

# Severe Weather

Loulousis

# What is severe weather?

- \* Weather that causes property damage or loss of life.
- \* Types we will study
  - \* Thunderstorms
  - \* Tornadoes
  - \* Hurricanes

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# Thunderstorms

What is a thunderstorm?

- A thunderstorm is a weather event where there is heavy rain, lightning, thunder roars, and possible hail.
- How do they form?
- They occur in warm moist air masses and along fronts.
- The air is forced upward where it is cooled, and condensation occurs forming cumulonimbus clouds.
- Then precipitation happens in the form of rain or hail. The rain cooled air sinks and strong updrafts of warmer air causes strong winds.

# Can thunderstorms cause damage?

- \* YES!
- \* How?
- \* By flooding
- \* Hail damage
- \* Wind damage
- \* Lightning strikes (possible fires)

## What is lightning?

- Lightning is a bright flash of electricity produced by a thunderstorm.
- All thunderstorms produce lightning and are very dangerous.
- If you hear the sound of thunder, then you are in danger from lightning. Lightning kills and injures between 75 to 100 people each year. (in the US)



## What causes lightning?

- Lightning is an electric current.
- In a thundercloud, many small bits of ice (frozen raindrops) bump into each other as they move around in the air. All the collisions create an electric charge. Once the cloud fills, with electrical charges, the positive charges form at the top of the cloud and the negative charges form at the bottom of the cloud.
- Since opposites attract, this causes a positive charge to build up on the ground **beneath** the cloud. The ground's electrical charge concentrates around anything that sticks up, such as mountains, people, or single trees.
- The charge coming up from these points eventually connects with a charge reaching down from the clouds and - zap - lightning strikes!
- Lightning also forms within and between clouds.
- Lightning is 30,000 degrees Celsius



## Lightning by the numbers

- A typical lightning flash contains about 300 million volts of electricity, or enough power to light a 100-watt compact fluorescent bulb for a **year**, according to the National Weather Service.
- In the United States, lightning strikes kill about 100 people each year and injure about 1,000, according to the National Oceanic and Atmospheric Administration (NOAA).
- FEMA estimates that your chances of being struck by lightning are now about 1 in 600,000. Over the past 100 years, the rate at which people are struck has dropped substantially, as fewer people now work outdoors on farms or ranches.
- [lightning](#) strikes kill about 24,000 people worldwide each year, and about 240,000 people are injured by lightning and survive.
- [https://www.youtube.com/watch?v=eNxDgd3D\\_bU](https://www.youtube.com/watch?v=eNxDgd3D_bU) - how to survive being struck by lightning
- Info taken from <http://www.livescience.com/38313-how-to-survive-a-lightning-strike.html>





# What causes thunder ?



- Thunder is caused by lightning. When a lightning bolt travels from the cloud to the ground it actually opens up a little hole in the air, called a channel.
- The lightning heats up the air and causes it to expand.
- Once the lightning is gone the air collapses back due to quick cooling, and creates a sound wave that we hear as thunder. The reason we see lightning before we hear thunder is because light travels faster than sound!



