Severe Weather

Thunderstorms

Thunderstorms form when ground temperatures are high, typically during late afternoons and early evenings in the summer.

The formation of a thunderstorm can be broken down into three stages:

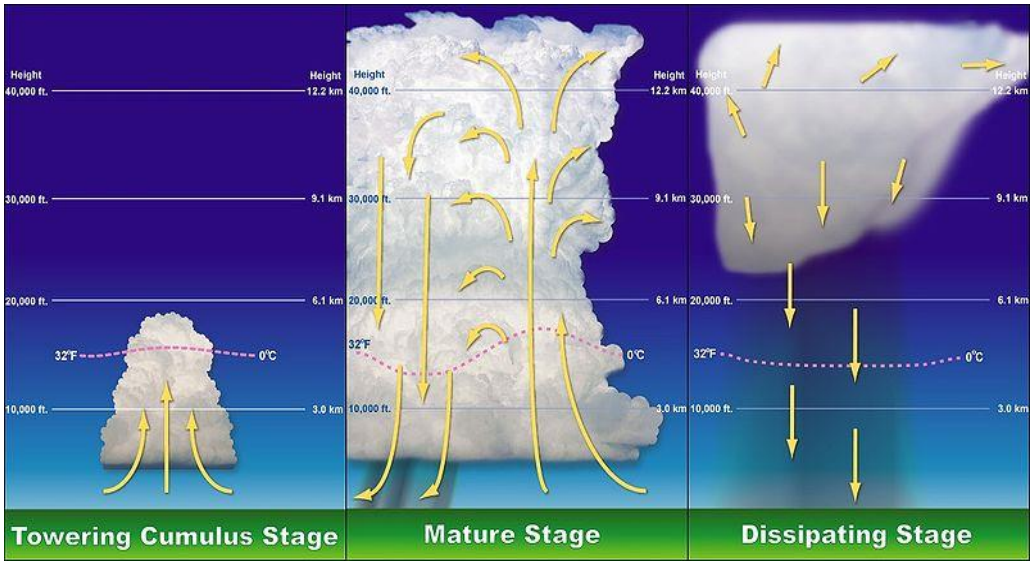
Cumulus	• Sun heats earth's surface • Hot air rises • Air is moist, cumulus clouds form vertically
Mature	• Cumulus cloud becomes large • Water within cloud becomes heavy • Cool, dry air enters cloud and begins to descend down the cloud • Downdraft pulls heavy water downward
Dissipating	• Downdrafts in the cloud begin to dominate over updrafts • Since warm air can no longer rise, clouds stop forming • Convection ceases and water vapor does not condense • Storm begins to dissipate and clouds disappear from bottom to top

Thunderstorms: Thunder and Lightning

- Thunder storms can form individually or as part of a squall line along a cold front.
- Large amounts of energy collected within cumulonimbus clouds is released as electricity called **lightning**
- The rapid heating of the air surrounding a lightning strike produces a loud clap of **thunder,** which is a result of the rapidly expanding air.

Study Tip

Hurricanes, typhoons, tornadoes, and cyclones… These terms can be confusing to differentiate from one another. A cyclone is the umbrella term that includes tropical storms and typhoons. Tornadoes and cyclones are considered different types of storms.



The three stages in the formation of a thunderstorm

Tornadoes

Characteristics:

- Tornadoes form at the front of severe thunderstorms
- Tornadoes generally last only a few minutes
- When tornadoes form over water, they are referred to as waterspouts

Formation:

- Tornadoes are typically products of severe thunderstorms.
- As air in a thunderstorm rises, the surrounding air races in to fill the gap,
- This forms a funnel-shaped whirling column of air that extends down to the earth from the thundercloud.

Destruction:

- Damages a small area but can destroy everything it passes
- An average of 90 people are killed by tornadoes each year

Location:

- Tornadoes form during the spring where maritime tropical and continental polar air masses meet.

Tornadoes: Measurement

The Fujita scale measures the intensity of tornadoes based on wind speed and damage.

F Scale	(km/hr)	(mph)	Damage
F0	64-116	40-72	Light - tree branches fall and chimneys may collapse
F1	117-180	73-112	Moderate - mobile homes, autos pushed aside
F2	181-253	113-157	Considerable - roofs torn off houses, large trees uprooted
F3	254-332	158-206	Severe - houses torn apart, trees uprooted, cars lifted
F4	333-419	207-260	Devastating - houses leveled, cars thrown
F5	420-512	261-318	Incredible - structures fly, cars become missiles

F6	>512	>318	Maximum tornado wind speed

Differences between Cyclones and Tornadoes

Storm	Width	Duration	Strength
Tornado	Hundreds of meters	A few seconds to a few hours	Maximum tornado wind speeds can reach 318 mph
Tropical cyclone (hurricane)	Hundreds of miles	5-10 days	Category 5 (strongest) wind speeds up to 156 mph

Mid-latitude Cyclones

A **cyclone** is any rotating low-pressure system. Cyclones rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere

Mid-latitude cyclones form at a polar front where temperature differences are high between two air masses.

