

Why do lightning strikes can take many different forms?

The reason crooked or forked lightning forms is due to the fact that as the precursor to lightning tries to work its way to the ground it searches for the path of least resistance. When the atmosphere has too much resistance a new path takes. By the time the strike makes contact with the ground its path has often been altered many times.

Why humid days favor thunderstorm development?

Often on days when we receive thunderstorms you can walk outside and feel the large amount of moisture in the air.

In fact, the strongest thunderstorms usually develop in air masses that contain large amounts of moisture near the surface.

Indeed, thunderstorms can be quite greedy when it comes to moisture. Even a small thunderstorm, only a few miles in diameter, can easily contain over a million tons of condensed ice and water.

What is lightning?

Lightning, as best we understand, is a channel of negative charge, called a stepped leader that zigzags downward in roughly 50-yard segments in a forked pattern. This step leader is invisible to the human eye, and shoots to the ground in less time than it takes to blink. As it nears the ground, the negatively charged step leader is attracted to a channel of positive charge reaching up, a streamer, normally through something tall, such as a tree, house, or telephone pole. When the oppositely-charged leader and streamer connect, a powerful electrical current begins flowing. 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. We see flicker when the process rapidly repeats itself several times along the same path. The actual diameter of a lightning channel is one-to-two inches.

What causes lightning to be colored rather than the usual white or blue?

Lightning can appear to be many different colors depending on what the light travels through to get to your eyes. In snowstorms, where is somewhat rare, pink and green are often described as colors of lightning. Haze, dust, moisture, raindrops and any other particles in the atmosphere will affect the color by absorbing or diffracting a portion of the white light of lightning.

Why are positive lightning bolts deemed more dangerous than the more common negatively charged bolts?

Positive lightning is often considered more dangerous because its electrical field is stronger (forming at the top of the storm), the flash duration is typically longer, and its peak charge can be much greater than a negative strike. Plus, positively charged lightning can occur near the edge of a cloud or strike more than 10 miles away – when people aren't aware of the danger.

What are cloud flashes?

A cloud flash is lightning that occurs inside the cloud, travels from one part of a cloud to another, or from the cloud to the air.

Does lightning strike from the sky down, or the ground up?

The answer is both. Cloud-to-ground lightning comes from the sky down, but the part you see comes from the ground up. A typical cloud-to-ground flash lowers a path of negative electricity (that we cannot see) towards the ground in a series of spurts. Objects on the ground generally have a positive charge. Since opposites attract, an upward streamer is sent out from the object about to be struck. When these two paths meet, a return stroke zips back up to the sky. It is the return stroke that produces the visible flash, but it all happens so fast - in about one-millionth of a second - so the human eye doesn't see the actual formation of the stroke.

How does the Earth benefit from lightning?

The earth benefits from lightning in several ways. First, lightning helps the Earth maintain electrical balance. The Earth is recharged by thunderstorms. The Earth's surface and the atmosphere conduct electricity easily—the Earth is charged negatively and the atmosphere, positively. There is always a steady current of electrons flowing upwards from the entire surface of the Earth. Thunderstorms help transfer the negative charges back to Earth (lightning is generally negatively charged). Without thunderstorms and lightning, the earth-atmosphere electrical balance would disappear in 5 minutes. Lightning also produces ozone, a gas that helps protect the Earth from the dangerous rays of the sun.

How many people are killed by lightning?

According to the National Weather Service, during the past 30 years (1979-2008) lightning killed an average of 58 people each year. Documented injuries average about 300 per year, although undocumented injuries are likely to be much higher.

What happens to the ground when lightning strikes it?

What tends to happen when lightning strikes ground is that it fuses dirt and clays in to silica. The result is often a black, glassy rock (called a fulgarite) in the shape of a convoluted tube. The shape in the ground is the shape of the path the lightning current followed in the ground. There is often damage to grasses along this path too. Lightning traveling down a tree trunk turns water to steam. If it gets under the bark into the surface moisture of the wood, the rapidly expanding steam can blast pieces of bark from the tree, and the wood along the path is often killed.

Can lightning strike the same place twice?

Lightning does hit the same spot (or almost the same spot) more than once, contrary to folk wisdom. It could be simply a statistical fluke (i.e., with all the lightning that occurs, eventually lightning will strike somewhere near a previous lightning strike within a short period of time). It could also be that something about the site makes it somewhat more likely to be struck. Typically, when lightning strikes something on the ground, the object that is struck sends a faint channel upward that joins the downward developing flash and creates the connection to the ground. Taller objects are more likely than shorter objects to produce the upward channel. But it is also possible that something that locally affects the ability of the ground to conduct electricity (such as the salt or moisture content of the ground at the time, the presence or absence of rock, standing water, pipes or other metal objects in the ground), the terrain shape, the shape of leaves or twigs, or something else might make a particular location more likely than another nearby location to be struck.

