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Thunderstorms & Lightning

8 Articles

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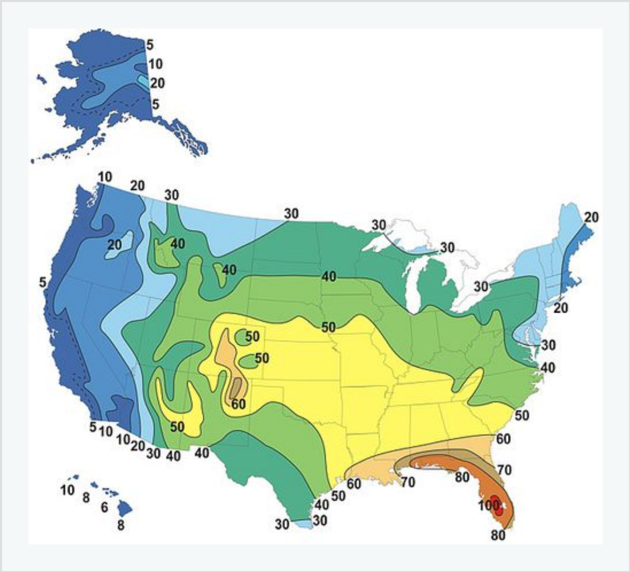
Introduction to Thunderstorms

The text and image are from the U.S. National Oceanic and Atmospheric Administration.

It is estimated that there are as many as 40,000 thunderstorm occurrences each day world-wide. This translates into an astounding 14.6 million occurrences annually! The United States certainly experiences its share of thunderstorm occurrences.



Annual number of thunderstorms the U.S.

The figure above shows the average number of thunderstorm days each year throughout the U.S. The most frequent occurrence is in the southeastern states, with Florida having the highest number "thunder" days (80 to 100+ days per year).

It is in this part of the country that warm, moist air from the Gulf of Mexico and Atlantic Ocean (which . . . are necessary ingredients for thunderstorm development) is most readily available to fuel thunderstorm development.

Ingredients for a Thunderstorm

The text and images are from the U.S. National Oceanic and Atmospheric Administration.

All thunderstorms require three ingredients for their formation:

- Moisture,
- Instability, and
- a lifting mechanism.

[This text will examine each ingredient and explain how each ingredient helps in forming thunderstorms.]

Sources of [M]oisture

[The typical sources] of moisture for thunderstorms are the oceans. However, water temperature plays a large role in how much moisture is added to the atmosphere.

. . . [W]arm ocean currents occur along *east* coasts of continents with cool ocean currents [occurring] along *west* coasts. Evaporation is higher in warm ocean currents and therefore puts more moisture into the atmosphere as compared to the cold ocean currents at the same latitude.

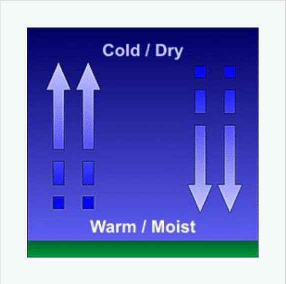
The oceans are the [sources] of moisture for the United States.

Therefore, in the southeastern U.S. the warm water from the two moisture sources (Atlantic Ocean and Gulf of Mexico) helps explain why there is much more precipitation in that region as compared to the same latitude in Southern California.

Instability

Air is considered *unstable* if it continues to rise when given a nudge upward (or continues to sink if given a nudge downward). An unstable air mass is characterized by warm, *moist* air near the surface and cold, *dry* air aloft.

In these situations, if a bubble or parcel of air is forced upward, it will continue to rise on its own. As



this parcel rises, it cools, and some of the water vapor will condense, forming the familiar tall cumulonimbus cloud that is the thunderstorm.

Sources of Lift (upward)

Typically, for a thunderstorm to develop, there needs to be a mechanism [that] initiates the upward motion, something that will give the air a nudge upward. This upward nudge is a direct result of air density.

Some of the sun's heating of the earth's surface is transferred to the air, which, in turn, creates different air densities. The propensity for air to rise increases with decreasing density. This . . . difference in air density is the main source for lift and is accomplished by several methods.

Differential Heating

The sun's heating of the earth's surface is not uniform. For example, a grassy field will heat at a slower rate than a paved street. A body of water will heat slower than the nearby landmass.

