


Basic SKYWARN Spotting – High Impact Weather (Thunderstorms) and their Attributes



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Overview: Topics to Cover

- Thunderstorm life cycle
 - Stages
 - Lightning
 - Lightning safety
- Non – tornadic severe weather
 - Downbursts / Damaging wind
 - Hail
 - Hail safety
 - Flooding
 - Flash flood safety
- Tornadoes
 - Tornado look-alikes

Thunderstorm Life Cycle


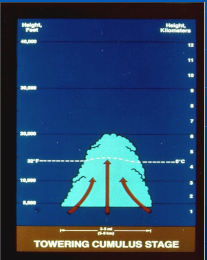
What are the basic ingredients needed for thunderstorms?

- **Moisture:** most notably in the lower levels of the atmosphere.
- **Instability:** the ability of air to accelerate upward given an initial push.
- **Lifting mechanism:** the ‘push’ that gets it started.



Towering Cumulus Stage

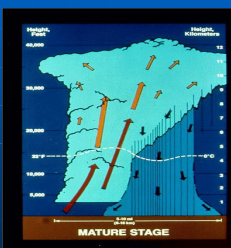

- Still not really a ‘storm’ yet
- Cloud is mostly updrafts
- Flat cloud base is where relative humidity reaches 100 %
- Hard outline or ‘cauliflower’ appearance indicates strongest updrafts

Mature Stage


When severe weather is most likely

- Storm now has downdrafts and updrafts
- Downdrafts are recognized by dark fuzzy areas
- Storm is now at its greatest intensity





Dissipating Stage

- Storm is predominantly downdrafts
- More dark and fuzzy in appearance
- Microbursts may occur as thunderstorm enters this stage (more about microbursts later)




Thunderstorm Life Cycle



Question: What is the average lifetime of a thunderstorm?



- Severe weather is still possible!

Answer: Only 20 - 30 minutes !





Severe Thunderstorm and Tornado Watches and Warnings – A big difference

- A Severe Thunderstorm Watch means:**
 - Conditions are favorable for severe weather over the next several hours
 - Does NOT mean that a severe thunderstorm has actually developed yet
- A Severe Thunderstorm Warning means:**
 - A severe thunderstorm has either been detected by radar or has been reported to the NWS by spotters or the general public. Severe weather possible over the next several minutes to an hour
- The same applies to tornadoes and floods/flash floods

Severe Thunderstorm Definitions


- The term severe thunderstorm refers to a thunderstorm producing hail that is at least 1.00 in diameter (quarter size) or larger, and/or gusts to 58 mph or greater, and/or a tornado.
- Although lightning can be deadly, the NWS doesn't use it to define a severe thunderstorm. If it did, every thunderstorm would be severe, by definition.
- Also, excessive rainfall may lead to deadly flash flooding, but heavy rain is not a severe criterion either. The flood threat is handled through a separate set of watches and warnings from your local NWS forecast office.

Preparing for a "Change" in National Severe Hail Warning Criteria Beginning January 5, 2010

Why change to 1 inch?

- Key research -- Hail damage threshold sizes for common roofing materials**
 - Marshall, T.P., Richard F. Herzog, and Steven K. Smith, 2002; 21st Conference on Severe Local Storms, San Antonio, TX
- Numerous types of shingles tested
 - No damage at 0.75 inch
 - Some 11 year old shingles damaged at 1.00 inch
 - Several shingles (some new) damaged at 1.25 inch



Ice ball launching (IBL) device with light sensors (chronograph)

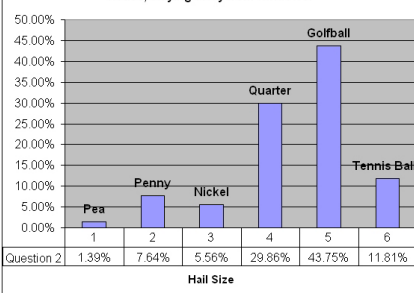
Damage to Cars

- It typically takes golf ball size hail (1.75 inch) to dent cars




7 Inch Hailstone
Aurora Neb, June 22, 2003

When I see this size hail, I move to the center of the house, staying away from windows:

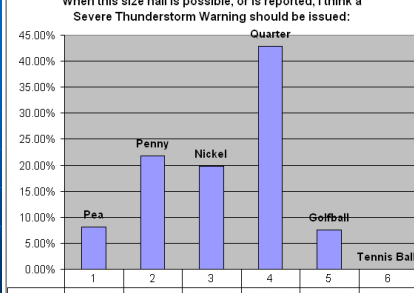


Question 2	1	2	3	4	5	6
	1.39%	7.64%	5.56%	29.86%	43.75%	11.81%

Hail Size

Used with permission – WFO Wichita
30th Annual Meeting of the National Weather Association

When this size hail is possible, or is reported, I think a Severe Thunderstorm Warning should be issued:



Question 3	1	2	3	4	5	6
	8.16%	21.77%	19.73%	42.86%	7.48%	0.00%

Used with permission – WFO Wichita
30th Annual Meeting of the National Weather Association

Summary

- No damage to roofing materials or vehicles at hail sizes less than 1 inch
- Feedback from experimental studies overwhelmingly positive

MEDIA PARTNERS

- Warnings are now more credible and meaningful
- Fewer viewer complaints about breaking into programming for weather events that pose little or no damage threat

EMERGENCY MANAGERS

- Stronger confidence that a genuine threat exists for warnings that are issued
- Fewer spotter activations for marginal events



Manufactured home damaged by wind driven hail (estimated tennis ball size) near Callison, South Carolina, on 15 March 2008.
- Image courtesy of Greenwood County Emergency Management.

Weather Fatalities



Category	30 Year Average (1977-2006)	10 Year Average (1997-2006)
Flood	99	74
Lightning	62	44
Tornado	54	32
Hurricane	49	117
Heat	170	170
Cold	18	18
Winter Storm	41	41
Wind	47	47




Every Year There Are An Estimated
25 Million Cloud-to-Ground
Lightning Flashes In The United States

Each Flash Is A Potential
KILLER !

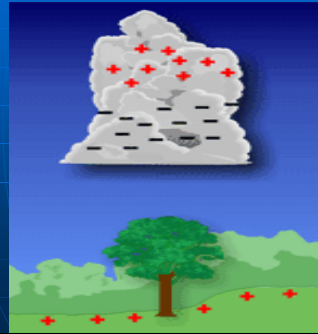
How Lightning is Created




Charge Separation



Field Generation




How Lightning Develops Between The Cloud And The Ground



A channel of negative charge, called a "stepped leader" will descend from the bottom of the storm toward the ground (image 2). It is invisible to the human eye, and shoots to the ground in a series of rapid steps, each occurring in less time than it takes to blink your eye. As the negative leader approaches the ground, positive charge collects in the ground and in objects on the ground.

Step 1



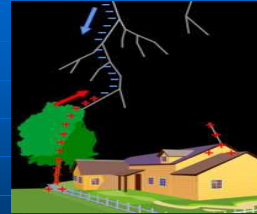
In what can be loosely described as an "avalanche of electrons", the stepped leader usually branches out in many directions as it approaches the ground, carrying an EXTREMELY strong electric potential: about 100 MILLION volts with respect to the ground and about 5 coulombs of negative charge

Step 2



As the stepped leader approaches the ground, its strong, negative charge repels all negative charge within the immediate strike zone of the earth's surface, while attracting vast amounts of positive charge. The influx of positive charge into the strike zone is so strong that the stepped leader actually induces electric channels up from the ground known as "streamers".

Step 3



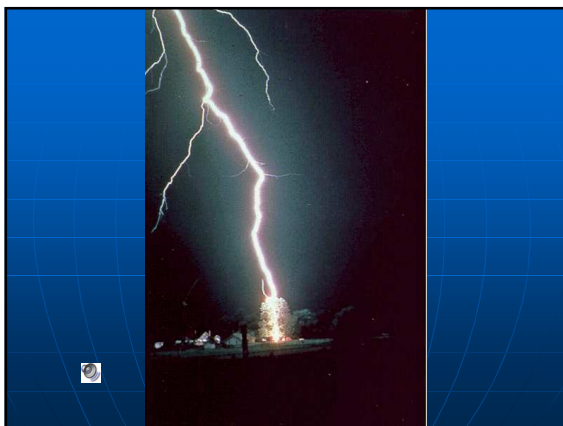
The electric potential of the stepped leader is connected to the ground and the negative charge starts flowing **DOWN** the established channel

Step 4




An electric current wave, called a "return stroke", shoots UP the channel as a brilliant pulse. Behind the wave front, electric charge flows up the channel and produces a ground current. It takes the current about 1 microsecond to reach its peak value, which averages around 30,000 amperes

The Lightning Process: Animation





How Far Can Lightning Travel? How Far Can You Hear Thunder?