## Can you tell how far away a thunderstorm is?

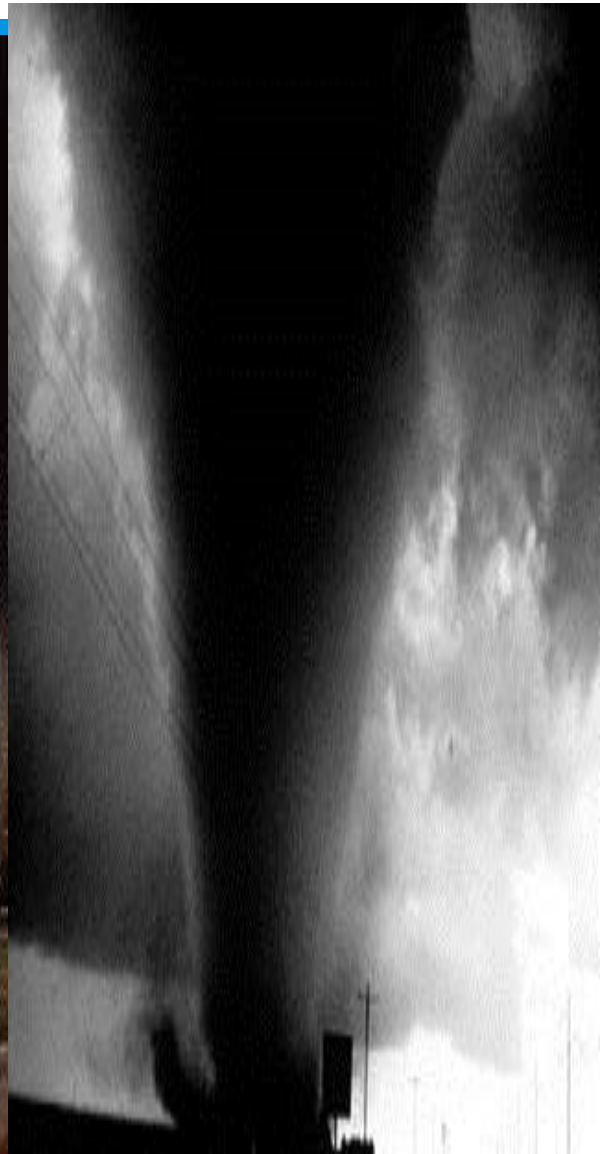
- Yes, you can use thunder to tell how far away a storm is.
- Next time you see a storm, count the number of seconds between when you see the lightning and hear the thunder.
- Take the number of seconds and divide by 5 and that will tell you how far away the storm is in miles.
- For example: If you counted 10 seconds between the lightning and the thunder, the lightning is 2 miles away!

$$10 / 5 = 2 \text{ Miles}$$



- \* Static electricity

- \* [https://www.youtube.com/watch?v=fT\\_LmwnmVNM](https://www.youtube.com/watch?v=fT_LmwnmVNM)



# What is a Tornado?

- \* Tornado – violent rotating column of air extending from a thunderstorm to the ground
- \* Capable of wind speeds up to 300mph, most are between 65-110mph
- \* Most are short lived and last less than a hour
- \* Cause a lot of property damage, kill about 90 people each year in U.S.
- \* In one year 1000 tornadoes are reported in U.S.

# Where do Tornadoes Occur?

- \* Tornadoes occur on every continent except Antarctica.
- \* The geography of the central United States (Great Plains) is suited to bring all necessary ingredients to form a tornado.
  - \* Texas, Kansas, and Oklahoma are included in this region.
  - \* Region Commonly referred to as Tornado Alley.



# What's needed to Form a Tornado?

- \* Scientists don't entirely understand how tornadoes form or stop, but have a good idea how they develop
- \* Need:
  - \* 1. A lot of warm, moist air close to the ground
  - \* 2. Instability in the atmosphere, that promotes vertical movement of air
  - \* 3. Clashing air fronts that push moist air upward



# Tornado Formation

- \* Most tornadoes form from thunderstorms when the thunderstorm reaches supercell status
  - \* Supercell – thunderstorm (usually over 40,000ft large) that has a mesocyclone
  - \* Mesocyclone – spinning air mass, its presence generates a tornado watch, found in supercell thunderstorms
- \* Usually occurs when warm, moist air from the Gulf of Mexico collides with cool, dry air from Canada creating instability in the atmosphere



# How does a Tornado Form?

- \* 1. Column of warm, moist air rises very quickly
- \* 2. Air Rotates because of wind shear creating a horizontal rotating column of air
- \* Wind shear – winds at two different altitudes blow at two different speeds



# How do Tornadoes Form?



- \* 3. Faster spin makes a funnel cloud
  - \* Funnel cloud – funnel-shaped cloud of condensed water droplets in a rotating column of wind, does not touch the ground
  - \* The horizontal rotating column gets caught in a supercell updraft that tightens the spin and increases wind speed
    - \* This is similar to when a skater's spins become faster because she pulls her arms close to her body

