Regional Health Services of Howard County

Howard County Healthcare Coalition

EMERGENCY MANAGEMENT HOWARD COUNTY

Planning Ahead for Severe Weather

Tornado Safety

Use the guidelines below to develop a personal tornado safety plan for you and your family. Remember you need to have a plan for wherever you may be when a tornado strikes - at home, at school, at work, on the road or in a public building. Continued vigilance and quick response to tornado watches and warnings are critical, since tornadoes can strike virtually anywhere at any time. Most tornadoes are abrupt at onset, short-lived and often obscured by rain or darkness. That's why it's so important to plan ahead. Every individual, family, and business should have a tornado emergency plan for their homes or places of work, and should learn how to protect themselves in cars, open country, and other situations that may arise.

The most important step you can take to prepare for a tornado is to have a shelter plan in place. Where will you go when a tornado warning has been issued for your county or city? Is it a basement or a storm cellar? Is there an interior room on the ground floor that you can use as a storm shelter? Have a plan, and make sure everyone in your family or workplace knows it. You must be able to get to your safe shelter area quickly - you may only have seconds to act! **Your first step to surviving a tornado is to develop a plan before storms are on the horizon.**

Having a NOAA Weather Radio can save your life. Weather Radios are sold at many retailers and websites, including electronics, department, sporting goods, and boating accessory stores. FEMA suggests the following actions before, during, and after a tornado:

Know the difference between a **watch** and a **warning**

Tornado Watch - Conditions are right for tornadoes, and tornadoes are possible. Remain alert: watch the sky and tune in to NOAA Weather Radio, commercial radio, or a local television station in case a warning is issued.

Tornado Warning - A tornado has been spotted by human eye or radar, and is moving toward you in the warning area. Take shelter immediately.

Look for the following danger signs:

- Dark, greenish sky
- Large hail
- A large, dark, low-lying cloud (particularly if rotating)
- A loud roar, similar to a freight train

When a tornado warning has been issued for your county or city, seek shelter immediately!

If you are in:	Take this action:
A structure (residence, building, school, hospital, etc)	Head to your pre-designated shelter area. This could be a basement, storm cellar, or the lowest building level. If you are home and you don't have a basement, go to the most interior room of the ground floor. Often a bathroom or laundry room makes a suitable shelter area because the water pipes reenforce the walls, providing a more sturdy structure. Stay away from corners, windows, doors, and exterior walls. Put as many walls as possible between you and the outside. Get down on your knees and use your hands to protect your head and neck. Do not open windows.
A vehicle	If you can drive away from the tornado, do so. If you don't have time or not sure if you have time, or you're not sure which way the tornado is moving, get out of the vehicle. Head to the lowest floor of a nearby building or storm shelter. If there's no building or shelter nearby, follow the instructions for what to do if you're outside with no shelter.

If you are in:	Take this action:
A mobile home or trailer	Get out immediately and go to the lowest floor of a nearby building or storm shelter. Mobile homes provide little to no protection against tornadoes.
The outside with no nearby shelter	Lie flat in a nearby ditch or depression and cover your head and neck with your hands. Be aware of the potential for flooding in the ditch you are occupying. *Do not get under and overpass or bridge.* You are safer in a low, flat location. More on overpasses and bridges here. If you are in an urban or congested area, do not try and outrun the tornado in your vehicle. Instead, leave the vehicle immediately and seek shelter. Be aware of flying debris. Tornadoes can pick up large objects and turn them into missiles. Flying debris cause the most tornado deaths.

Developing a Tornado Safety Kit

These items would be extremely useful to have in your storm shelter, or to take with you to your storm shelter, when severe weather strikes.

- **Disaster Supply Kit**
  You should store your emergency supplies as close to your shelter as possible.
- **Battery Operated Weather Radio**
  You will want to be able to monitor the latest information directly from your National Weather Service.
- **A Map to Track Storms**
  You will need to be able to track the progress of the storm. Since warning texts include county names, a county outline map of your area is a great thing to keep handy. You might also keep a state highway map, which includes most of the cities and towns referred to in NWS warnings and statements. The NWS Norman provides a handout with a county map, which can be downloaded in pdf format.
- **Battery Operated TV and/or Radio**
  This will allow you to monitor news and severe weather information. Radios that offer TV audio can be helpful. Also, many TV stations simulcast their broadcasts on AM or FM radio stations.
- **Shoes**
  This will be very important if your home is damaged and you must walk across broken glass or other debris!
- **Indentification**
  You may need identification to move around in the area should significant damage occur.
- **Your Car Keys**
  If your car is drivable, you will need the keys to be able to use it. It's a good idea to keep an extra set in your shelter area.
- **Cell Phone**
  If there is phone service, you will certainly want your phone. However, remember that cell phone service may be interrupted after a tornado or other disaster!