What is a "stepped leader?"

A stepped leader is a stream of weakly charged particles that flows from the cloud – it moves towards the ground, starting and stopping, and sometimes branching, trying to find the path of least resistance.

Is it possible to have lightning without thunder?

No, it is not possible to have lightning without thunder. Thunder is a direct result of lightning. However, it IS possible that you could not hear the thunder because it was too far away. Sometimes it is called “heat lightning” because it occurs most often in the summer.

What is it called when lightning strikes sand and melts it, forming a tube?

Fulgurites- Fulgurites has been found all over the world, but is relatively rare. The color depends on the minerals in the sand that was struck.

Is lightning always produced by a thunderstorm?

Yes, lightning is always produced by a thunderstorm. Lightning causes thunder, and you can't have a thunderstorm without thunder. Thunderstorms are the only weather condition strong enough to carry water droplets to the upper parts of the atmosphere where they will freeze and become charged – because thunderstorms have an updraft.

Does lightning always strike the tallest object?

Never say always! Lightning USUALLY strikes the tallest object. It makes sense that the tallest object is most attractive, because it is the easiest path for the lightning to take.

NOAA safety posters say lightning can strike 10 miles away from a thunderstorm. Is this true?

Yes, it is true. Lightning that strikes away from a thunderstorm are often called "bolts from the blue." Lightning has its own agenda. It is random and unpredictable, and defies our attempts to fit it into a convenient box to describe its behavior. We don't really know why it sometimes connects with the ground and not a tree, or a beach instead of the water. Check out these photos:

- www.srh.weather.gov/ffc/html/swaw05_lightning.shtml,
- www.crh.noaa.gov/gid/Web_Stories/2004/other/lightningsafety/intro/introduction.php,
- www.srh.noaa.gov/mlb/BBX.html shows a radar section with lightning data overlaid (white dots). See the white dots extending out from the core of the storm to the right – about 17km away from the back of the storm?

A helmeted bicyclist experienced a lightning strike to the head under fair weather conditions with a cloudless sky. It was determined that the bolt probably originated in a thunderstorm that was about 16km away and obscured by mountains.

Lightning strikes the ground approximately 25 million times each year in the U.S. According to the NWS, the chance of an individual in the U.S. being killed or injured during a given year is one in 240,000. Assuming an average life span of 80 years, a person's odds over their lifetime becomes one in 3000. Assuming the average person has ten family members and others with whom they are close, then the chances are one in 300 that a lightning strike will closely affect a person during their lifetime.

What type of electricity is lightning?

Lightning is an electrostatic discharge accompanied by the emission of visible light and other forms of electromagnetic radiation.

How many volts and watts are in lightning?

Lightning can have 100 million to 1 billion volts, and contains billions of watts.

How hot can lightning make the air?

Energy from lightning heats the air anywhere from 18,000 degrees Fahrenheit to up to 60,000 degrees Fahrenheit.

How many lightning deaths are water-related?

In a study of 35 years of lightning incident statistics, 8% were water-related.

Can lightning kill fish?

Lightning striking the water can penetrate down and kill fish nearby.

Where can I get information on lightning strikes that occur in my area?

NSSL does not archive lightning data, but there are several other companies that do. We actually purchase lightning data ourselves (we do not have the funds to maintain our own network) and have strict rules about how we can use it.

What is dry lightning?

Dry lightning is lightning that occurs without rain nearby. The NOAA Storm Prediction Center routinely forecasts dry lightning because this kind is more likely to cause forest fires.

What causes thunder?

Thunder is caused by lightning. The bright light of the lightning flash caused by the return stroke mentioned above represents a great deal of energy. This energy heats the air in the channel to above 50,000 degrees F in only a few millionths of a second! The air that is now heated to such a high temperature had no time to expand, so it is now at a very high pressure. The high pressure air then expands outward into the surrounding air compressing it and causing a disturbance that propagates in all directions away from the stroke. The disturbance is a shock wave for the first 10 yards, after which it becomes an ordinary sound wave, or thunder. Thunder can seem like it goes on and on because each point along the channel produces a shock wave and sound wave.

How long can a lightning bolt be?

Recent research from Vaisala-GAI's LDAR and LDAR II lightning detection networks show that lightning can travel 60 miles or more. The longest bolts start at the front of a squall line and travel horizontally back into clouds trailing behind the squall line. The longest bolt they have seen to date was 118 miles long in the Dallas-Ft. Worth, TX area. Since 3-D lightning measurements are relatively new, scientists are learning more every day and these numbers may change.

Where does lightning usually strike?

Lightning comes from a parent cumulonimbus cloud. These thunderstorm clouds are formed wherever there is enough upward motion, instability in the vertical, and moisture to produce a deep cloud that reaches up to levels somewhat colder than freezing.