Lightning Can Travel 10 miles or more; Thunder can be heard 10 to 15 miles away. If you Hear Thunder you are close enough to be struck by Lightning!

A slide with a dark blue background. At the top, it asks "How Far Can Lightning Travel? How Far Can You Hear Thunder?". In the center, there is a photograph of a lightning bolt striking a cloud. At the bottom, it provides the answer: "Lightning Can Travel 10 miles or more; Thunder can be heard 10 to 15 miles away. If you Hear Thunder you are close enough to be struck by Lightning!".

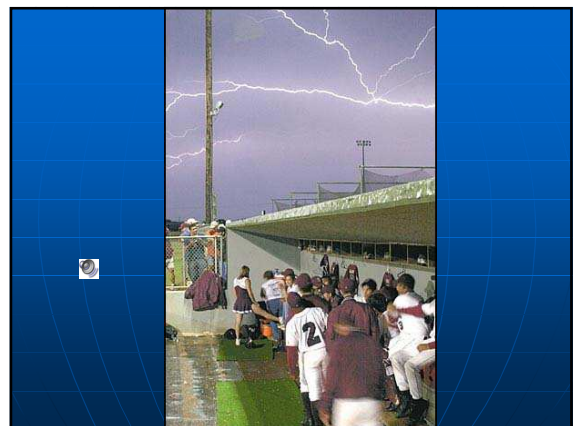
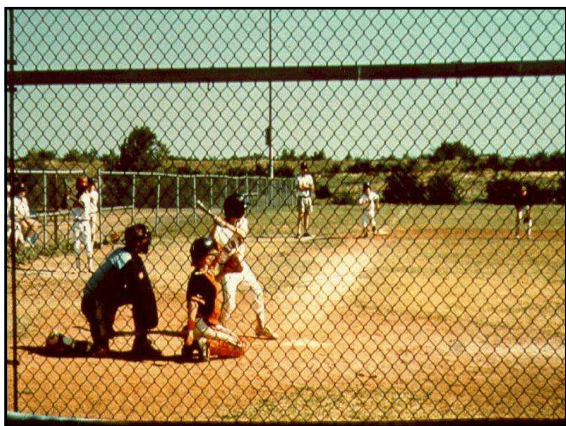
Lightning Safety 

RULE #1

No Place Outside Is Safe During A Thunderstorm



A slide with a dark blue background. At the top, it says "Lightning Safety" in white, with a small NWS logo to the right. Below that, it says "RULE #1" in white. In the center, it says "No Place Outside Is Safe During A Thunderstorm" in red. At the bottom, there is a photograph of a lightning bolt striking a cloud.



