Thunderstorms

What is a SEVERE thunderstorm?

A thunderstorm that produces any of these:

- One inch hail or larger in diameter
- Winds greater than 58 mph
- Damage to trees, telephone/utility poles and/or any structures
- Tornado

Overview of Thunderstorm Development

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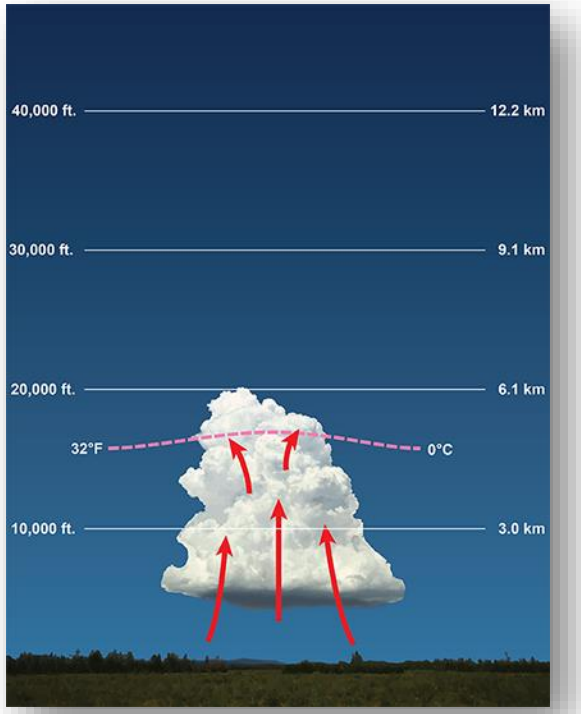
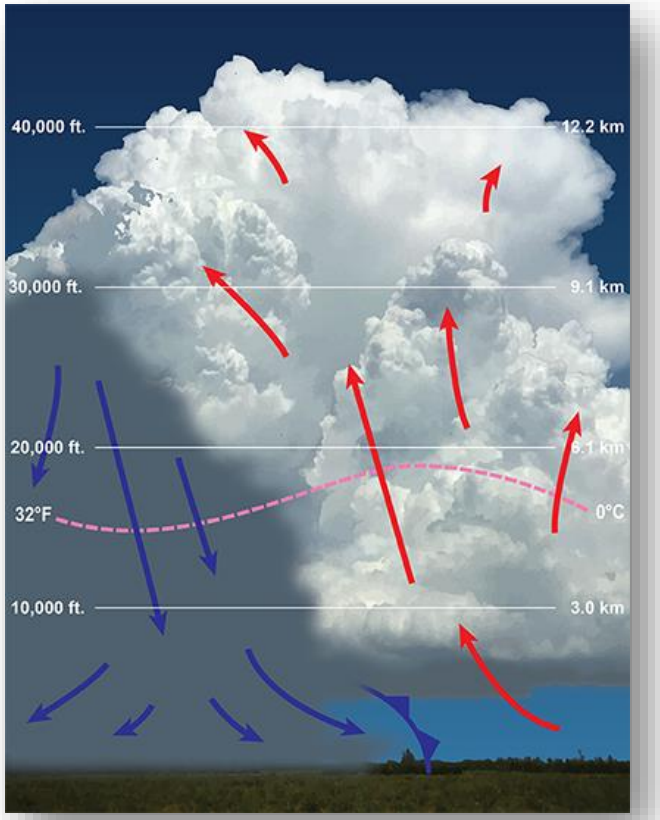
Cumulus Stage



