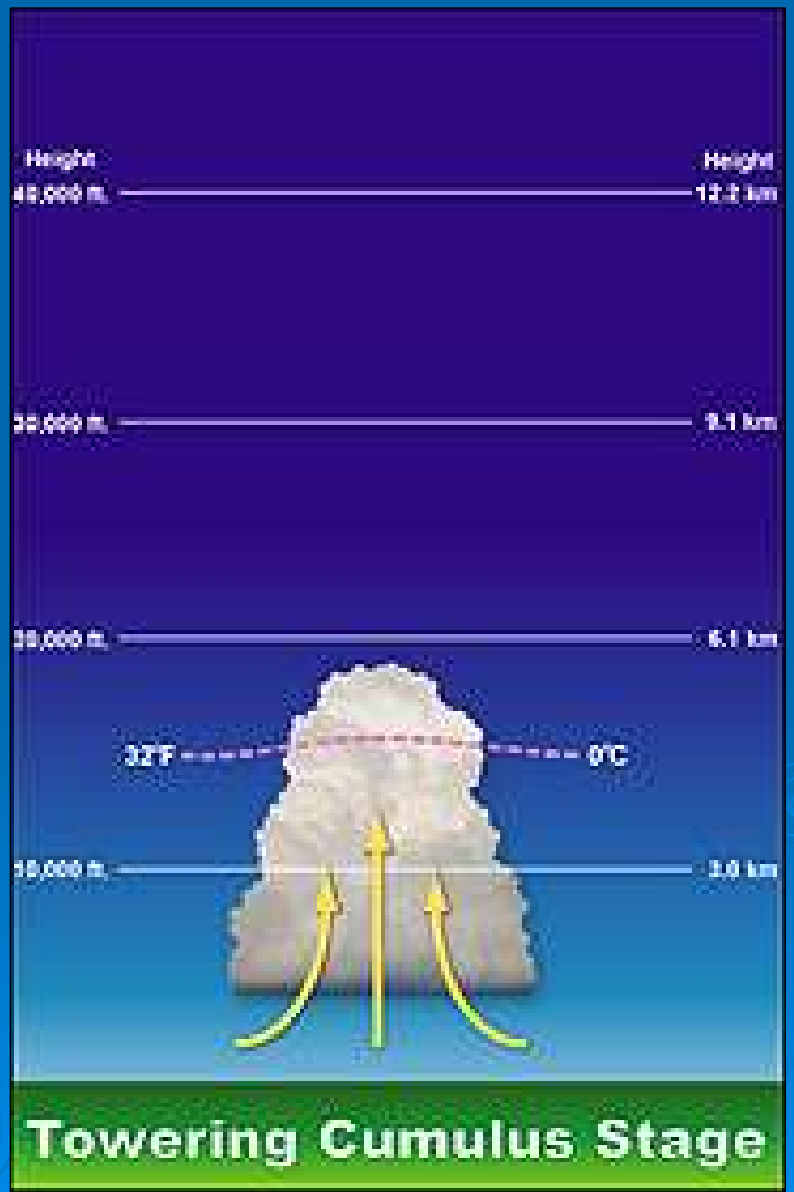


Thunderstorms develop in three stages.