This will create two adjacent areas where the air is of different densities. The cooler air sinks, pulled toward the surface by gravity, forcing up the warmer, less dense air, creating thermals.

Fronts, Drylines and Outflow Boundaries

[A **front** is] the boundary between two air masses of different temperatures and therefore different air densities. The colder, more dense air behind the front [lifts] warmer, less dense air abruptly. If the air is moist, thunderstorms will often form along the cold front.

[A **dry line** is] the boundary between two air masses of different moisture content and divides warm, moist air from hot, dry air. Moist air is less dense than dry air. [Dry lines] therefore act similarly to fronts in that the moist, less dense air is lifted up and over the drier, more dense air.

The air temperature behind a [dry line] is often much higher due to the lack of moisture. That alone will make the air less dense, but the moist air ahead of the [dry line] has an even lower density making it more buoyant. The end result is air lifted along the [dry line] forming thunderstorms. This is common over the plains in the spring and early summer.

[An **outflow boundary** is] a result of the rush of cold air as a thunderstorm moves overhead. The rain-cooled, more dense air acts as a "mini cold front" called an outflow boundary. Like fronts, this boundary lifts warm, moist air and can cause new thunderstorms to form.

Terrain

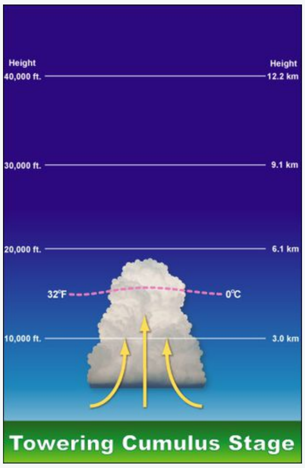
As air encounters a mountain, it is forced up because of the terrain. Upslope thunderstorms are common in the [Rocky Mountains] . . . during the summer.

Clouds [are] covering [a] mountain peak as air is forced up due to terrain.

Life Cycle of a Thunderstorm

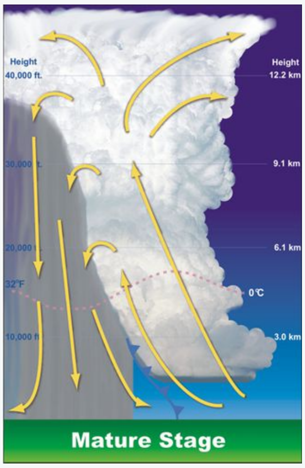
The text and images are from the U.S. National Oceanic and Atmospheric Administration.

The building block of all thunderstorms is the thunderstorm cell. The thunderstorm cell has a distinct [life cycle] that lasts about 30 minutes. [The life cycle has three stages: a cumulus cloud growing in the towering cumulus stage, the cloud forming into a cumulonimbus cloud in the mature cumulus stage, and the cloud collapsing in the dissipating stage.]



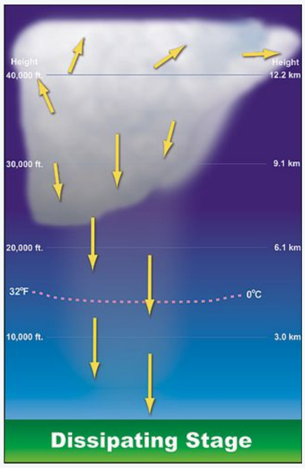
The Towering Cumulus Stage

A cumulus cloud begins to grow vertically, perhaps to a height of 20,000 feet (6 km). Air within the cloud is dominated by updraft with some turbulent eddies around the edges.



The Mature Cumulus Stage

The storm has considerable depth, often reaching 40,000 to 60,000 feet (12 to 18 km). Strong updrafts and downdrafts coexist. This is the most dangerous stage when tornadoes, large hail, damaging winds, and flash flooding may occur.



The 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.

Thunderstorm Types

The text and images are from the U.S. National Oceanic and Atmospheric Administration.

[The building block of thunderstorms is the thunderstorm cell. A thunderstorm can be made of one cell or multiple cells. A single-cell thunderstorm can be an ordinary cell or a supercell thunderstorm. Thunderstorms with more than one cell can be multi-cell clusters or multi-cell lines, which are also called squall lines.]