Other Things To Consider

Check and replace batteries in your weather radio, flashlights and other devices in your safety kit often, preferably twice a year. Do this at the same time you set clocks back/ahead in the spring and fall, and when you replace smoke detector batteries. Check you disaster supplies kit often, as well to maintain fresh food and water, etc. Remember that your disaster supplies kit could also be critical in other types of disasters, including winter storms, etc.

Make sure you have something to cover up with. Pillows, blankets, sleeping bags, a mattress could help to protect you from falling/flying debris. Above all protect your head, neck and upper body. Wear a helmet (bicycle, football, baseball, motorcycle, hard hat, etc) if you have one. If there's room, lie flat and cover up. Otherwise, get as low to the ground as possible and make as small a target as possible.

Unfortunately, there are no safety **rules** - absolute safety facts that will keep you safe 100% of the time. Instead, we offer guidelines for personal safety. The vast majority of tornadoes are weak and don't last very long. By following the guidelines included in this document, you and your family can survive a tornado. These tornado safety guidelines should reduce - but will not totally eliminate - your chances of being seriously injured or killed in a tornado. The good news is that you can survive most tornadoes. The key to survival is planning - knowing what you need to do to be safe **before** a tornado threatens.

GET IN ... GET DOWN ... COVER UP!

You can survive a tornado! Even in the heart of tornado alley, chances are you will never experience a direct hit by a tornado. *However*, being prepared is critical. By following these simple guidelines, you can protect yourself and your family from nature's most violent storm. No matter where you are, use these basic guidelines for tornado safety. Refer to other sections of this guide for more details on staying safe in specific locations and circumstances.

The most **important** things to remember are:

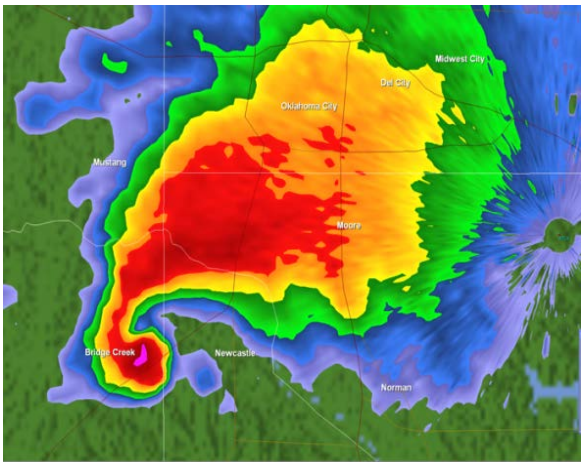
- **GET IN** - If you are outside, get inside. If you're already inside, get as far into the middle of the building as possible.
- **GET DOWN** - Get underground if possible. If you cannot, go to the lowest floor possible.
- **COVER UP** - Flying and falling debris are a storm's number one killer. Use pillows, blankets, coats, helmets, etc to cover up and protect your head and body from flying debris.

What is a tornado?

A tornado is a violently rotating column of air which descends from a thunderstorm to the ground. No other weather phenomenon can match the fury and destructive power of tornadoes. Tornadoes can be strong enough to destroy large buildings, leaving only the bare concrete foundation, or lift 20-ton railroad cars from the tracks. A tornado might not have a visible funnel until it picks up debris from the ground. The strength of a tornado is measured by the Enhanced Fujita Scale.

How do tornadoes form?

The truth is that scientists don't fully understand how tornadoes form. A parent supercell thunderstorm is needed. Beyond that, each storm is different. Some research suggests it has to do with how strongly the wind changes direction with height, how much moisture is in the air, or the difference between the temperature of the surrounding air and the temperature of the cold downdrafts coming from the storm.



What is a supercell thunderstorm?

A supercell is an organized thunderstorm that contains a very strong, rotating updraft. This rotation helps to produce severe weather events such as large hail, strong downbursts, and tornadoes. Supercells usually form isolated from other thunderstorms because it allows the storm more energy and moisture from miles around. These storms are relatively rare, but always a threat to life and property.