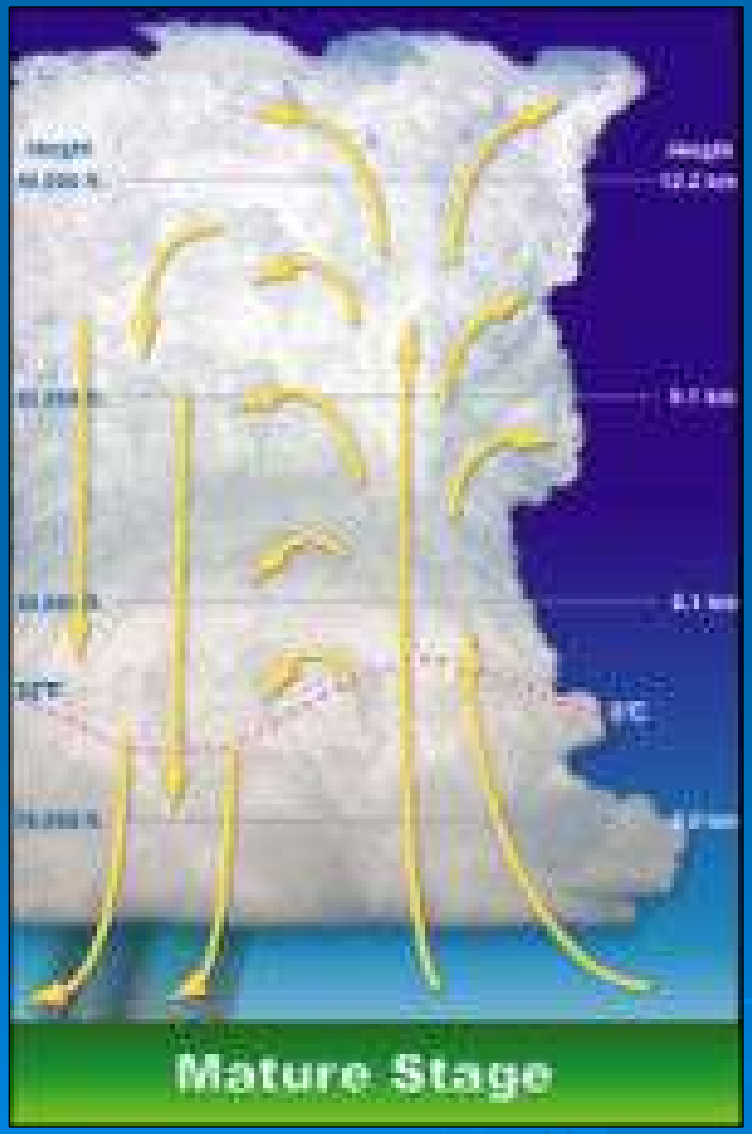
- Cumulus Stage
- Mature Stage
- Dissipation Stage

Cumulus Stage

- Air starts to rise vertically creating updrafts that which transport water vapor to cooler upper regions in the cloud.
- As water condenses the clouds become larger and heavier until updrafts can no longer sustain them and they fall back to Earth as precipitation.



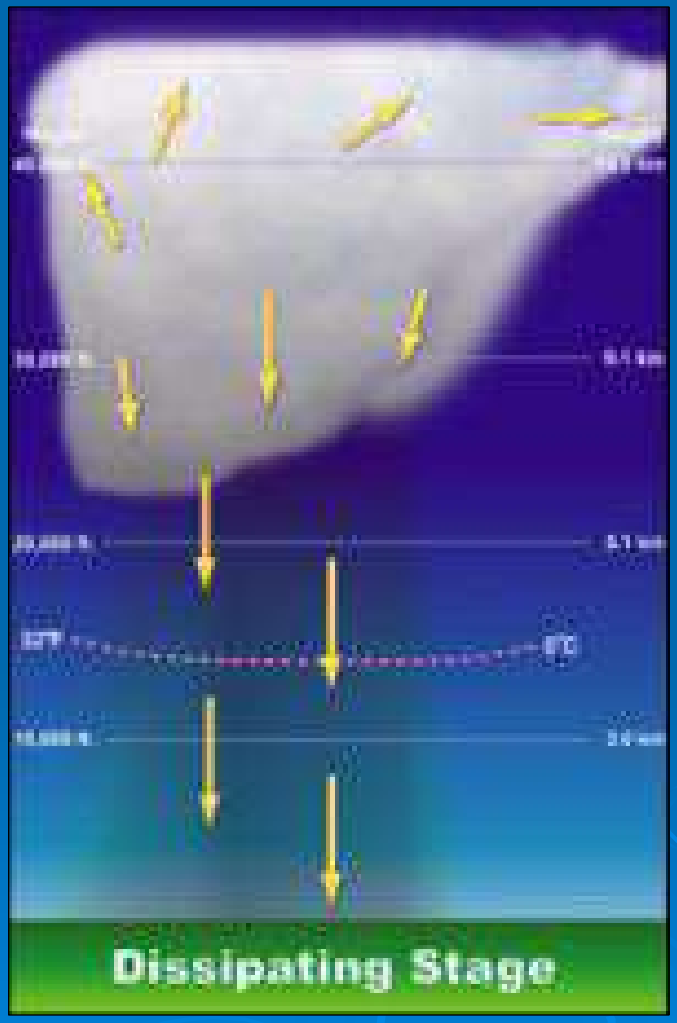
Mature Stage



- Updrafts and downdrafts exist side by side.
- Precipitation cools the air, the new cool air sinks rapidly causing down drafts.
- The updrafts and down drafts form a convection cells which cause winds to develop.