Ordinary Cell

As the name implies, there is only one cell with this type of thunderstorm. Also called a "pulse" thunderstorm, the ordinary cell [consists] of a [one-time] updraft and [one-time] downdraft. In the towering cumulus stage, the rising updraft will suspend growing raindrops until the point where the weight of the water is greater than what can be supported.

At which point, [a] drag of air from the falling drops begins to diminish the updraft and, in turn, [allows] more raindrops to fall. In effect, the falling rain turns the updraft into a downdraft. With rain falling back into the updraft, the supply of rising moist air is [cut off] and the life of the single cell thunderstorm is short.

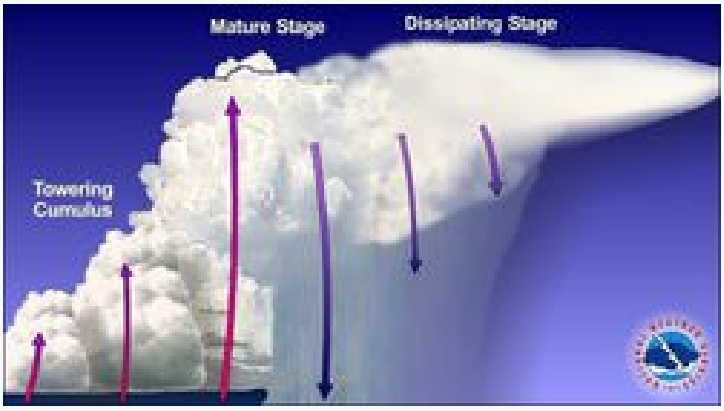
They are [short-lived], and while hail and gusty wind can develop, these occurrences are typically not severe. However, if atmospheric conditions are right and the ordinary cell is strong enough, there is the potential for more than one cell to form and can include microburst winds (usually less than 70 mph, [or] 112 km/h) and weak tornadoes.

Multi-cell Cluster

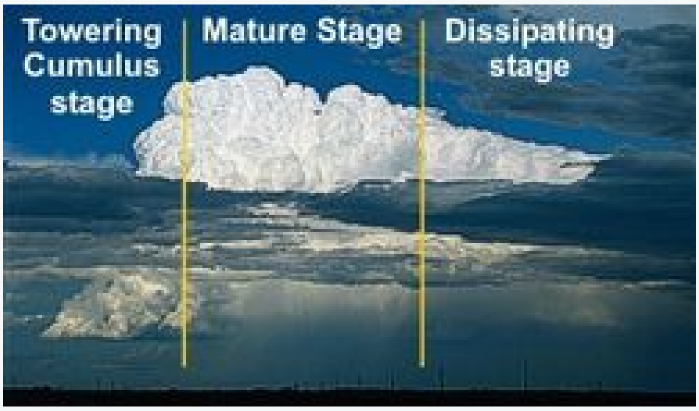
Although there are times when a thunderstorm consists of just one ordinary cell that transitions through its life cycle and dissipates without additional new cell formation, thunderstorms often form in clusters with numerous cells in various stages of development, merging together.

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.

The speed at which the entire cluster of thunderstorms move downstream can make a huge difference in the amount of rain any one place receives. There are many times where the individual cell moves downstream, but [additional] cells [form] on the upwind side of the cluster and move directly over the path of the previous cell.



The term for this type of pattern when viewed by radar is "training echoes."



Training thunderstorms produce tremendous rainfall over relatively small areas leading to flash flooding.

Sometimes the atmospheric condition are such that new cell growth is quite vigorous. They form so fast that each new cell develops further and further upstream giving the appearance . . . the thunderstorm cluster is stationary or is moving backwards, against the upper level wind.

Tremendous rainfall amounts can be produced over very small areas by back-building thunderstorms. In 1972, 15" (380 mm) fell in six hours over parts of Rapid City, SD, due to back-building storms.

Multi-cell Line (Squall Line)

Sometimes thunderstorms will form in a line, which can extend laterally 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 [the] leading edge of [a] 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 [sheer] force of the [downdraft] from a thunderstorm spreading horizontally as it reaches the earth's surface.

Long-lived strong squall lines [are] called "derechos" (Spanish for “straight”). Derechos can travel many hundreds of miles and can produce considerable widespread damage from wind and hail. . . .