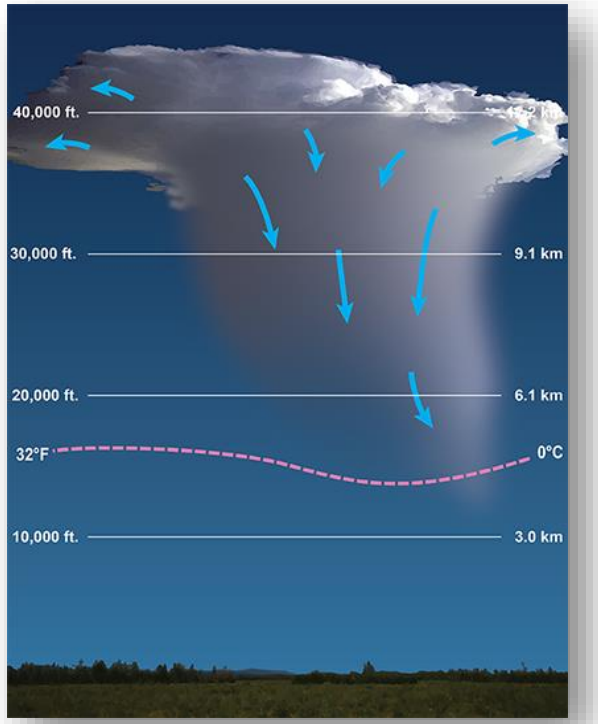
A cumulus cloud begins to grow vertically, perhaps to a height of 20,000 feet Air within the cloud is dominated by updraft with some turbulent eddies around the edges.

Mature Cumulonimbus



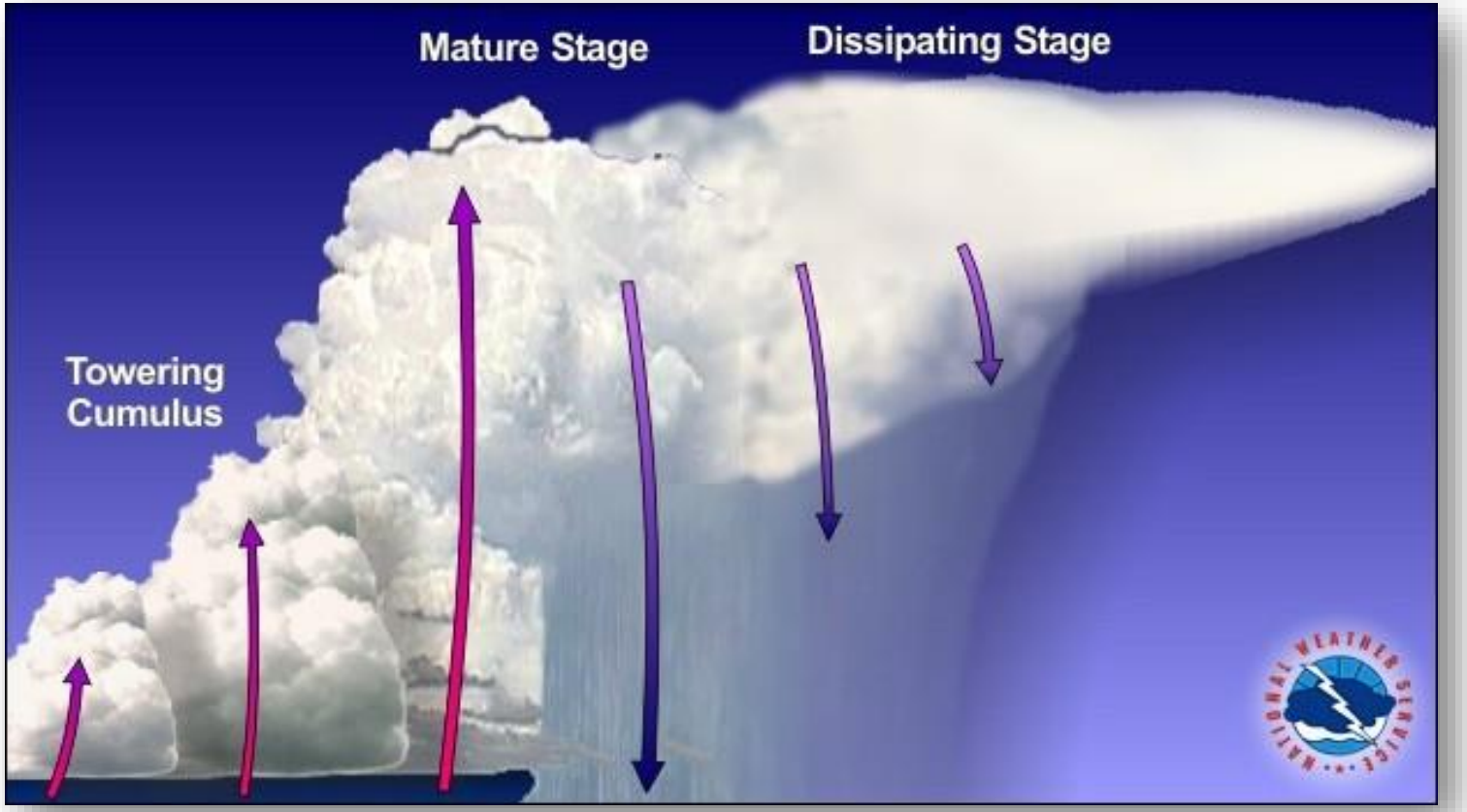
The storm has considerable depth, often reaching 40,000 to 60,000 feet. Strong updrafts and downdrafts coexist. This is the **most dangerous stage** when tornadoes, large hail, damaging winds, and flash flooding may occur.