Dissipation

- Once the supply of warm air is used up convection stops.
- The cool downdrafts spread out and eventually stop.
- The storm eventually dissipates or dies out.

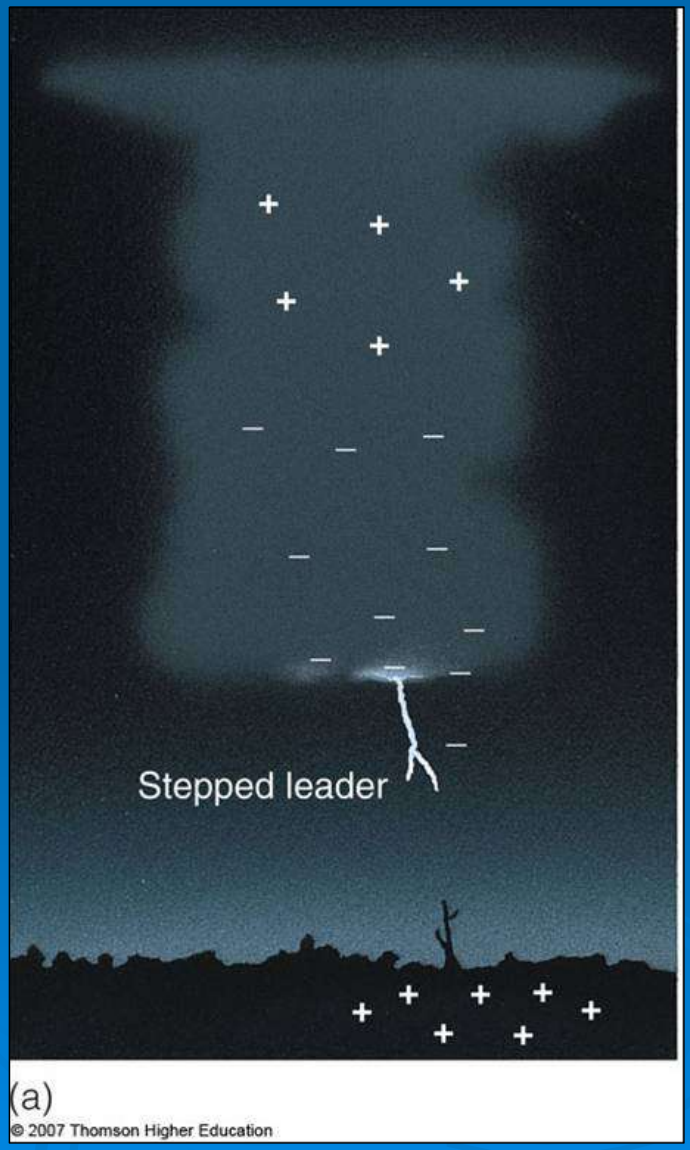


What causes lightning

- Lightning is the transfer of electricity generated by the rapid rushes of air in a cloud.
- Clouds become charged when friction between the updrafts and downdrafts cause atoms to lose or gain electrons.