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

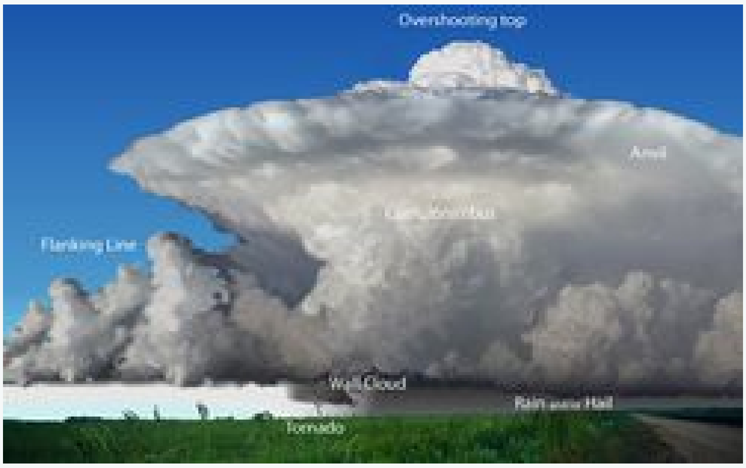
This appearance is a result of the [rain-cooled] air spreading out from underneath the squall line acts as a mini cold front. The cooler dense air forces the warmer, less dense air . . . up. The rapidly rising air cools and condenses, creating the shelf cloud.

Supercell Thunderstorms

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



An idealized supercell.

mph (160 km/h) 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 (160 km/h), posing a high threat to life and property.

The most ideal conditions for supercells occur when the winds are veering or turning clockwise with height. For example, in a veering wind situation the winds may be from the south at the surface and from the west at 15,000 feet (4,500 meters). This change in wind speed and direction produces storm-scale rotation, meaning the entire cloud rotates, which may give a striated or corkscrew appearance to the storm's updraft.

Dynamically, all supercells are fundamentally similar. However, they often appear quite different visually from one storm to another depending on the amount of precipitation accompanying the storm and whether precipitation falls adjacent to, or is removed from, the [storm's] updraft.

Based on their visual appearance, supercells are often divided into three groups:

- Rear Flank Supercell - Low precipitation (LP),
- Classic (CL), or
- Front Flank Supercell - High precipitation (HP).

In low precipitation supercells the updraft is on the rear flank of the storm, providing a barber pole or corkscrew appearance to the cloud. Precipitation is sparse or well removed from the updraft and/or often is transparent.

Also, large hail is often difficult to discern visually. With the lack of precipitation no "hook" [is] seen on Doppler radar.

The majority of supercells fall in the "classic" category. The classic supercell will have a large, flat updraft base with striations or banding seen around the periphery of the updraft. Heavy precipitation falls adjacent to the updraft with large hail likely and has the potential for strong, long-lived tornadoes.

An idealized "low precipitation" supercell.

An idealized "high precipitation" supercell.

High precipitation supercells will have...

- the updraft on the front flank of the storm
- precipitation that almost surrounds updraft at times
- the likelihood of a wall cloud (but it may be obscured by the heavy precipitation)
- tornadoes that are potentially wrapped by rain (and therefore difficult to see), and
- extremely heavy precipitation with flash flooding.

Beneath the supercell, the rotation of the storm is often visible as well. [It] is visible as a lowered, rotating cloud . . . called a [wall cloud, which] forms below the rain-free base and/or below the main storm tower updraft. Wall clouds are often located on the trailing flank of the precipitation.

The wall cloud is sometimes a precursor to a tornado. If a tornado were to form, it would usually do so within the wall cloud.

With some storms, such as high precipitation supercells, the wall cloud area may be obscured by precipitation or located on the leading flank of the storm.

[A wall cloud] associated with potentially severe storms can . . .

- Be a persistent feature that lasts for 10 minutes or more,
- Have visible rotation, [and]
- Appear with lots of rising or sinking motion within and around the wall cloud.