What is the difference between a funnel cloud and a tornado?

A tornado begins as a rotating, funnel-shaped cloud extending from a thunderstorm cloud base, which meteorologists call a funnel cloud. A funnel cloud is made visible by cloud droplets, however, in some cases it can appear to be invisible due to lack of moisture. A funnel cloud is not affecting the ground. If the funnel extends far enough down to begin affecting the ground, then it becomes a tornado.

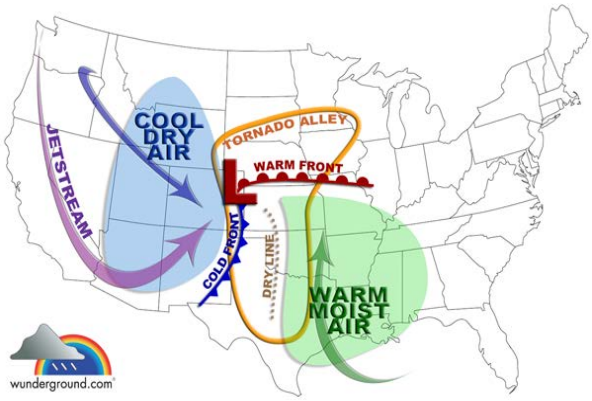
What is the path length of tornadoes? How long do they last? How fast do they move?

Tornado paths range from 100 yards to 2.6 miles wide and are rarely more than 15 miles long, although some strong tornadoes on record have crossed through multiple states (e.g. the Tri-State Tornado of 1925. They can last from several seconds to more than an hour, however, most don't exceed 10 minutes. Most tornadoes travel from the southwest to northeast with an average speed of 30 mph, but the speed has been observed to range from almost no motion to 70 mph.

When and where do tornadoes occur?

Most tornadoes occur in the deep south and in the broad, relatively flat basin between the Rockies and the Appalachians, but no state is immune. Peak months of tornado activity in the U.S. are April, May, and June. However, tornadoes have occurred in every month and at all times of the day or night. A typical time of occurrence is on an unseasonably warm and sultry Spring afternoon between 3 p.m. and 9 p.m.

What causes tornadoes?



Tornadoes form under a certain set of weather conditions in which three very different types of air come together in a certain way. Near the ground lies a layer of warm and humid air, along with strong south winds. Colder air and strong west or southwest winds lie in the upper atmosphere. Temperature and moisture differences between the surface and the upper levels create what we call **instability**, a necessary ingredient for tornado formation. The change in wind speed and direction with height is known as wind shear. This wind shear is linked to the eventual development of rotation from which a tornado may form.

A third layer of hot dry air becomes established between the warm moist air at low levels and the cool dry air aloft. This hot layer acts as a cap and allows the warm air underneath to warm further, making the air even more unstable. Things start to happen when a storm system aloft moves east and begins to lift the various layers. Through this lifting process the cap is removed, thereby setting the stage for explosive thunderstorm development as strong updrafts develop. Complex interactions between the updraft and the surrounding winds may cause the updraft to begin rotating-and a tornado is born.

Dr. T. Theodore Fujita developed the Fujita Tornado Damage Scale (F-Scale) to provide estimates of tornado strength based on damage surveys. Since it's practically impossible to make direct measurements of tornado winds, an estimate of the winds based on damage is the best way to classify a tornado. The new Enhanced Fujita Scale (EF-Scale) addresses some of the limitations identified by meteorologists and engineers since the introduction of the Fujita Scale in 1971. The new scale identifies 28 different free standing structures most affected by tornadoes taking into account construction quality and maintenance. The range of tornado intensities remains as before, zero to five, with 'EF-0' being the weakest, associated with very little damage and 'EF-5' representing complete destruction, which was the case in Greensburg, Kansas on May 4th, 2007, the first tornado classified as 'EF-5'. The EF scale was adopted on February 1, 2007.

EF-Scale:	Old F-Scale:	Typical Damage:
EF-0 (65-85 mph)	F0 (65-73 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)	F1 (73-112 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)	F2 (113-157 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)	F3 (158-206 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)	F4 (207-260 mph)	Devastating damage. Whole frame houses Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF-5 (>200 mph)	F5 (261-318 mph)	Incredible damage. Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur. Inconceivable damage.
EF No rating	F6-F12 (319 mph to speed of sound)	Should a tornado with the maximum wind speed in excess of EF-5 occur, the extent and types of damage may not be conceived. A number of missiles such as iceboxes, water heaters, storage tanks, automobiles, etc.will create serious secondary damage on structures.