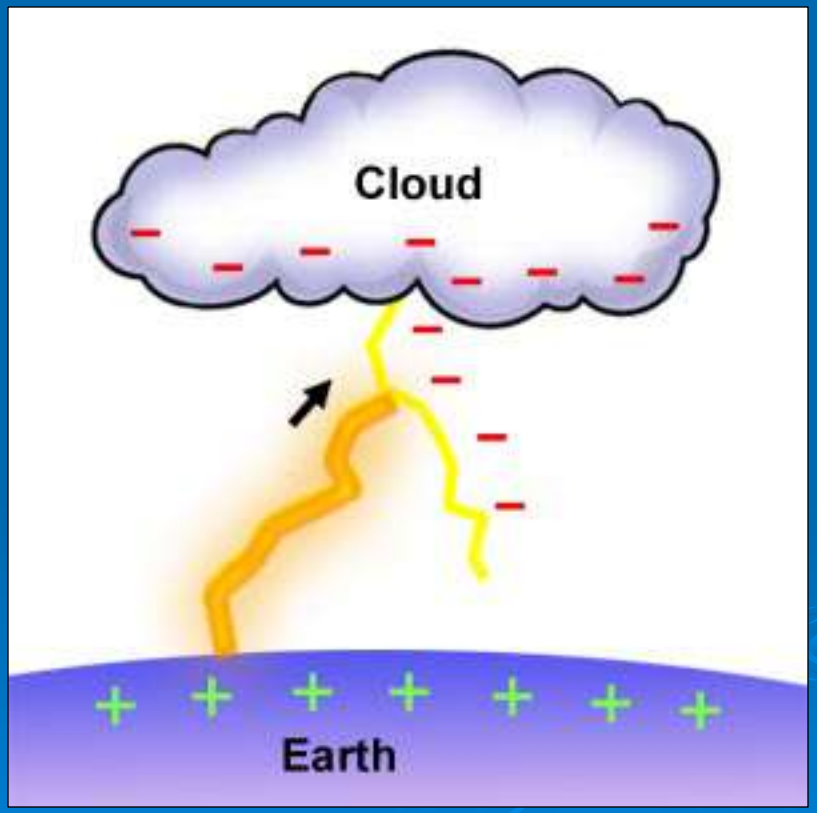
Stepped Leader

- Is a channel of partially charged air.
- A path of ionized air which extends downward from the cloud during the initial stages of a lightning strike.



Return Stroke

- A branch channel of positively charged ions that rushes upward from the ground to meet the stepped leader.



Thunder

- Lightning heats air to 30,000 degrees Celsius! (5 times the temperature of the Sun's surface!)
- Thunder is the sound produced by this super heating of air expanding and contracting.

Thunder

- Because sound travels more slowly than light you see lightning before you hear thunder.
- Sound travels through air at about 1100-1200 feet (330-350 meters) per second, which is a little more than one mile per five seconds.
- Time between lightning and thunder / 5 = distance from lightning strike in miles.

Thunderstorms and Lightening Safety

- Each year Lightening causes
  - 7,500 forest fires
  - 300 injuries
  - 93 human deaths

Precautions for Thunderstorms and lightening

- Inside precautions
- Stay at least a few feet away from open windows, sinks, toilets, tubs, showers, electric boxes, outlets, and appliances. Lightning can flow through these systems and "jump" to a person.
- Do not shower or take a bath during a thunder or lightning storm.
- Avoid using regular telephones, except in an emergency. If lightning hits the telephone lines, it could flow though the phone. Cell or cordless phones, not connected to the building's wiring, are safe to use.