Dissipating Stage

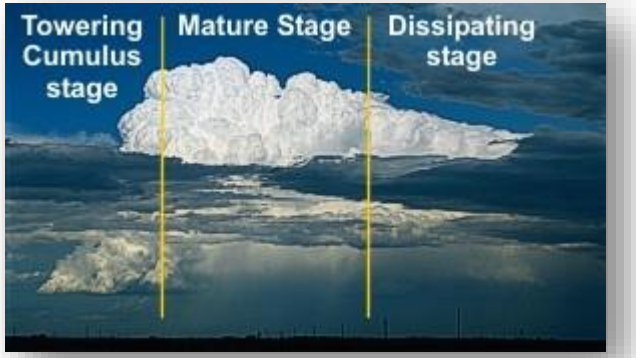


The downdraft cuts off the updraft. The storm no longer has a supply of warm moist air to maintain itself and therefore it dissipates. Light rain and weak outflow winds may remain for a while during this stage, before leaving behind just a remnant anvil top.

Thunderstorms: Multi-cell Cluster



While each individual thunderstorm cell, in a multi-cell cluster, behaves as a single cell, the prevailing atmospheric conditions are such that as the first cell matures, it is carried downstream by the upper level winds with a new cell forming upwind of the previous cell to take its place.



Thunderstorms: Multi-Cell Line (Squall Line)