Introduction to Lightning

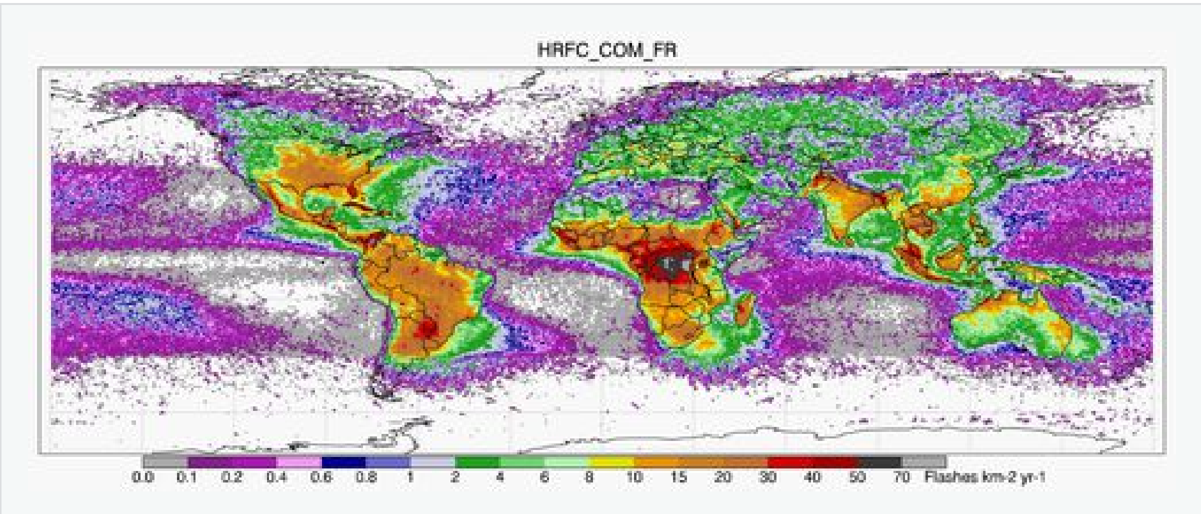
The text and image are from the U.S. National Oceanic and Atmospheric Administration.

Lightning is one of the oldest observed natural phenomena on earth. At the same time, it also is one of the least understood. While lightning is simply a gigantic spark of static electricity (the same kind of electricity that sometimes shocks you when you touch a doorknob), scientists do not have a complete grasp on how it works, or how it interacts with solar flares impacting the upper atmosphere or the earth's electromagnetic field.

Lightning has been seen in volcanic eruptions, extremely intense forest fires, surface nuclear detonations, heavy snowstorms, and in large hurricanes. However, it is most often seen in thunderstorms. In fact, lightning (and the resulting thunder) is what makes a storm a thunderstorm.

At any given moment, there can be as many as 2,000 thunderstorms occurring across the globe. This translates to more than 14.5 MILLION storms each year. NASA satellite research indicated these storms produce lightning flashes about 40 times a second worldwide.

This is a change from the commonly accepted value of 100 flashes per second, which was an estimate from 1925. Whether it is 40, 100, or somewhere in between, we live on an electrified planet.



Annual number of lightning flashes based on observations from NASA satellites.

How Lightning Is Created

The text and images are from the U.S. National Oceanic and Atmospheric Administration.

The conditions needed to produce lightning have been known for some time. However, exactly how lightning forms has never been verified, so there is room for debate.

Leading theories focus around separation of electric charge and generation of an electric field within a thunderstorm. Recent studies also indicate that ice, hail, and semi-frozen water drops known as graupel are essential to lightning development. Storms that fail to produce large quantities of ice usually fail to produce lightning.

Forecasting when and where lightning will strike is not yet possible and most likely never will be. But by educating yourself about lightning and learning some basic safety rules, you, your family, and your friends can avoid needless exposure to the dangers of one of the most capricious and unpredictable forces of nature.

Charge Separation

Separated charges in a thunderstorm

Thunderstorms have very turbulent environments. Strong updrafts and downdrafts occur with regularity and within close proximity to each other. The updrafts transport small liquid water droplets from the lower regions of the storm to heights between 35,000 and 70,000 feet, miles above the freezing level.

Meanwhile, downdrafts transport hail and ice from the frozen upper regions of the storm. When these collide, the water droplets freeze and release heat. This heat in turn keeps the [surfaces] of the hail and ice slightly warmer than their surrounding environment, and a "soft hail", or "graupel," forms.