# How do Tornadoes Form?

- \* 4. The force of rain or hail makes the funnel rotate from a horizontal direction to a vertical direction down toward the ground
- \* 5. When the funnel touches the ground it's a tornado



## Know the Lingo

**TORNADO WATCH** - Tornadoes are possible in your area. Stay tuned to the radio or television news.

**TORNADO WARNING** - A tornado is either on the ground or has been detected by Doppler radar. Seek shelter immediately!



## Measuring Tornadoes

<b>The Fujita Scale</b>	
<b>F0</b> gale tornado 40-72 mph	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages sign boards.
<b>F1</b> moderate tornado 73-112 mph	Lower limit is the beginning of hurricane-force winds. Peels surface off roofs; mobile homes pushed over; moving autos pushed off roads.
<b>F2</b> significant tornado 113-157 mph	Roofs torn off frame houses; mobile homes demolished; boxcars pushed over, large trees snapped or uprooted; light-object missiles generated.
<b>F3</b> severe tornado 158-206 mph	Severe damage. Roofs and some walls torn off well-constructed homes; trains overturned; most trees in forest uprooted; heavy cars lifted off the ground and thrown.
<b>F4</b> devastating tornado 207-260 mph	Well-constructed homes leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
<b>F5</b> incredible tornado 261-318 mph	Phenomenal damage. Strong frame homes disintegrate or lifted off foundations and carried considerable distance; trees debarked.



EF Rating	Wind Speeds	Expected Damage	
EF-0	65-85 mph	<p>'Minor' damage: shingles blown off or parts of a roof peeled off, damage to gutters/siding, branches broken off trees, shallow rooted trees toppled.</p>	
EF-1	86-110 mph	<p>'Moderate' damage: more significant roof damage, windows broken, exterior doors damaged or lost, mobile homes overturned or badly damaged.</p>	
EF-2	111-135 mph	<p>'Considerable' damage: roofs torn off well constructed homes, homes shifted off their foundation, mobile homes completely destroyed, large trees snapped or uprooted, cars can be tossed.</p>	
EF-3	136-165 mph	<p>'Severe' damage: entire stories of well constructed homes destroyed, significant damage done to large buildings, homes with weak foundations can be blown away, trees begin to lose their bark.</p>	
EF-4	166-200 mph	<p>'Extreme' damage: Well constructed homes are leveled, cars are thrown significant distances, top story exterior walls of masonry buildings would likely collapse.</p>	
EF-5	> 200 mph	<p>'Massive/incredible' damage: Well constructed homes are swept away, steel-reinforced concrete structures are critically damaged, high-rise buildings sustain severe structural damage, trees are usually completely debarked, stripped of branches and snapped.</p>	