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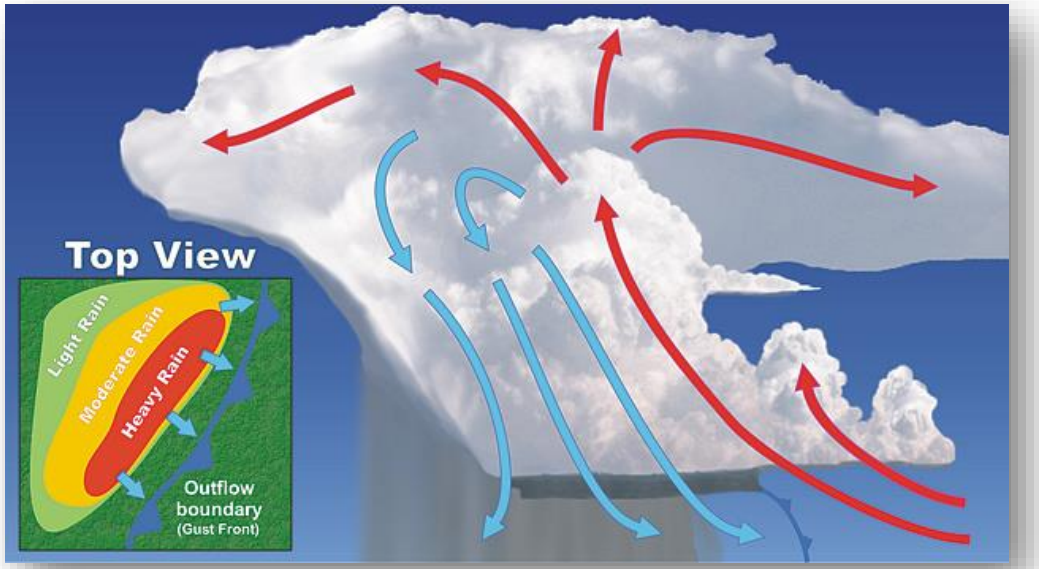
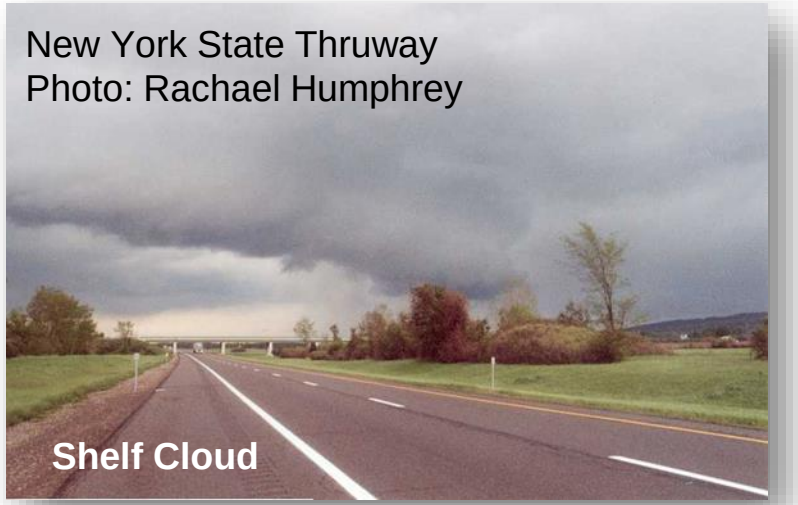




Sometimes thunderstorms will form in a line which can extend for hundreds of miles.

These "squall lines" can persist for many hours and produce damaging winds and hail.

Updrafts, and therefore new cells, continually re-form at leading edge of system with rain and hail following behind.

Individual thunderstorm updrafts and downdrafts along the line can become quite strong, resulting in episodes of large hail and strong outflow winds which move rapidly ahead of system.

While tornadoes occasionally form on the leading edge of squall lines they primarily produce "straight-line" wind damage.

This is damage as a result of the force of the down draft from a thunderstorm spreading horizontally as it reaches the earth's surface.

Often along the leading edge of the squall line is a low hanging arc of cloudiness called the shelf cloud.

Long-lived strong squall lines are called derechos. Derechos can travel many hundreds of miles and can produce considerable widespread damage from wind and hail.

Thunderstorms: Derechos

Derechos are widespread, long-lived windstorms associated with a band of rapidly moving showers or thunderstorms. Coined by Dr. Gustavus Hinrichs in 1888, "derechos", a Spanish word which means "direct" or "straight ahead".

Derechos are produced by a family of downbursts clusters.
Downburst clusters have overall lengths of 50 to 60 miles