What to do after a tornado

After a tornado passes, it is important to take some precautions. Be careful as your leave your tornado shelter, since there might be unseen damage waiting for you on the other side of doors. If your home has been damaged, walk carefully around the outside and check for things like loose power lines, gas leaks, and general structural damage. Leave the premises if you smell gas or if floodwaters exist around the building. Call your insurance agent and take pictures of the damage to your home or vehicle. If the destruction is extensive, don't panic. The American Red Cross and other volunteer agencies will arrive with food and water, and temporary housing will be designated by FEMA.

Thunderstorms

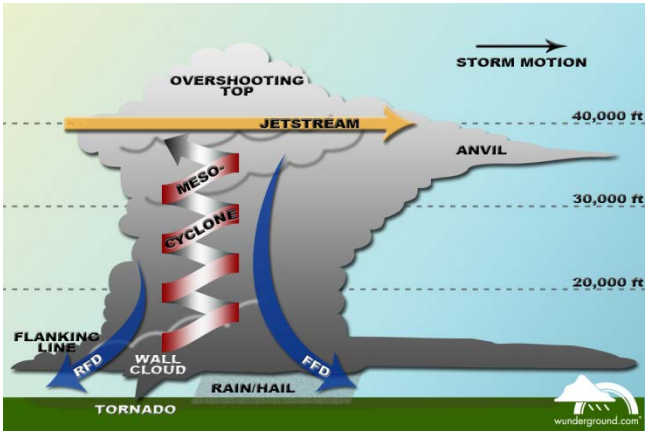
The National Weather Service defines a severe thunderstorm as a thunderstorm that is producing:

- hail that is at least quarter size (1 inch diameter or larger)
- and/or wind gusts 58 mph or greater
- and/or a tornado

If a storm that meets these criteria are possible for an area, the Storm Prediction Center will issue a severe thunderstorm watch or a tornado watch. If a storm with these criteria is imminent, your local Weather Service office will issue a severe thunderstorm warning or a tornado warning.

Lightning and heavy rainfall are dangerous elements of a thunderstorm, but they are not in the severe thunderstorm criteria for a few reasons. If lightning were a prerequisite, all thunderstorms would be severe. Also, flash flooding is handled by a separate set of watches and warnings which are issued by your local Weather Service office.

Supercell Thunderstorms



A supercell is a highly organized thunderstorm with some components that set it apart from other "garden variety" thunderstorms. Supercells have the capability to produce tornadoes, damaging hail, and strong downdrafts (which translate into straight-line winds at the surface). All tornadoes are spawned from a parent supercell, but not all supercells produce tornadoes.

In addition to the standard necessary ingredients for a thunderstorm (instability, moisture, source of lift), supercells require strong "veering" of the winds, which means the winds are turning clockwise with height. So, for example, the surface wind could be out of the southeast, wind at the mid-levels will be out of the southwest, and winds at the upper levels will be out of the northwest. The turning of the winds with height helps the thunderstorm develop its most essential component: the mesocyclone.

A mesocyclone (or "meso" for short) is formed when a thunderstorm updraft meets veering winds. As the air rises in the thunderstorm, the winds will begin to twist the updraft until the whole column of air is rotating. Although each storm is different, the meso is usually found in the right rear flank of the supercell, and is typically 2-6 miles wide. Technically, the mesocyclone is defined as the radar signature that appears if one is present (a yellow circle on Doppler velocity products), but you can often see the rotation with your bare eyes.

Lightning

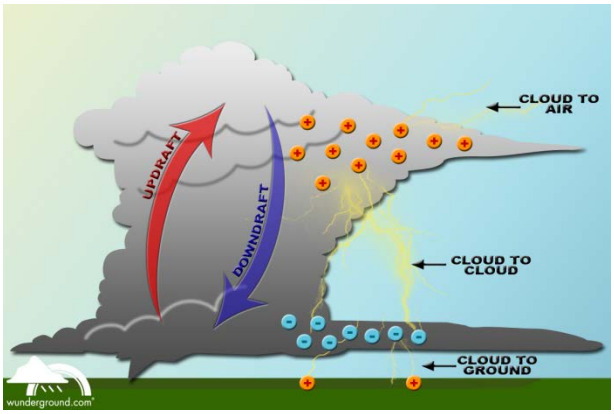
Lightning has fascinated and excited humans for as long as they have watched the skies. Although meteorologists understand the cloud conditions necessary to produce it, lightning cannot be forecasted. At any moment, there are as many as 1,800 thunderstorms in progress somewhere on Earth, and each is producing deadly lightning. Lightning detection systems in the U.S. see an average of 25 million strokes of lightning each year, from some 100 thousand storms. It is estimated that the Earth is struck by 100 lightning bolts every second.