Mid-latitude Cyclones: Formation

- Warm air at the cold front rises and creates a low pressure cell
- Winds rush into the low pressure cell, creating a column of air
- Air twists counter-clockwise in the northern hemisphere and clockwise in the southern hemisphere
- Air is moist so rain or snow falls

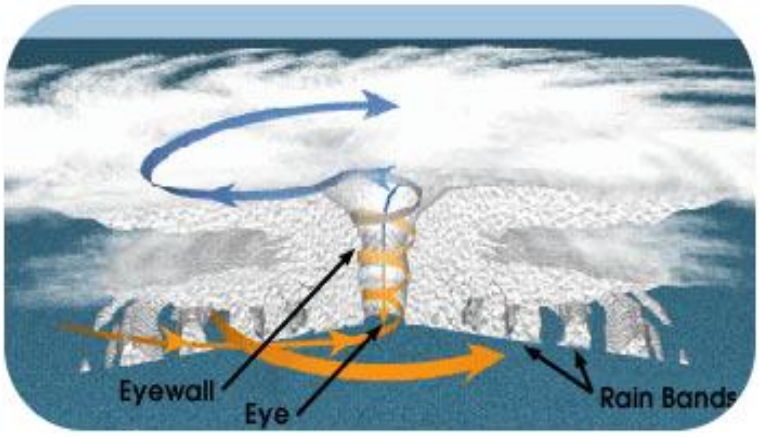
Mid-latitude Cyclones:

Nor'easters

Nor'easters are mid-latitude cyclones in the Mid-Atlantic and New England states.

Hurricanes

Hurricanes are special types of cyclones that form in the tropics. They are also referred to as tropical cyclones.



A cross-sectional view of a hurricane

Hurricanes: Formation

Hurricanes arise in the tropical latitudes in summer and autumn when sea surface temperatures are over 28°C.

- Warm seas create a large humid air mass.

- Warm air rises and forms a low pressure cell called a **tropical depression.**
- Air begins to rotate around the low pressure.
- As air rises, water vapor condenses, releasing energy from latent heat.
- If wind shear is low, the storm will build into a hurricane within 2-3 days

Hurricanes: Storm Activity

- Hurricanes can cover 800km (500 miles) in one day.
- Hurricanes that form in the Northern Hemisphere originate in the trade winds and move to the west. Hurricanes switch direction and travel toward the north once they reach latitude of the westerlies.

Hurricanes: Saffir-Simpson Scale

Hurricanes are categorized based on wind speed on the Saffir-Simpson Scale

Category	Kph	Mph	Estimated Damage
1 (weak)	119-153	74-95	Above normal; no real damage to structures
2 (moderate)	154-177	96-110	Some roofing, door, and window damage, considerable damage to vegetation, mobile homes, and piers
3 (strong)	178-209	111-130	Some buildings damaged; mobile homes destroyed
4 (very strong)	210-251	131-156	Complete roof failure on small residences; major erosion of beach areas; major damage to lower floors of structures near shore
5 (devastating)	>251	>156	Complete roof failure on many residences and industrial buildings; some complete building failures

Blizzards

Blizzards are large snowstorms with high winds.

Conditions:

- Temperatures below –7° C (20° F); –12° C (10° F) for a severe blizzard.
- Winds greater than 56 kmh (35 mph); 72 kmh (45 mph) for a severe blizzard.
- Snow so heavy that visibility is 2/5 km (1/4 mile) or less for at least three hours; near zero visibility for a severe blizzard.

Blizzards: Formation

- Occur across the middle latitudes and towards the poles
- Usually part of a mid-latitude cyclone
- Commonly occurs when the jet stream has traveled south and a cold, northern air mass comes into contact with a warmer, semitropical air mass.

- Pressure gradient between the low-pressure and high-pressure parts of the storm create strong winds

Blizzards: Lake-Effect Snow

Lake effect snow occurs when an air mass reaches the leeward side of a lake. The air mass is very unstable and drops a tremendous amount of snow.

Heat Waves and Droughts

Heat Wave:

- According to the World Meteorological Organization a region is in a **heat wave** if it has more than five consecutive days of temperatures that are more than 9° F (5° C) above average.
- A high-pressure area sitting over a region with no movement is the likely cause of a heat wave.

Drought:

- When a region gets significantly less precipitation than normal for an extended period of time, it is in **drought**.
- Consequences to droughts include dust storms, blown over soil, and wildlife disturbance

Concept Check

- Compare and contrast tornadoes and cyclones.
- Describe how a blizzard is formed.
- Describe the causes of both of the following natural phenomena: heat waves and droughts.