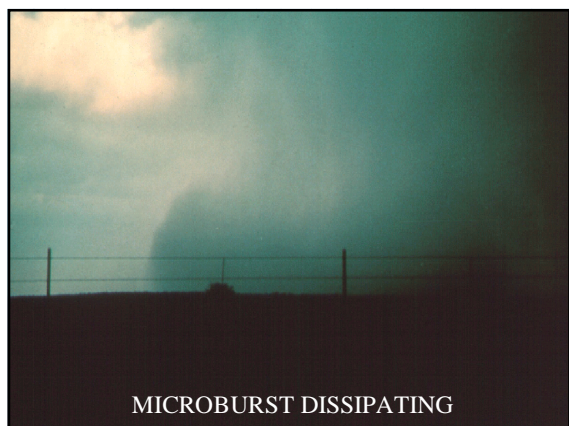
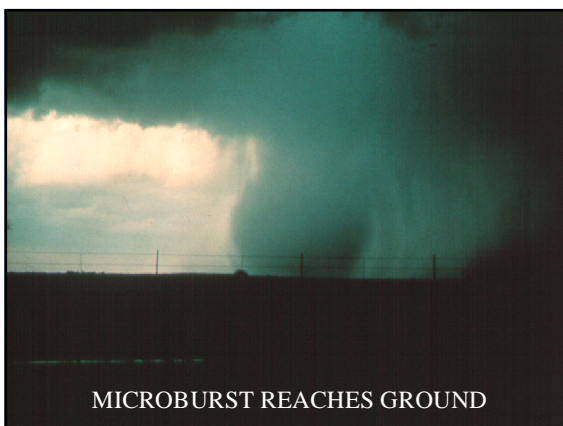
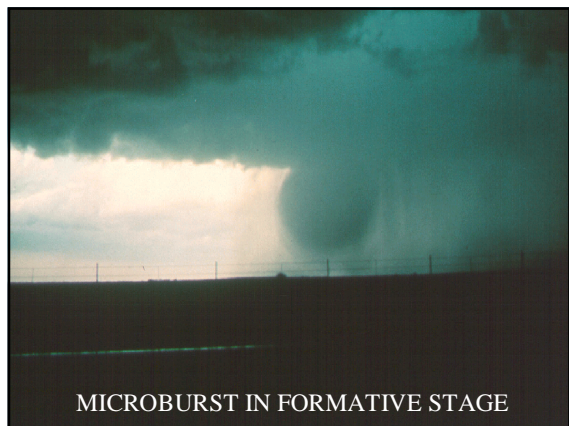
<p>Where to Go</p> <p>The safest location during a thunderstorm is inside a large enclosed structure with plumbing and electrical wiring. These include shopping centers, schools, office buildings, and private residences.</p> <p>If lightning strikes the building, the plumbing and wiring will conduct the electricity more efficiently than a human body. If no buildings are available, then an enclosed metal vehicle such as an automobile, van, or school bus makes a decent alternative.</p>	<p>Where NOT to Go</p> <p>Not all types of buildings or vehicles are safe during thunderstorms. Buildings which are NOT SAFE (even if they are "grounded") have exposed openings. These include beach shacks, metal sheds, picnic shelters/pavilions, carports, and baseball dugouts. Porches are dangerous as well.</p> <p>Convertible vehicles offer no safety from lightning, even if the top is "up". Other vehicles which are NOT SAFE during lightning storms are those which have open cabs, such as golf carts, tractors, and construction equipment.</p>
<p>What To Do</p> <p>Once inside a sturdy building, stay away from electrical appliances and plumbing fixtures. As an added safety measure, stay in an interior room.</p> <p>If you are inside a vehicle, roll the windows up, and avoid contact with any conducting paths leading to the outside of the vehicle (e.g. radios, CB's, ignition, etc.).</p>	<p>What NOT to Do</p> <p>Lightning can travel great distances through power lines, especially in rural areas. Do not use electrical appliances, ESPECIALLY corded telephones unless it is an emergency (cordless and cell phones are safe to use).</p> <p>Computers are also dangerous as they usually are connected to both phone and electrical cords. Do not take a shower or bath or use a hot tub.</p>