When this graupel collides with additional water droplets and ice particles, a *critical* phenomenon occurs: [electrons] are sheared off of the ascending particles and collect on the descending particles. Because electrons carry a negative charge, the result is a storm cloud with a negatively charged base and a positively charged top.

Field Generation

In the world of electricity, opposites attract and insulators inhibit. As positive and negative charges begin to separate within the cloud, an electric field is generated between its top and base. Further separation of these charges into pools of positive and negative regions results in a strengthening of the electric field.

The electric field within a thunderstorm

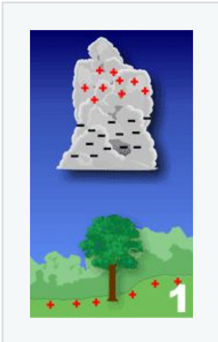
However, the atmosphere is a very good insulator that inhibits electric flow, so a TREMENDOUS amount of charge has to build up before lightning can occur. When that charge threshold is reached, the strength of the electric field overpowers the atmosphere's insulating properties, and lightning results.

The electric field within the storm is not the only one that develops. Below the negatively charged storm base, positive charge begins to pool within the surface of the earth....

This positive charge will shadow the storm wherever it goes, and is responsible for cloud-to-ground lightning. However, the electric field within the storm is much stronger than the one between the storm base and the earth's surface, so most lightning (~75-80%) occurs within the storm cloud itself.

How Lightning Develops Between [the] Cloud [and the] Ground

A moving thunderstorm gathers another pool of positively charged particles along the ground that travel with the storm (image 1).



Thunderstorm gathers another pool of positively charged particles

As the differences in charges continue to increase, positively charged particles rise up taller objects such as trees, houses, and telephone poles.

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.

Negatively charged area in the storm will send out a charge

This positive charge "reaches" out to the approaching negative charge with its own channel, called a "streamer" (image 3).

When these channels connect, the resulting electrical transfer is what we see as lightning. After the initial lightning stroke, if enough charge is leftover, additional lightning strokes will use the same channel and will give the bolt its flickering appearance.

Lightning channel develops

[. . .]

Tall objects such as trees and skyscrapers are commonly struck by lightning. Mountains also make good targets. The reason for this is their tops are closer to the base of the storm cloud.

Remember, the atmosphere is a good electrical insulator. The less distance the lightning has to burn through, the easier it is for it to strike.

However, this does not always mean tall objects will be struck. It all depends on where the charges accumulate. Lightning can strike the ground in an open field even if the tree line is nearby.

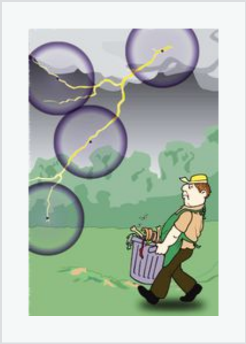
The Sound of Thunder

The text and images are from the U.S. National Oceanic and Atmospheric Administration.

Regardless of whether lightning is positive or negative, thunder is produced the same way. Thunder is the acoustic shock wave resulting from the extreme heat generated by a lightning flash.

Lightning can be as hot as 54,000°F (30,000°C), a temperature that is five times hotter than the surface of the sun! When lightning occurs, it heats the air surrounding its channel to that same incredible temperature in a fraction of a second.

Like all gases, when air molecules are heated, they expand. The faster they are heated, the faster their rate of expansion. But when air is heated to 54,000°F (30,000°C) in a fraction of a second, a phenomenon known as "explosive expansion" occurs. This is where air expands so rapidly that it compresses the air in front of it, forming a shock wave similar to a sonic boom. Exploding fireworks produce a similar result.



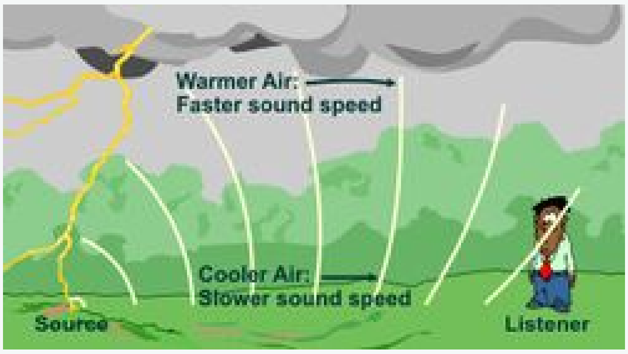
When lightning strikes, a shock wave is generated at each point along the path of the lightning bolt. (The [illustration shows] only four points.) When the shock wave is first created, there is a sharp boundary associated with it.

