

## Extreme Weather Phenomena

Thunderstorms, Tornadoes,  
Hurricanes, Monsoons, Blizzards

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## Thunderstorms

- Warm, humid air fuels all thunderstorms.
- Warm air rises
- Clouds form as warm air carrying moisture rises within cooler air
- As the warm air rises, it cools
- The moist water vapour begins to condense
- As the moisture condenses, energy is released keeping the air warmer than its surroundings, so that it continues to rise

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- If enough instability is present in the atmosphere, this process will continue long enough for cumulonimbus clouds to form, which support lightning and thunder.

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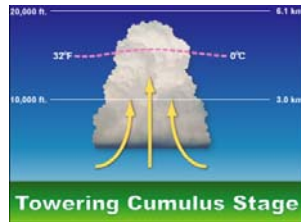
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## Cumulus (Developing) stage

- Moisture is lifted upwards into the atmosphere
- The moisture rapidly cools into liquid drops of water, which appears as cumulus clouds



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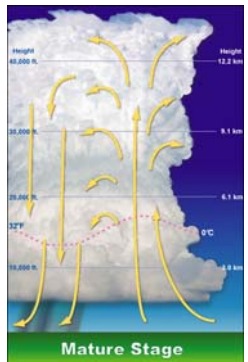
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## Mature Stage

- Warm air rises into the cloud and condenses
- The condensation releases energy causing it to still be warmer than the surrounding air and thus keeps rising causing an updraft that pulls in more air



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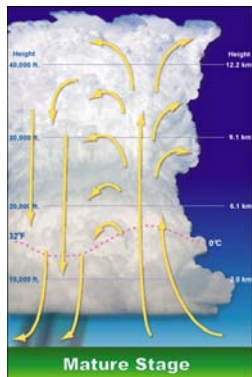
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- The water droplets combine to form droplets that freeze to become ice particles.
- When the ice particles get too big they fall
  - If they melt it's rain, otherwise hail
- The falling rain cools the air underneath the storm creating a downdraft



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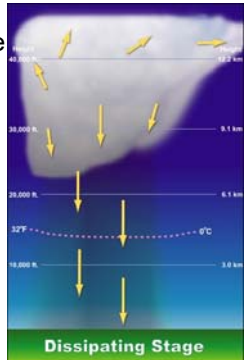
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## Dissipating stage

- The downdraft cools the air to the point that the updraft stops
- The rain continues until the supply of moisture has run out
- The thunderstorm will dissipate.



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## Tornadoes

- Tornadoes are the most violent storms on Earth
- Winds spiraling into them can vary from 60 km/h to as high as 500 km/h
- A tornado is "a violently rotating column of air in contact with the ground and pendant from a thunderstorm."



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## How a Tornado Forms

- Tornadoes form in within a thunderstorm's updraft.
- Small cyclones of air in the updraft intensify
- The air pressure in the center of the cyclone is lower causing it to spin faster and narrower
- A funnel cloud appears

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## Intensity of Tornadoes

- The Enhanced Fujita Scale is used to rate the intensity of a tornado by examining the damage caused by the tornado after it has passed over a man-made structure.
- Wind speeds are estimated from damage to structures based on the degree of damage to 28 damage indicators.

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	Estimated Wind Speed	Typical Observations
EF-0	65-85 mph	Light damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF-1	86-110 mph	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF-2	111-135 mph	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF-3	136-165 mph	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF-4	166-200 mph	Devastating damage. Whole frame houses Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF-5	Over 200 mph	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m; high-rise buildings have significant structural deformation; incredible phenomena will occur.

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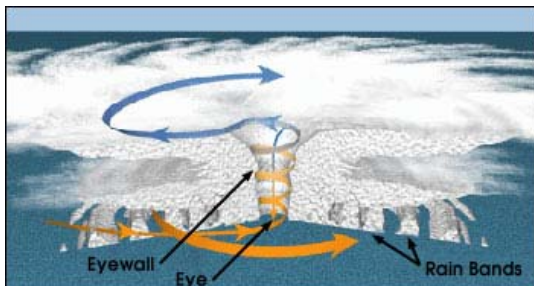
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## Hurricanes, Typhoons, Tropical Cyclones

- Spinning storms formed over the ocean




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- The main characteristics of a hurricane, are:
  - Hurricanes have no fronts
  - Hurricane winds weaken with height
  - The centers of hurricanes are warmer than their surroundings
  - Hurricanes and tropical systems form under weak high-altitude winds.
  - Air sinks at the center of a hurricane
  - Hurricanes' main energy source is the latent heat of condensation
  - Hurricanes weaken rapidly over land

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### Classification

- Tropical disturbance, tropical wave
  - Unorganized mass of thunderstorms, very little, if any, organized wind circulation.
- Tropical depression
  - Has evidence of closed wind circulation around a center with sustained winds from 20-34 knots (23-39 mph).
- Tropical storm
  - Maximum sustained winds are from 35-64 knots (40-74 mph)
- Hurricane or typhoon
  - Maximum sustained winds exceed 64 knots (74 mph).

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### Monsoon

- A system of winds that causes torrential rain and extensive flooding

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## Blizzard

- Usually formed when the jet stream dips far to the south, allowing cold air from the north to clash with warm air from the south.
- It's a blizzard if...
  - heavy falling or blowing snow
  - winds exceeding 40 km/h
  - visibility reduced to less than 400 m
  - for at least 4 hours

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