\* How Tornadoes form

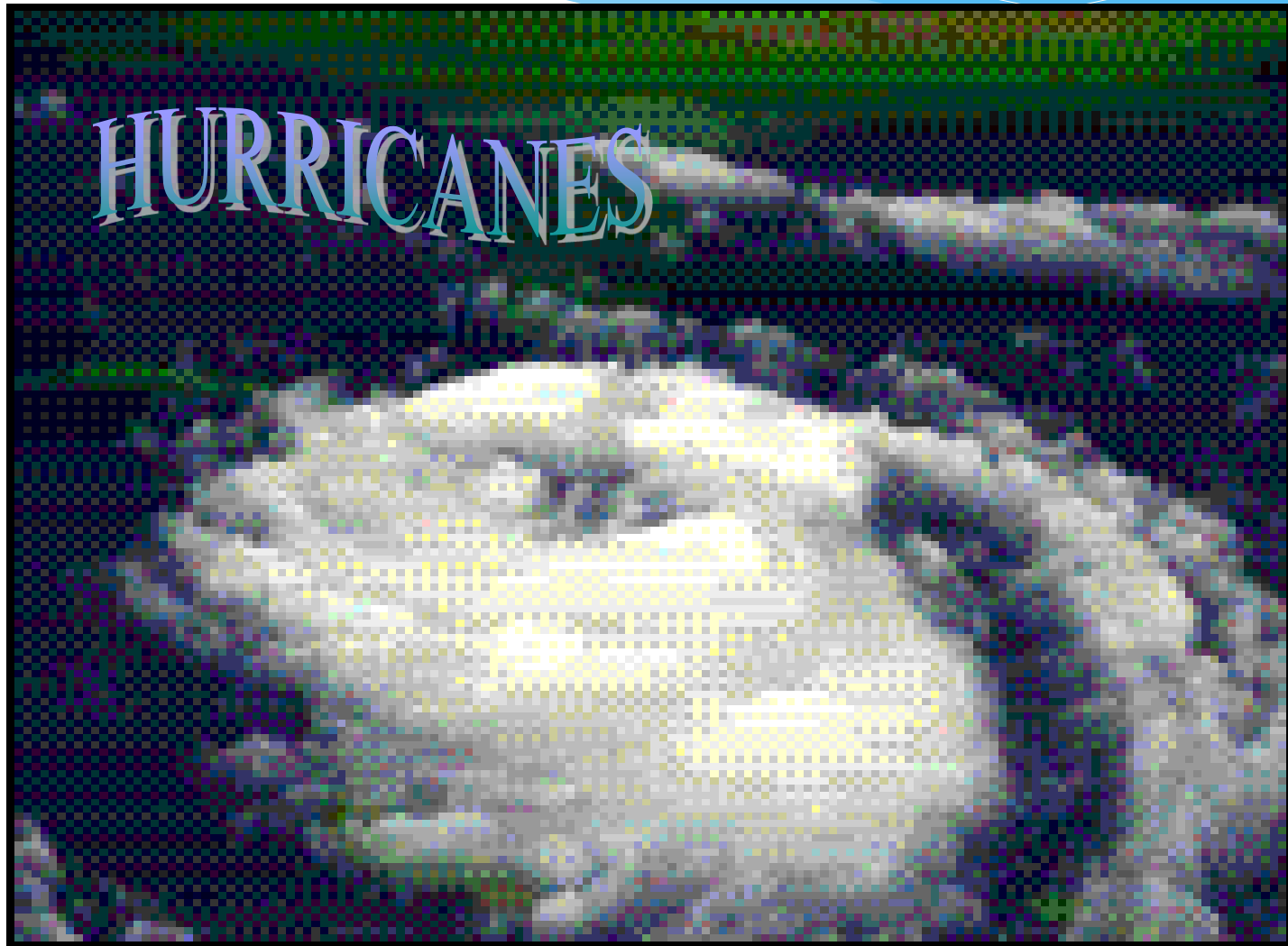
[https://www.youtube.com/watch?v=lmWh9jV\\_1ac](https://www.youtube.com/watch?v=lmWh9jV_1ac)

\* Tornado Safety

\* [https://www.youtube.com/watch?v=\\_5TiTfuvotc](https://www.youtube.com/watch?v=_5TiTfuvotc)