The clouds at the high levels of the thunderstorm are made of ice crystals. The formation of ice in a cloud is an important element in the development of lightning. Those storms that fail to produce large numbers of ice crystals may also fail to produce a lot of lightning. Strong rising and sinking motions within the cloud are important too, as they enhance collisions among cloud particles causing a separation of electrical charges. Positively charged ice crystals rise to the top of the thunderstorm and negatively charged ice particles and hailstones drop to the middle and lower parts of the storm.

As the differences in charges continue to increase, positive charges rise up taller objects such as trees, houses, and telephone poles. The charge can also move up you, causing your hair to stand on end! This is natures final way of warning you that lightning can strike near you very soon.

If the negatively charged area at the bottom of the storm gets large enough, sends out a channel toward the ground called a *step leader*. It is invisible to the human eye and moves in steps toward the ground. When the step leader nears the ground, or a target like a radio tower, it repels all the negatively charged in the surrounding area, and attracts all the positive charge. As the positive charges collect in high enough concentration, they send out small bolts of ground to air lightning called streamers. If the streamers can make contact with the step leader, an electric current wave propagates up the channel as a bright pulse -- lightning!

And of course, with lightning comes thunder. Lightning heats the surrounding air to as much as 50,000 degrees Fahrenheit, which is five times the temperature of the surface of the sun! When air is heated, it expands, and this expansion is what's causing the sound of thunder. The expansion is happening faster than the speed of sound, which creates a sonic boom.



Lightning Medical Impacts

Lightning usually claims only one or two victims at a time and usually does not cause the mass destruction left in the wake of tornadoes or hurricanes. Lightning generally receives less attention than any other weather hazard.

During a thunderstorm, each flash of cloud to ground lightning is a potential killer. However, lightning deaths can be prevented if people are aware of the dangers and seek shelter. Lightning can strike as much as 10 miles away from the rain area in a thunderstorm. That is about the distance that you are able to hear the thunder from the storm. If you can hear the thunder from a storm, you are close enough to be struck by lightning.

Where organized sports activities are taking place, coaches, umpires, referees, or camp counselors must protect the safety of the participants and spectators by stopping the activities so that participants and spectators can get to a safe place before the lightning threat becomes significant.

Lightning Facts

- An average of 85 lightning fatalities occur each year
- Approximately 10% of the people struck by lightning are killed
- 70% of lightning strike victims suffer long-term effects
- Approximately 400 people survive lightning strikes each year
- The primary cause of death from lighting is cardiac arrest
- Unlike high voltage electrical injuries with which massive internal tissue damage may occur, lightning seldom causes substantial burns
- Most lightning injuries and deaths can be prevented with advance planning and being aware of developing weather situations
- A NOAA Weather Radio can help keep you informed with the latest thunderstorm information

Lightning Safety

Being outdoors is the most dangerous place to be during a lightning storm. The National Weather Service advises that when you hear thunder or see lightning to quickly move indoors or into a hard topped vehicle and remain there until well after the storm has passed. Any location is dangerous during a lightning storm, however, some areas are more dangerous than others. Some of the riskiest locations include:

- Anywhere near the water:
  - Boating
  - Fishing
  - Swimming
  - Activities on the beach
- Open areas like fields
- Areas near tall trees (especially isolated trees):
  - Golf course
  - Picnic areas
  - Hiking trails
- High terrains such as hill tops and ridges
- High places such as house roofs during construction

Outdoor Safety Rules

Knowing outdoor safety rules can help save your life or that of loved ones. When lightning approaches, get inside a completely enclosed building. Car-ports, open garages, storage sheds, metal sheds, and covered patios are **not** safe shelters. If no enclosed building is available, get inside a **hard-topped, all metal** vehicle. Get out of the water! Get off the beach and out of small boats and canoes. If caught in a boat, crouch down in the center of the boat away from metal hardware. Avoid standing in puddles of water, even if wearing rubber boots.