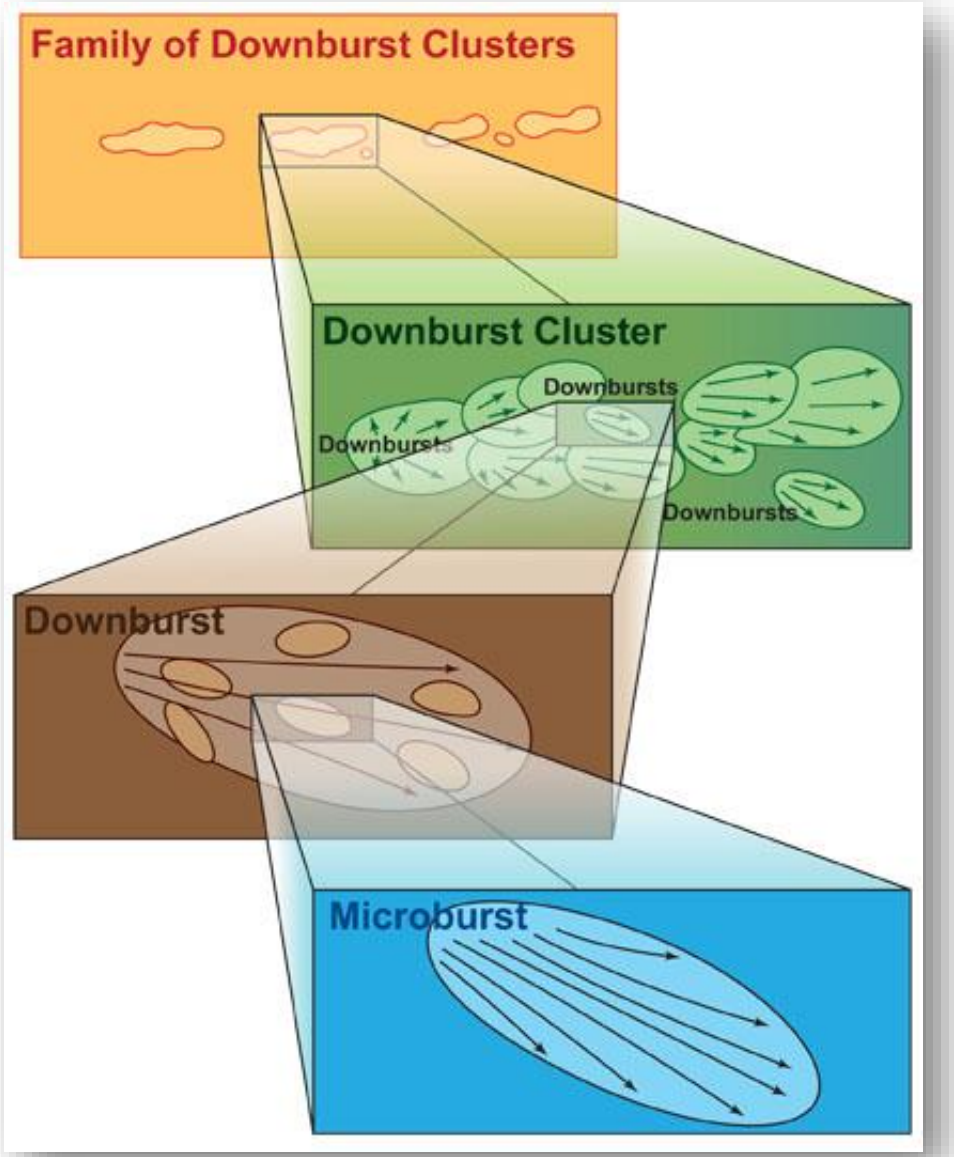
Although a derecho's strength can produce destruction similar to tornadoes, the damage pattern produced by these events will occur along relatively straight lines. Thus, the term *straight-line wind damage*.

A downburst cluster itself is made up of several downbursts. A downburst is an area of strong, often damaging wind produced by a convective downdraft with the overall size of the downburst varying from 4 to 6 miles.

Within the downbursts are microbursts; smaller pockets of more intense wind.

Due to this nature of the derecho, damage produced by these wind storms is highly variable along its path. Damage surveys following derecho events have shown that within large areas of overall damage are much smaller pockets of intense damage.

It is not uncommon for one house to be nearly destroyed while adjacent houses have relatively minor damage.