How to survive a hurricane

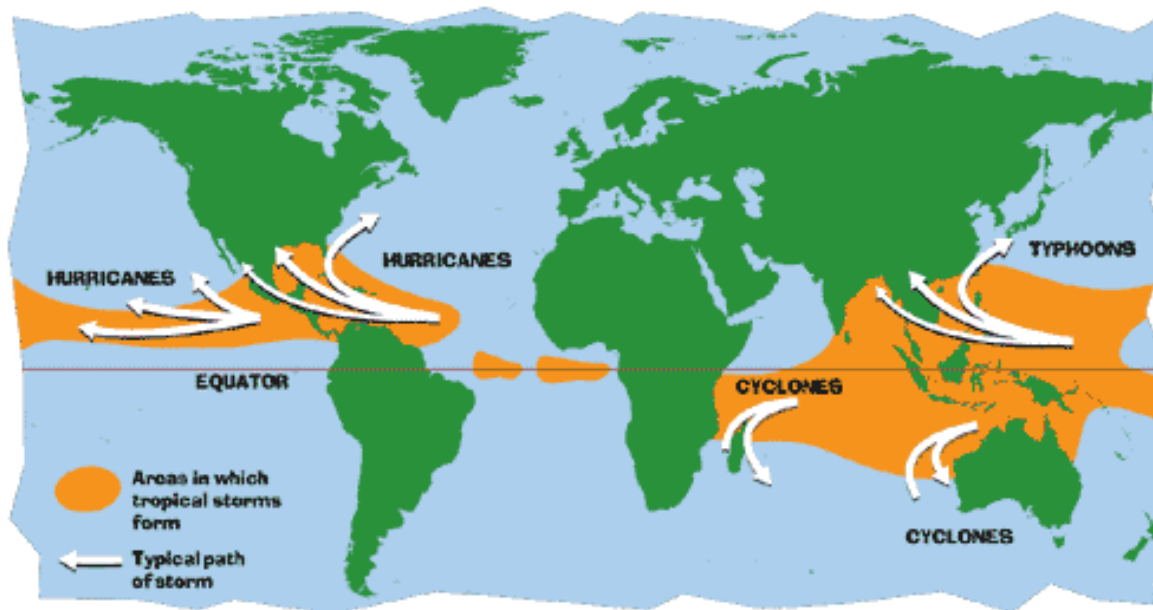
<https://www.youtube.com/watch?v=OwSaHcoX2KA>





# What is a hurricane?

- Large, swirling storms that produce winds of 74mph or higher that develop over the ocean
- It can be up to 600 miles across and have strong winds spiraling inward and upward at speeds of 74 to 200 mph.
- Hurricanes usually lasts for over a week, moving 10-20 mph over the open ocean.
- Called tropical cyclone
  - Also called typhoons (Pacific Ocean), cyclones (Indian Ocean), or hurricanes (Atlantic and part of Pacific Ocean) depending on where they are located



# Hurricanes Features

- \* Rotation
  - \* Storms that form North of the equator spin **counterclockwise**
  - \* Storms that form South of the equator spin **clockwise**
- \* Difference is due to?
  - \* **Coriolis Effect** – caused by the Earth's rotation on its axis
    - \* Coriolis Effect also helps contribute to the direction of the storm, not just the spin of the storm