These conditions are most often met in summer. In general, the US mainland has a decreasing amount of lightning toward the northwest. Over the entire year, the highest frequency of cloud-to-ground lightning is in Florida between Tampa and Orlando. This is due to the presence, on many days during the year, of a large moisture content in the atmosphere at low levels (below 5,000 feet), as well as high surface temperatures that produce strong sea breezes along the Florida coasts. The western mountains of the US also produce strong upward motions and contribute to frequent cloud-to-ground lightning. There are also high frequencies along the Gulf of Mexico coast westward to Texas, the Atlantic coast in the southeast US, and inland from the Gulf. Regions along the Pacific west coast have the least cloud-to-ground lightning.

Does lightning happen during the winter?

Lightning occurs less frequently in the winter because there is not as much instability and moisture in the atmosphere as there is in the summer. These two ingredients work together to make convective storms that can produce lightning. Without instability and moisture, strong thunderstorms are unlikely.

During the winter, the land surface is cooler because there is not as much heating by the sun to warm it up. Without warm surface temperatures, the near-surface air wouldn't rise in the atmosphere very far. Thus, the kinds of deep (8-15 km deep) thunderstorms that develop in the summertime wouldn't develop.

Warm air holds more water vapor. And, when water vapor condenses into liquid water cloud drops, latent heat is released which fuels the thunderstorm. So, warm, moist air near the surface (and the proper conditions aloft to give you lots of instability) can result in deep convection, which may produce lightning discharges.

Clouds become electrified when strong updrafts (fueled by the instability and moisture) bring super cooled liquid water drops and ice crystals at temperatures less than freezing (0 deg C) together. In this environment, interactions between the ice crystals and super cooled water droplets produce electric charges. The exact mechanisms by which this charging happens remain unknown. The electrical charges build up until they are strong enough to overcome the resistance of the surrounding air. The breakdown of the electric fields produced by these charges is the lightning bolt.

What is thunders now?

Although thunderstorms are less common in the winter, sometimes lightning can occur within snowstorms. Called thundersnow, relatively strong instability and abundant moisture may be found above the surface, such as above a warm front, rather than at the surface where it may be below freezing. Thundersnow is sometimes observed downstream of the Great Salt Lake and the Great Lakes during lake-effect snowstorms, too.

What is a "bolt from the blue"?

A "Bolt from the Blue" is a cloud-to-ground flash which typically comes out of the back side of the thunderstorm cloud, travels a relatively large distance in clear air away from the storm cloud, and then angles down and strikes the ground. These lightning flashes have been documented to travel more than 25 miles away from the thunderstorm cloud. They can be especially dangerous because they appear to come from clear blue sky.

Can lightning be detected?

Since the 1980s, cloud-to-ground lightning flashes have been detected and mapped in real time across the entire US by several networks. In 1994, the networks were combined into one national network consisting of antennas that detect the angle from ground strike points to an antenna (direction-finder antenna), that detect the time it took for them to arrive at an antenna (time-of-arrival method), or a combination of both detection methods.

Flashes have also been detected from space during the past few years by an optical sensor. This experimental satellite covers the earth twice a day in tropical regions. The satellite also detects flashes that do not strike the ground, but cannot tell the difference between ground strikes and cloud flashes.

How many flashes a year are there?

Over the continental 48 states, an average of 20,000,000 cloud-to-ground flashes has been detected every year since the lightning detection network covered the entire continental US in 1989. In addition, about half of all flashes have more than one ground strike point, so at least 30 million points on the ground are struck on the average each year in the US. Besides cloud-to-ground flashes, there are roughly 5 to 10 times as many cloud flashes as there are ground flashes.

What types of damage can lightning cause?

Cloud-to-ground lightning can kill or injure people by direct or indirect means. The lightning current can branch off to a person from a tree, fence, pole, or other tall object. It is not known if all people are killed who are directly struck by the flash itself. In addition, flashes may conduct their current through the ground to a person after the flash strikes a nearby tree, antenna, or other tall object. The current also may travel through power or telephone lines or plumbing pipes to a person who is in contact with an electric appliance, telephone, or plumbing fixture.

Similarly, objects can be directly struck and this impact may result in an explosion, burn, or total destruction. Or, the damage may be indirect when the current passes through or near it. Sometimes, current may enter a building and transfer through wires or plumbing and damage everything in its path. Similarly, in urban areas, it may strike a pole or tree and the current then travels to several nearby houses and other structures and enter them through wiring or plumbing.

How can I stay safe from lightning?

NOAA's National Weather Service is an excellent source for information on [indoor and outdoor lightning safety and lightning risks](#).

What are the odds of being struck by lightning?

The odds of being struck in your lifetime (estimated to be 80 years) are 1 in 3000.