Thunderstorms: Supercell

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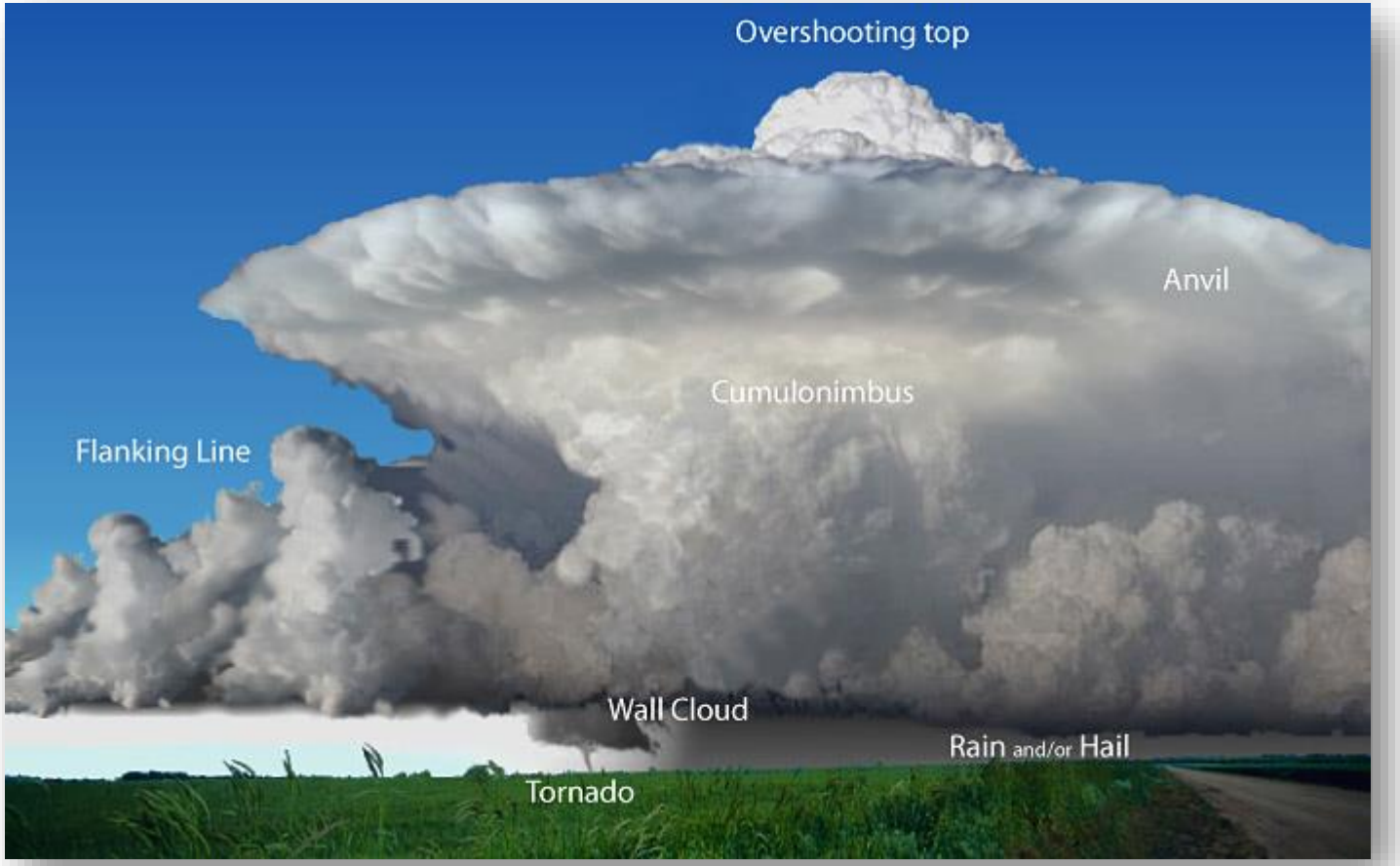

Supercell thunderstorms are a special kind of single cell thunderstorm that can persist for many hours.

They are responsible for nearly all of the significant tornadoes produced in the U.S. and for most of the hailstones larger than golf ball size.

Supercells are also known to produce extreme winds and flash flooding.

Supercells are highly organized storms characterized by updrafts that can attain speeds over 100 mph and are able to produce giant hail with strong or even violent tornadoes. Downdrafts produced by these storms can produce downbursts/outflow winds in excess of 100 mph, posing a high threat to life and property.