# Hurricane Features

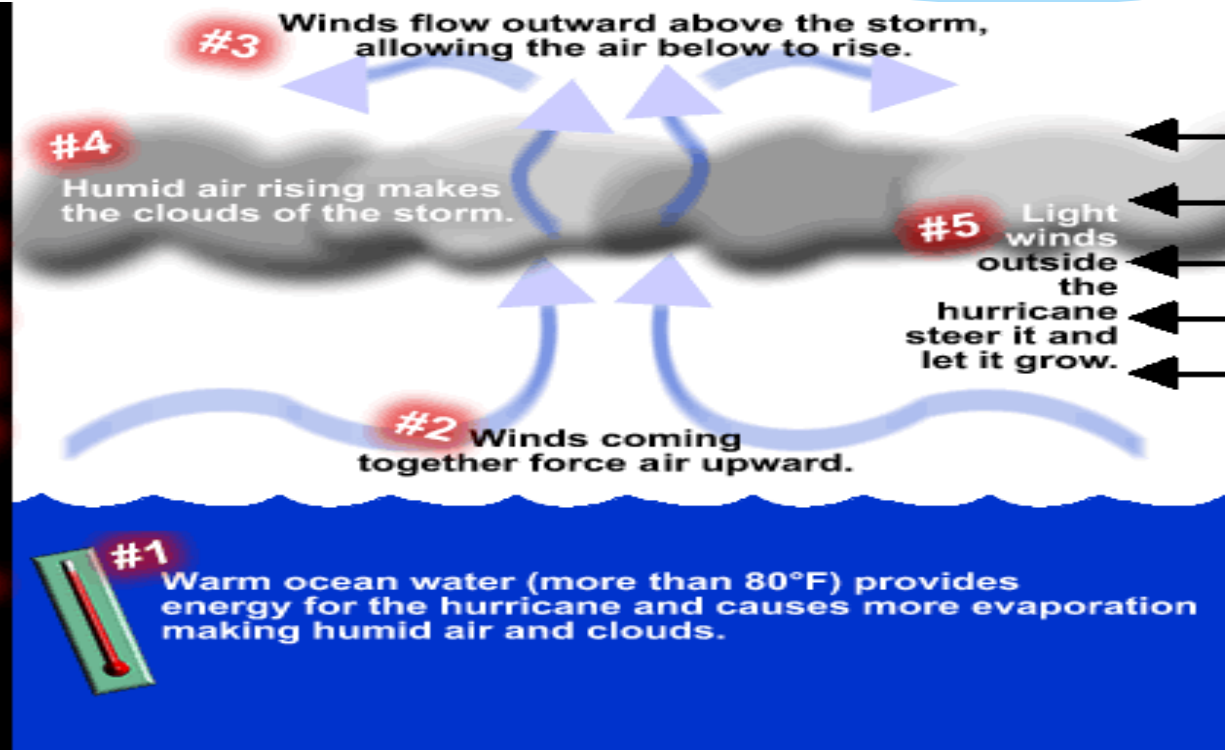
- \* All hurricanes develops an “eye”
- \* Eye- is the calmest part of the storm and has only light winds and fair weather
- \* The eye is typically 5-30 miles wide
- \* Surrounding the eye is the eyewall which contains the most violent rain storms of the hurricane

# Where does Hurricane Energy Come From?

- \* Form in warm ocean waters near the equator
- \* **typically form between 5 to 15 degrees latitude north and south of the equator.**
- \* where there is plenty of warm, moist air to fuel the storm
- \* **Hurricanes form over warm ocean water of 80°F or warmer.**
- \* Hurricanes gather heat and energy through contact with warm ocean waters.

# What do Hurricanes Need?

**WHAT  
DOES  
A  
HURRICANE  
NEED?**



# How do Hurricane Form?

## Stage 1 Tropical disturbance

- \* 1. For Hurricanes in Atlantic Ocean Wind starts to blow westward
- \* 2. The wind evaporates (turns into water vapor) the warm ocean water and it rises
- \* 3. As it rises the water vapor cools and condenses forming cumulonimbus clouds releasing heat into the air
- \* 4. The warm air rises and is pulled into the clouds
- \* 5. Evaporation and condensation continue eventually forming a **pattern** that has wind circulating around the center
- \* 6. Thunderstorms form - storm is considered tropical disturbance

# How Hurricane forms

## Stage 2 Tropical depression

- \* 7. As thunderstorm grows larger the top of the cloud that is cooling and becomes **unstable**
- \* 8. **air pressure increases** causing winds to move outward away from the high pressure area, winds circulate faster- Storm is now has a tropical depression