The initial sound reaches the ear with a loud bang, crack, or snap.

As shock waves propagate away from the path of the lightning bolt, they are distorted becoming stretched and elongated. The sound is more muted. Then other shock waves from more distance locations arrive to the listener. Shock waves emanating along the lightning bolt's path, arriving to the listener's ear at the same time, enhance the intensity of the sound.

At large distances from the center, the shock wave (thunder) can be many miles across. The shock wave is greatly elongated. To the listener, it is the combination of the millions of shock waves that gives thunder the continuous booming . . . [or] rumbling sound we hear.

[. . .]



How sound waves travel through cool and warm air

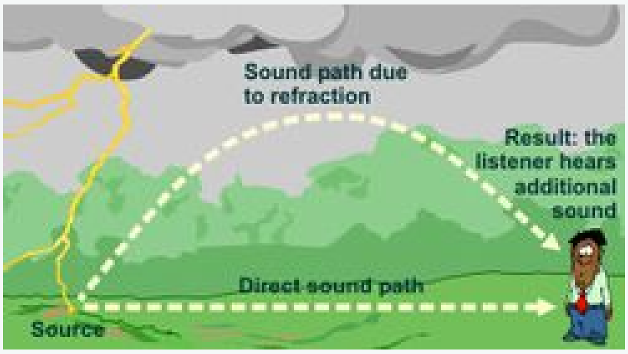
In addition, the temperature of the atmosphere affects the thunder sound you hear as well as how far away you can hear it.

Sound waves move faster in warm air than they do in cool air. Typically, the air temperature decreases with height. When this occurs, thunder will normally have an audible range up to 10 miles (16 km).

However, when the air temperature increases with height, called an inversion, sound waves are refracted (bent back toward the earth) as they move due to their faster motion in the warmer air. Normally, only the direct sound of thunder is heard. But refraction can add some additional sound, effectively amplifying the thunder and making it sound louder.

This is more common in the winter as thunderstorms develop in the warm air above a cooler surface air mass.

If the lightning in these "elevated thunderstorms" remains above the inversion, then most of the thunder sound also remains above the inversion. However, many of the sound waves from cloud-to-ground strikes remain below the inversion giving thunder a much louder impact.



How warm and cool air affect the sound of thunder

Lightning Safety

The text and images are from the U.S. National Oceanic and Atmospheric Administration.

Lightning is the MOST UNDERRATED weather hazard. On average, only floods kill more people. Lightning makes every single thunderstorm a potential killer, whether the storm produces one single bolt or ten thousand bolts.

In the United States, lightning routinely kills more people each year than tornadoes or hurricanes. Tornadoes, hail, and wind gusts get the most attention, but only lightning can strike outside the storm itself. Lightning is the first thunderstorm hazard to arrive and the last to leave.

Lightning is one of the most capricious and unpredictable characteristics of a thunderstorm. Because of this, no one can guarantee an individual or group absolute protection from lightning. However, knowing and following proven lightning safety guidelines can greatly reduce the risk of injury or death. Remember, **YOU** are ultimately responsible for your personal safety, and should take appropriate action when threatened by lightning.

Where to Go 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. 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.	**Where NOT to Go** 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. Convertible vehicles offer **no** safety from lightning, even if the top is "up." Other vehicles [that] are NOT SAFE during lightning storms are those [that] have open cabs, such as golf carts, tractors, and construction equipment.
What [to] Do Once inside a sturdy building, stay away from electrical appliances and plumbing fixtures. As an added safety measure, stay in an	**What NOT to Do** Lightning can travel great distances through power lines, especially in rural areas. Do not use electrical appliances, ESPECIALLY corded

interior room. 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.).	telephones unless it is an emergency (cordless and cell phones are safe to use). 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.

Lightning Safety Plan

A lightning safety plan should be an integral part of the planning process for any outdoor event. Do not wait for storm clouds to develop before considering what to do should lightning threaten! An effective plan begins **LONG** before any lightning threat is realized. You can't control the weather, so you have to work around it!