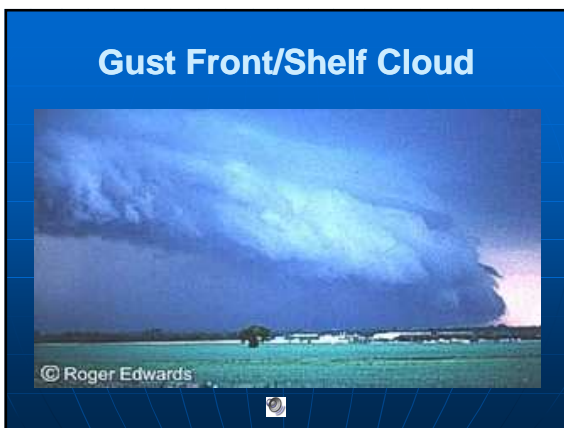
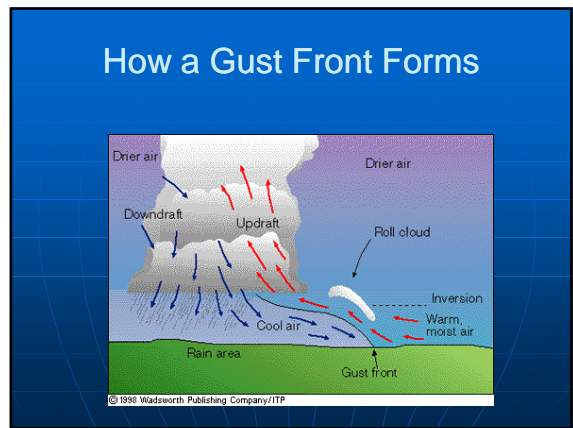
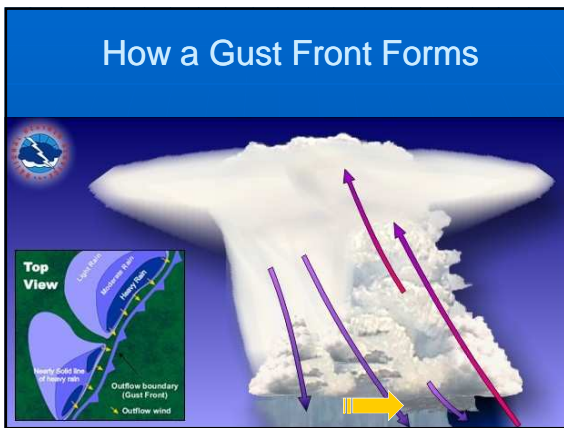
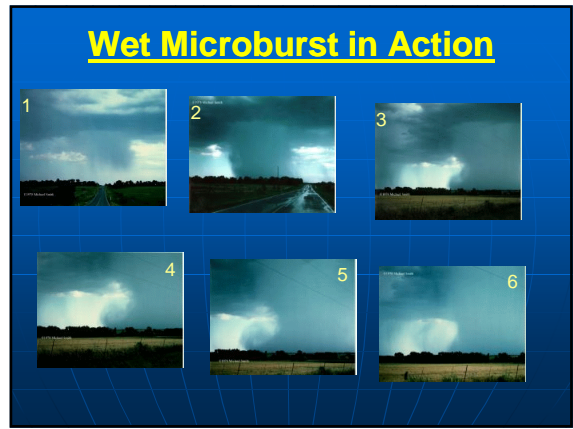


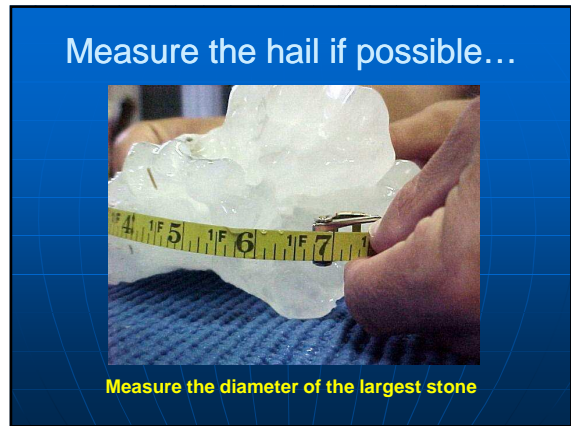
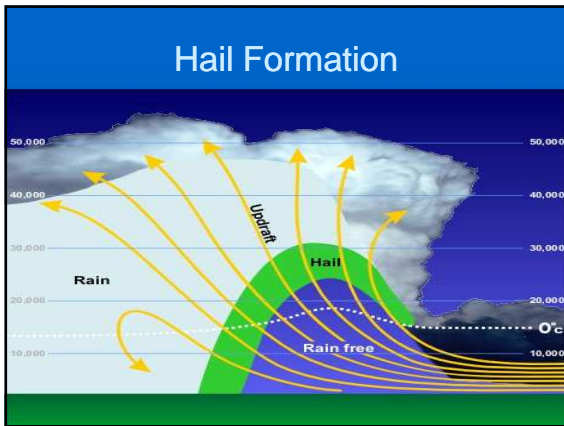
The Downburst

A strong downdraft with an out-rush of damaging wind on or near the surface.