Wall cloud near Cheyenne, WY.
Photo courtesy:
NWS Meteorologist Christina Speciale

Hail: Development & Formation

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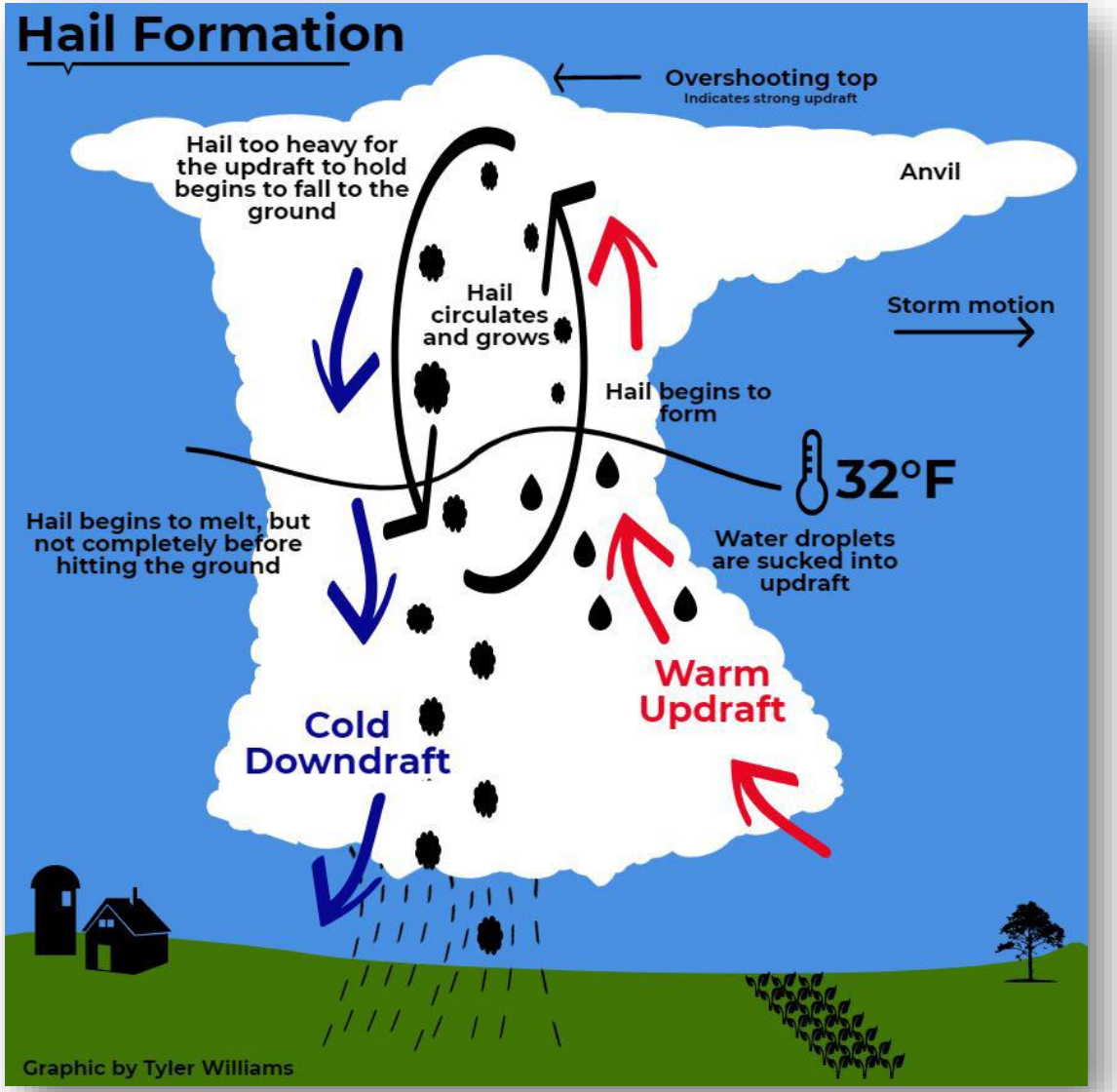