Detailed weather forecasts are accurate only out to seven days at best, but outdoor events often are planned many months in advance. Because of this limitation, every outdoor event coordinator should consider the possibility of lightning, especially if the event is scheduled during the late spring to early autumn months.

The key to an effective lightning safety action plan lies in your answers to the following questions:

1. Where is the safest lightning shelter?
2. How far am I (or the group I am responsible for) from that location?
3. How long will it take me (or my group) to get there?

Knowing the answers to these questions will greatly reduce your chances of being struck by lightning, provided you know them BEFORE thunderstorms threaten!

When Thunder Roars, Go Indoors

Studies have shown most people struck by lightning are struck not at the height of a thunderstorm, but before and after the storm has peaked. Most are unaware of how far lightning can strike from its parent thunderstorm. *Lightning can strike . . . more than 10 miles away from [the] location of rainfall.*

Therefore, if you can hear thunder, that **IS YOUR WARNING** that you are within striking distance. Seek safe shelter immediately. Remember this lightning safety rule... **When thunder roars, go indoors and stay there until 30 minutes after the last clap of thunder.** DO NOT wait for the rain to start before seeking shelter, and do not leave shelter just because the rain has ended.

With common sense, you can greatly increase your safety and the safety of those around you. At the first clap of thunder, go to a large building or fully enclosed vehicle and wait 30 minutes after the last clap of thunder before you go back outside.

Safety Guidelines

For YOU!

Plan Ahead! Make sure you get the latest weather forecast at weather.gov before going out.

It is your behavior when thunderstorms are in the area that determines your personal risk of being struck by lightning. The best way for you to protect yourself from lightning is to avoid the threat. You simply don't want to be caught outside in a storm.

Carry a NOAA weather radio (found at most electronics stores) or a portable AM radio with you, especially if you will be away from sturdy shelter (such as while boating, camping, etc.). This way you will always be able to get the latest forecast.

As lightning occurs, it creates static on the AM radio band. The loudness of the static is directly related to the proximity of the thunderstorm. So if you begin to hear static, keep an eye to the sky as a thunderstorm may be approaching.

To minimize your personal risk of being struck by lightning, when going outside, plan ahead so that you can get to a safe place quickly if a thunderstorm threatens. If the sky looks threatening or if you hear thunder, get inside a safe place immediately.

Once inside, avoid contact with corded phones, electrical equipment, plumbing, and windows and doors. Finally, wait 30 minutes after the last lightning or thunder before going back outside.

For Small Groups

Plan Ahead! Make sure you and someone else in the group gets the weather forecast before going out and make your lightning safety action plan known by all members in the group.

Designate one of the members to monitor NOAA weather radio or a portable radio. This way you will always be able to get the latest forecast. If you have a wireless device that is internet capable, you can also obtain that information. If your wireless device can also display graphics, you can also view the local [National Weather Service] Doppler radar to determine [the] location of thunderstorms.

If thunderstorms are expected and you go ahead with your planned outdoor activity, have a lightning safety plan in place. Upon arriving on-site, determine how far away your shelter is in case lightning threatens. Remember to account for the time it will require to get to your safe location.

If you hear thunder, even a distant rumble, immediately move all to a safe place. Do not wait. You are in danger of being struck by lightning. Do not resume outdoor activities until 30 minutes after the last thunder clap.

For Large Groups

Plan Ahead! Make sure the event organizers responsible for safety get a good weather forecast before the event begins, and make your lightning safety action plan known and used by all event organizers.

Safety organizers should monitor NOAA weather radio (found at most electronics stores), a portable radio, or local cable, radio or TV broadcasts.

Since it may take considerable time to evacuate people to a safe location, personal observation of the lightning threat may not be adequate, especially for fast moving lightning storms. [Handheld] or portable lightning detectors should be made available so that lightning can be observed significant distances from the event site. ***Event organizers should know how long it will take to get people to safe shelter.***

With large groups of people, safe locations must be identified beforehand, along with a means to route people to these locations. Event organizers might consider placing lightning safety tips on programs, score cards, etc. Lightning safety placards set up in strategic locations can be an effective means of raising awareness and communicating the lightning threat to the attending audience.

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