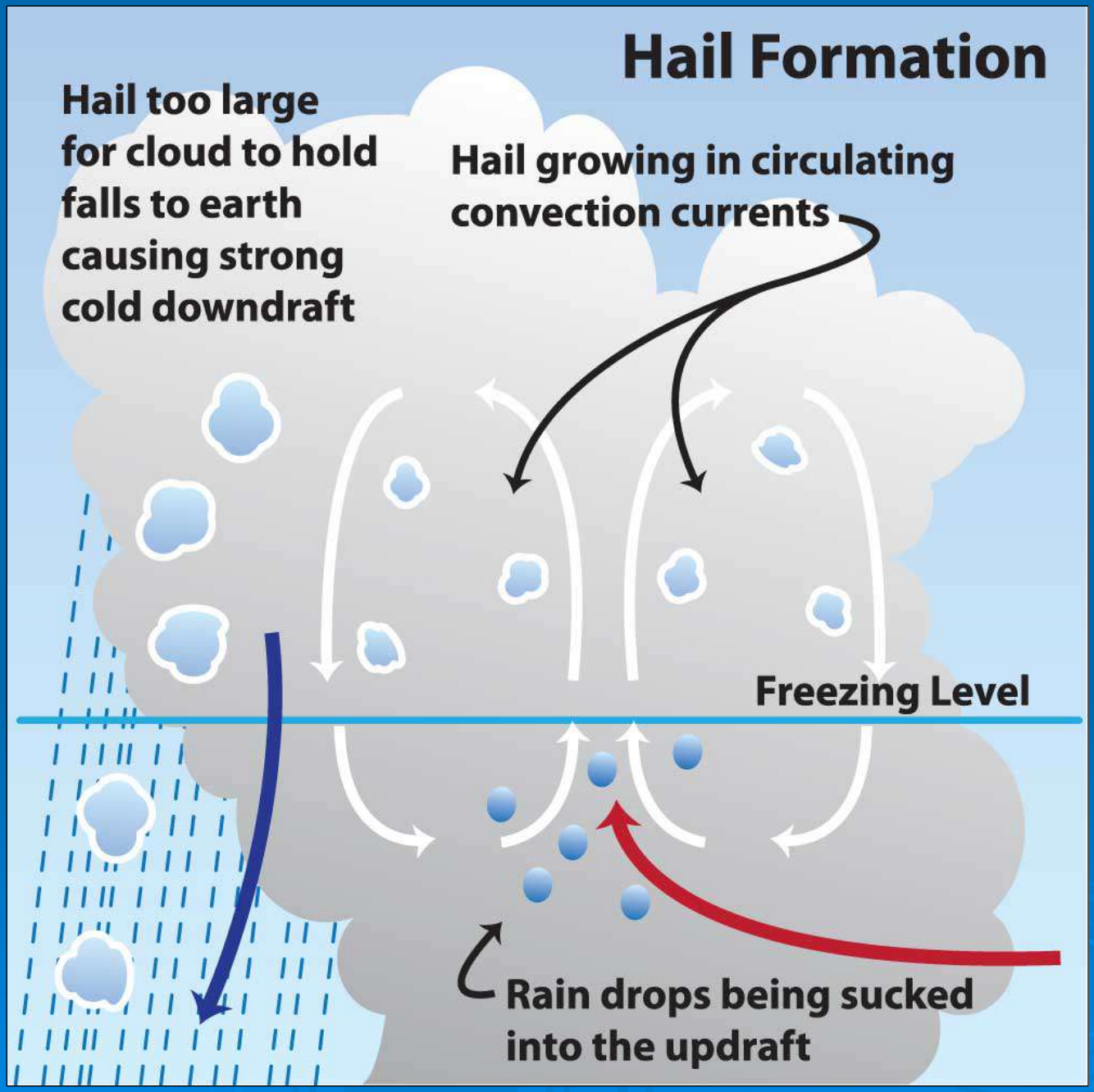
- Outside precaution
- Crouch down on the balls of your feet with your feet close together. Keep your hands on your knees and lower your head. Get as low as possible without touching your hands or knees to the ground. DO NOT LIE DOWN!
- If you are in a boat and cannot get to shore, crouch down in the middle of the boat. Go below if possible.
- If you are on land, find a low spot away from trees, metal fences, pipes, tall or long objects.
- If you are in the woods, look for an area of shorter trees. Crouch down away from tree trunks.

Severe Weather 13.2 pg 350

- All thunderstorms produce wind, rain and lightning, which can have dangerous and damaging effects under certain circumstances.

Supercells

- Self-sustaining, extremely powerful storm.
- Supercells are characterized by intense, rotating updrafts taking 10 to 20 mins to reach the top of the cloud.
- Super storms can last for hours and have updrafts as strong as 240 km/hr!


Hail Formation
Hail too large for cloud to hold falls to earth causing strong cold downdraft
Hail growing in circulating convection currents
Freezing Level
Rain drops being sucked into the updraft

Tornadoes!