If you cannot reach shelter, avoid being the tallest object in the area. **Do not take shelter under a tree.** If you are in the woods, find shelter under the shortest trees. If only isolated trees are nearby, crouch on the balls of your feet. A rule of thumb to follow is to stay twice as far away from a tree as it is tall. **Don't lie on the ground.** Avoid leaning against vehicles and get off bicycles and motorcycles.

Indoor Safety Rules

When lightning strikes a building, house or other structure, it follows metal conductors such as electrical wiring, plumbing, and telephone lines from the structure to the ground. When this process occurs, it usually leaves the inhabitants unharmed.

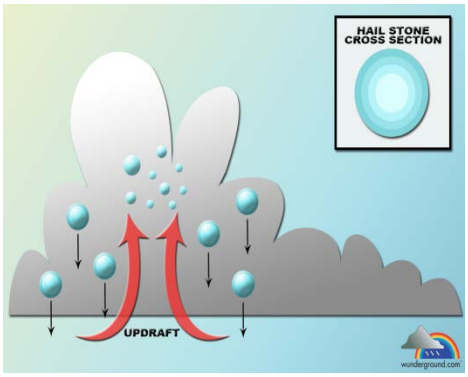
Once lightning enters the home it can surge through the electrical, phone, plumbing, and radio/television reception systems. It can also travel through any metal wires or bars in concrete walls or flooring as well as windows and doors. It is important to avoid these conductors during an electrical storm. Phone use is the leading cause of lightning injuries within the home. Lightning can travel long distances in both phone and electrical wiring, especially in rural areas where other conductors are limited.

Basements should be used with caution during lightning storms (unless there's a tornado warning!) because they usually contain conductors. Avoid contact with washers and dryers since they not only have contacts with the plumbing and electrical systems, but also have an electrical path to the outside through the dryer vent. Concrete floors should also be avoided as they usually contain some form of reinforcement which can easily become electrified by a nearby lightning strike. Avoid **bathing** during a lightning storm as the household plumbing can carry a deadly

Hail

Hail is a form of frozen precipitation that's created by strong thunderstorms with fast updrafts—air being pulled upward into a thunderstorm. It can cause serious damage, especially to cars, aircraft, glass-roofed structures, and most notably, farmers' crops. Hail causes approximately $1 billion in property and crop damage each year. The costliest hailstorm happened in April 2001, from eastern Kansas to southwest Illinois, including the St. Louis area. Property damage in this storm exceeded $2.4 billion in 2010 dollars. Deaths from hail are rare—the last known death caused by hail in the U.S. was in the year 2000, when a man was killed by softball size hail in Fort Worth, Texas.

Hail Formation



Hail is formed when very strong thunderstorm updrafts meet supercooled water droplets. Supercooled water droplets are liquid water drops that are surrounded by air that is below freezing, and they're a common occurrence in thunderstorms. There are two methods of hail stone formation and growth that give hail stones their "layered" look.

Wet Growth - A tiny ice crystal will be the nucleus of the hail stone. In wet growth, supercooled water droplets collide with and spreads across the ice nucleus. Since this process is relatively slow (slower than the dry growth process) it results in a layer of clear ice.

Dry Growth - Unlike wet growth, the supercooled water meets the ice nucleus and immediately freezes. Because this process is so fast, everything within the supercooled droplet, including small air bubbles, freezes into the layer, which gives it a cloudy look.

Rain and hail is what creates the "bounded" portion of the bounded weak echo region (BWER) on radar. The weak echo region is created by a strong updraft, which also helps the hail to grow.

1. Hail forms and is carried upward through the storm by the updraft and held above the freezing line
2. The hail stone collides with supercooled droplets and grows in size
3. When the hail becomes too large and heavy to be supported by the updraft, it falls to the ground

Record-Setting Hail

The largest officially recognized hailstone on record to have been "captured" in the U.S. was that which fell near Vivian, South Dakota in 2010. It measured 8.0 inches in diameter, 18.5 inches in circumference, and weighed in at 1.9375 pounds. Mr. Lee Scott, who collected the monster stone, originally planned to make daiquiris out of the hailstone but fortunately thought better and placed it in a freezer before turning it over to the National Weather Service for certification.

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