## Stage 3 Tropical Storm

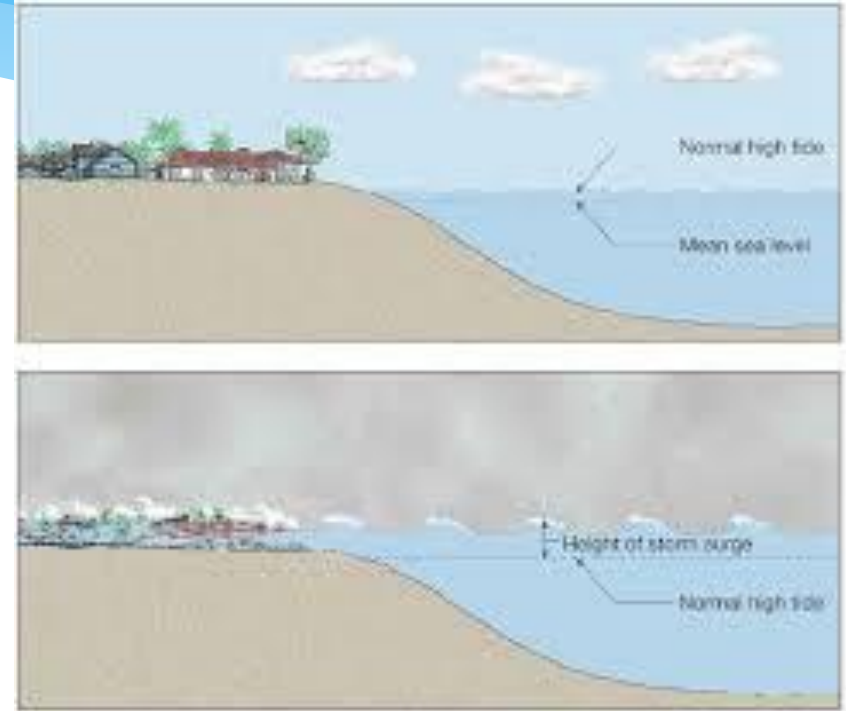
- \* 9. When wind speeds reach 39mph the tropical depression becomes a tropical storm
  - \* The storm is **named** at this point

## Stage 4 Tropical Cyclone

- \* When wind reaches 74mph the storm is officially a hurricane. The storm is at least 50,000 feet high and 125 miles across

# Storm Surge

- \* As a hurricane's winds spiral around and around the storm, they push water into a mound at the storm's center.
- \* This mound of water becomes dangerous when the storm reaches land because it causes **flooding along the coast**.
- \* The water piles up, unable to escape anywhere but on land as the storm carries it landward.
- \* A hurricane will cause more storm surge in areas where the ocean floor slopes gradually.





# How does a Hurricane End?

- \* When hovers over land for a long time the hurricane **loses the heat energy** it had been getting from the ocean water evaporating
- \* Without this energy fueling the storm it dissipates
- \* To monitor Hurricanes there are “**Hurricane Hunters**”
  - \* Work for National Oceanic and Atmospheric Administration(NOAA)
  - \* Missions last about 10 hours
  - \* Crew flies into the storm and retrieves data about it like air pressure, wind speed, temperature



## Saffir-Simpson Hurricane Scale



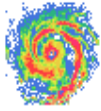
<u>Category</u>	<u>Winds (MPH)</u>		<u>Storm Surge (Feet)</u>	<u>Damage</u>
1	74-95		4'-5'	Minimal
2	96-110		6'-8'	Moderate
3	111-130		9-12'	Extensive
4	131-155		13'-18'	Extreme
5	>155		>18'	Catastrophic

Scale explained -

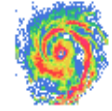
<https://www.youtube.com/watch?v=NEAxtD2IG14>

# Can Hurricanes cause damage?

- \* Absolutely!
- \* Storm surges usually cause the most damage and death
- \* Storm surge - rising of sea due to atmospheric pressure changes and wind associated with a s storm
- \* Winds can destroy homes and uproot trees
- \* Extensive rain can also cause major flooding



## Know the Lingo



Hurricane season in N. Atlantic is between June 1 - November 30  
(most in the fall)

**TROPICAL STORM WATCH** - Tropical Storm conditions with sustained winds from 39 -74 mph are possible in your area within the next 36 hours.

**TROPICAL STORM WARNING** - Tropical Storm conditions are expected in your area within the next 24 hours.

**HURRICANE WATCH** - Hurricane conditions with sustained winds of 74 mph or greater are possible in your area within the next 36 hours. This WATCH should trigger your family's disaster plan, and protective measures should be initiated. Especially, those actions that require extra time such as securing a boat and leaving a barrier island.

**HURRICANE WARNING** - Hurricane conditions are expected in your area within 24 hours. Once this WARNING has been issued, your family should be in the process of completing protective actions and deciding the safest location to be during the storm