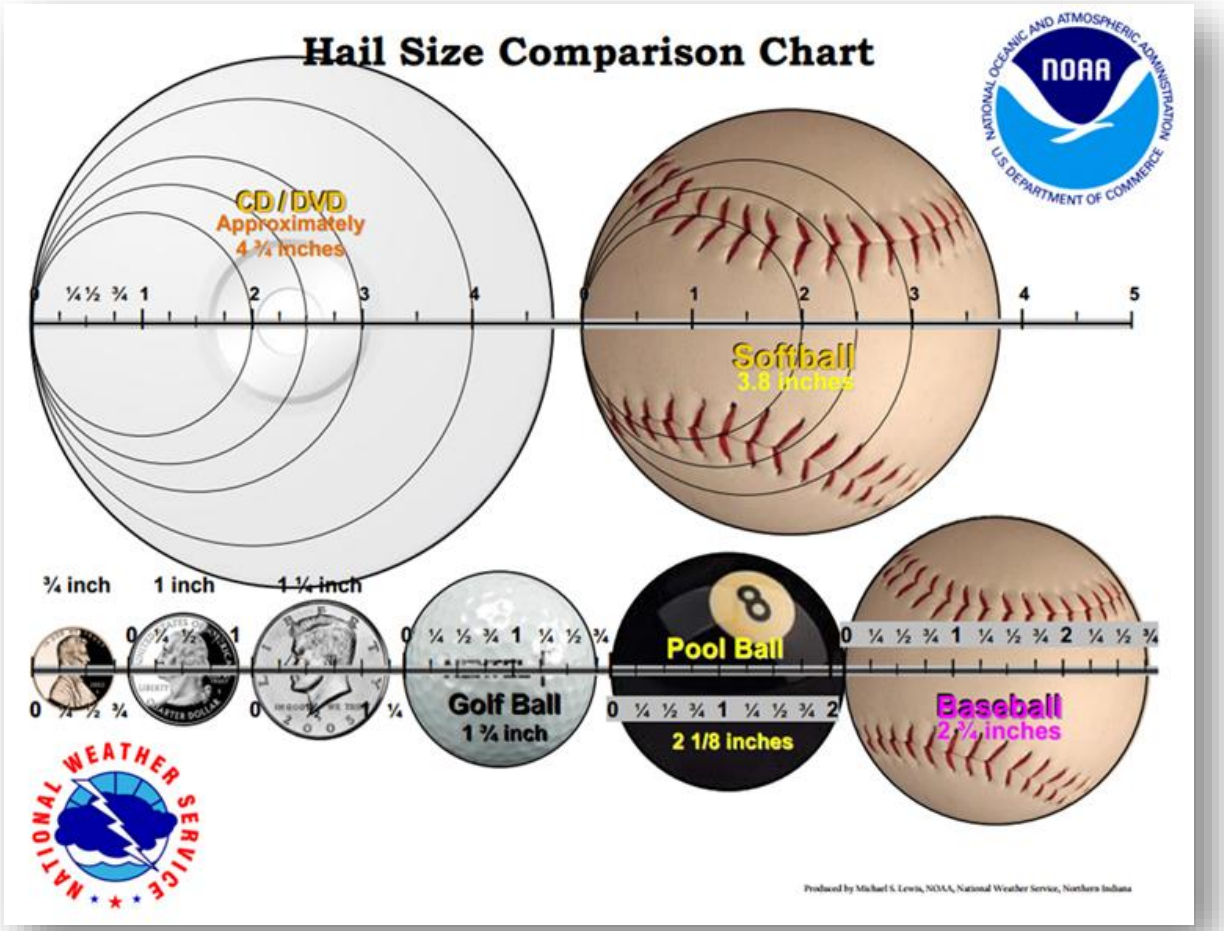

Lightning Types

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In **cloud-to-ground lightning (CG)**, a stepped leader, will zigzag downward in roughly 50-yard segments in a forked pattern. This stepped leader is invisible to the human eye.

A return stroke of bright luminosity travels about 60,000 miles per second back towards the cloud. A flash consists of one or perhaps as many as 20 return strokes.

Cloud flashes sometimes have visible channels that extend out into the air around the storm but do not strike the ground, known as **cloud-to-air (CA)**.

The terms sheet lightning or **intra-cloud lightning (IC)** refers to lightning embedded within a cloud that lights up as a sheet of luminosity during the flash.

Lightning can also travel from **cloud-to-cloud (CC)**.

From Flash to Thunder
Every 5 seconds = 1 mile away!

Funnel Cloud vs. Tornado

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