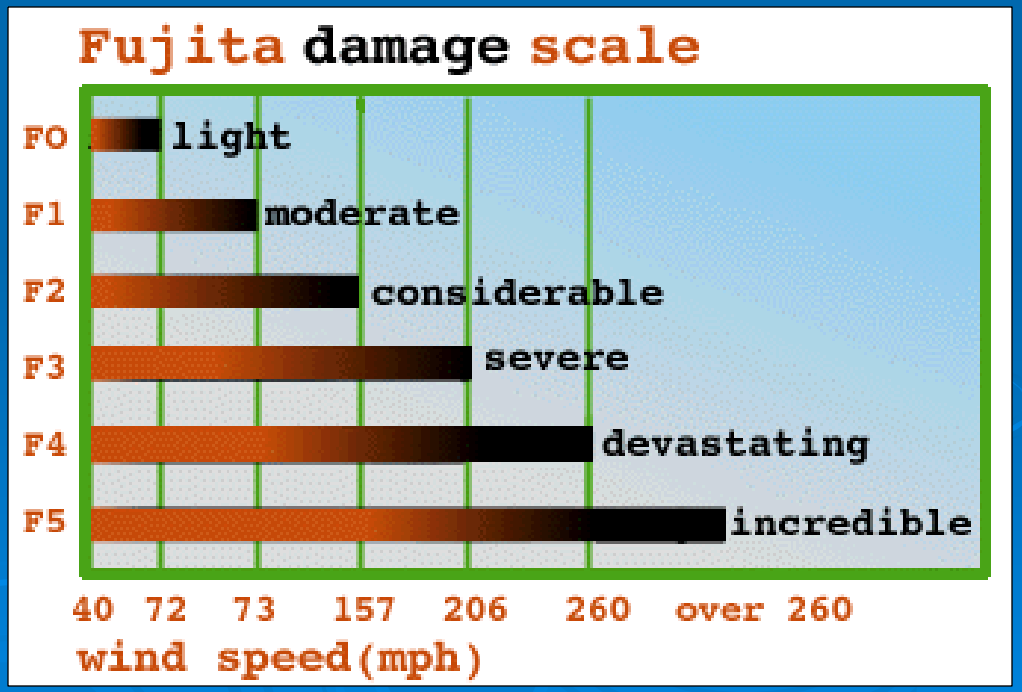
- Tornado: a violent, whirling column of air in contact with the ground.
- If the tornado never reaches the ground it is called a funnel cloud.
- Tornados are visible because of the debris picked up by the swirling column of air or vortex.

Development of Tornadoes

- Tornadoes most often form at the leading edge of an advancing cold front or along a line of thunderstorms where winds are converging to a center of very low pressure.
- A tornado forms when a vertical cylinder of rotating air develops in a thunderstorm.

Fujita Tornado Intensity Scale

- FTIS: ranks tornadoes according to their paths of destruction, wind speed and duration.



Tornado Distribution

- Most tornadoes form in the spring when temperatures contrasts between polar air and tropical air.
- Large temperature differences occur frequently over central United States

Tornado Alley

- **The main reason the plains in this area are prone to the more devastating tornadoes than any other region in the US is because this is where cold, dry air flowing south from Canada meets the warm, moist air moving northward from the Gulf of Mexico.**
- **The flat, open lands in these states are prime breeding grounds for tornadoes. Tornadoes cannot grow, stay on the ground, and thrive in mountainous regions or areas with lots of forest.**

Texas, Lousiana, Oklahoma, Arkansas, Kansas, Missouri, Iowa, Nebraska, South Dakota, North Dakota and Minnesota.

Tornado Safety

- Average of 80 human deaths and 1500 injuries result from tornadoes every year.
- Tornado Warnings: is an alert issued by government weather services to warn that severe thunderstorms with tornadoes may be imminent.
- Tornado Watches: is issued when conditions are right for a tornado to form

Tornado Precautions

- Inside Precautions
- Go at once to a windowless, interior room; storm cellar; basement; or lowest level of the building
- If there is no basement, go to an inner hallway or a smaller inner room without windows, such as a bathroom or closet
- Get away from the windows
- Get under a piece of sturdy furniture such as a workbench or heavy table or desk and hold on to it
- Use arms to protect head and neck
- If in a mobile home, get out and find shelter elsewhere

- **If outdoors:**
- If possible, get inside a building
- If shelter is not available or there is no time to get indoors, lie in a ditch or low-lying area or crouch near a strong building. Be aware of the potential for flooding
- Use arms to protect head and neck

- **If in the car:**
- Never try to out-drive a tornado in a car or truck
- Get out of the car immediately and take shelter in a nearby building
- If there is no time to get indoors, get out of the car and lie in a ditch or low-lying area away from the vehicle. Be aware of the potential for flooding