- Types of downbursts
 - Macroburst - a swath of damaging wind > 2.5 miles wide
 - Long lived
 - Long damage path
 - Microburst - a swath of damaging wind < 2.5 miles wide
 - Extremely difficult to detect and warn for!
 - Most common
 - Wet Microbursts
 - Dry Microbursts
- Both can produce very tornado-like damage








Floods and Flash Floods


- 

■ A **Flash Flood** occurs within six hours of the onset of precipitation. This is the type of flooding most often produced by thunderstorms in the warm season. We issue a **Flash Flood Warning** for this type of flood event.
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■ A **Flood** occurs more than six hours after the onset of precipitation. This type of flooding most often occurs with large winter-time areas of low pressure that cause several hours of moderate rain. We issue a **Flood Warning** for this type of event.

Low water crossing

- Never drive around a barricade.
- Never cross a water covered road.
- It only takes two feet of water to wash a car off of the road.





Do you really know how deep and fast the water is?

Turn Around Don't Drown

For important life-saving information please visit <http://tadd.weather.gov>


Flash Flood Safety

The number ONE thunderstorm killer!

- Most flood deaths occur at night and in automobiles
- 6 inches of fast-moving water can knock you off your feet
- 2 feet of water will float most cars; pickup trucks and SUV's are also vulnerable


If caught in flooding, abandon vehicles and move to higher ground

Do **NOT** drive into water in the road; it's probably deep!



Supercell Thunderstorms

- Strongest and longest lasting type storm
- Supercells produce
 - Tornadoes...damaging
 - Straight line winds and
 - Large hail
- Supercells contain a rotating updraft...a mesocyclone



Supercell thunderstorm

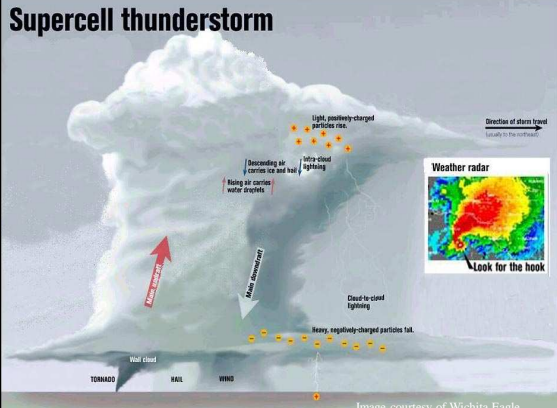


Image courtesy of Wichita Eagle

Directional Wind Shear



Rotating Updraft




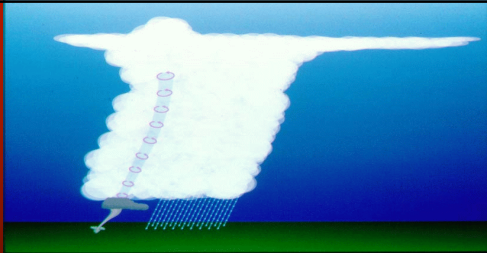

CRISP-EDGE ANVIL SUGGESTING STRONG UPDRAFT

Wall Clouds

Often the precursor to tornadoes

- An abrupt lowering of a rain-free thunderstorm base, forming an accessory cloud 1-4 miles in diameter
- Usually near the rear of the storm with respect to its motion
- Forms under the strongest part of the updraft





A violently rotating column of air slowly extends from the thunderstorm but not touching the ground is a **Funnel Cloud**.

Once the funnel touches the ground it is called a **Tornado**.



Our peak tornado season is March - May.



Tornado Safety


A sturdy structure is your best protection

- Go to lowest floor in the building
- An interior room is best
- Stay away from all windows
- Get under sturdy furniture if possible
- Cover yourself with blankets or coats
- If caught outside, as a last resort seek shelter in a ditch or depression
- Assume the tornado protection position
- Abandon mobile homes and trailers!



What Tornadoes Look Like

And the damage they cause



Resources

- NWS RIDGE Radar Display
 - Available on Every WFO Web Site
- Graphical displays via weather radios, cell phones, PDAs, etc.

