Thunder Storms

Thunderstorms can be broken down into two types – small ordinary cell thunderstorms and supercell thunderstorms.

Ordinary cell thunderstorms are small summer thunderstorms – also called scattered thunderstorms. They form when warm, wet air rises in an otherwise calm weather area with constant wind speed and direction. This is called low wind shear. These pop-up thunderstorms can often be seen growing by their quickly rising puffy clouds – called cumulonimbus. Ordinary cell thunderstorms don’t last long and are not very large (less than a mile wide). They are still dangerous, because they do produce lightning, but they don’t usually make hail or high winds.

Stronger winds (moderate wind shear) can make bigger thunderstorms. These thunderstorms can last for many hours, growing larger and larger with strong winds, lightening, heavy rains, flooding, and hail. A row of these storms, moving together is called a multicell storm.

Even stronger winds (strong shear) that change directions as the air rises can make a rotating thunderstorm. These extremely powerful sinning thunderstorms are called supercell thunderstorms. Like multicell storms, they can cause strong winds, lightening, heavy rains, flooding, and hail. The spinning nature of supercell storms can also from tornadoes. Some supercells carry a lot of rain and release downbursts with large hail and severe rain bursts that cause flooding. Other supercells have little rain, but can spin off tornadoes and hail. All these storms are very dangerous.

Sometimes when a cold front is moving into an area, a row of thunderstorms form along its leading edge. This is called a squall line. Squall lines are huge storms, stretching hundreds of miles, moving out in front of the cold air.

What Events Form This Kind of Storm?

Thunderstorms are convection storms. That mean they form when warm, wet air rises and meets the cold, dry air above it. The warmer the rising air, the stronger the force it makes. Warm air rises because the Earth’s surface heats unevenly. Winds move from one area to the next and when they come together, they can add to the force of the rising air.

The rising, wet air forms puffy cumulus clouds that rise until they hit the dry air above. When the warm, wet air hits the cool, dry air above, the water in the rising cloud turns to water vapor (it evaporates). This makes the dry air – wet. So the clouds can rise further and further into the newly wet air. From the ground this process looks like a rising dome of white puffy clouds. As the cloud grows, the water vapor turns into water droplets. This gives off heat, which makes the clouds grow even more. This is called the updraft. This process can happen very quickly. A cumulus cloud can rise into a thunderhead in just a few minutes.

As the clouds rise into the colder atmosphere, the water droplets come together and get bigger and heavier. Finally they will begin to fall. As they fall, they pull air with them. This is called a downdraft. Once a thundercloud has both updraft and downdraft going on, it is a mature thunderstorm cell.

Mature thunderstorm cells can rise so high that they reach the stratosphere, where winds will spread and flatten the top. This makes the anvil-shaped of thunderstorm clouds that you may have seen. By this time, the
thunderhead is huge. Ordinary thunderstorm cells can be several miles wide at the base and extend more than 7 miles (12 km) into the sky. Supercell thunderstorms are even bigger, rising 11 miles (18 km) into the atmosphere.

Supercell thunderstorms are a larger, more intense versions of the ordinary thunderstorm cell description above. They often form along a weather front where unstable air will add to the power of the growing storm. A supercell thunderstorm can be one big spiral updraft. Some make heavy rain and some don’t, but all can create hail and even spin off tornadoes.

The thunderstorm downdraft can bring a gust of cool air to the Earth’s surface. This is called a gust front. For people on the ground, the cool air before a thunderstorm can feel great on a hot summer day. But after the storm passes, the air can actually feel hotter and more humid than before the storm.

Weather Conditions That Are Good for This Kind of Storm
Hot, humid air, uneven heating of the Earth’s surface and strong, unstable winds are all conditions that add up to the formation of a thunderstorm.

Storm Dangers
There are many dangerous aspects of severe thunderstorms. Rain can fall so hard (torrential) that flash floods can appear suddenly, with no warning. Flash floods often build upstream and rush down in a wall of water to cause damage and loss of life below. Those affected downstream may experience little or no rain before the flash flood hits them.

Another dangerous product of a thunderstorm is lightning. Lightning is a giant electrical charge that forms in a thunderhead. About one in five lightning bolts form between the cloud and the ground (the rest stay up in the cloud itself). Lightning is hot – about 54,000°F. That’s 5 times as hot as the sun! This burst of heat expands the air in a shock wave that emits a sound wave boom – thunder. Because light travels faster than sound, we see lightning before we hear it. The sound travels about 1,000 feet per second, so it takes roughly 5 seconds for the sound of thunder to travel a mile. This is the time-honored way to know how far away a lightning storm is from where you are standing. A thunder crack that sounds deafeningly loud at the same time as the flash means that lightning has struck very close nearby.

If you are outside in a lightning storm, do not wait to count the seconds. Lightning storms can move very quickly. Seek shelter away from open spaces immediately. Do not stand under a tree. Go inside a house or car or make yourself as low as possible to the ground in a crouch. Do not lie down, as lightning that strikes the ground sends currents of electricity through the ground.

Historic Examples of This Kind of Storm
One of the most extreme examples of a flash flood was out of Estes Park, Colorado in 1976. The Big Thompson River flows east for 25 miles down the narrow Big Thompson Canyon from Estes Park out of the canyon to Loveland. More than 2,000 people live, work, camp and hike in the canyon on any given day in the summer. On July 31, 1976, more than 135 of them would drown.

Passing evening thunderstorms are not unusual for Colorado in the summer, but the thunderstorm on July 31, stayed at the top of the canyon for 4 hours and dropped 12 inches of rain. This was bad enough, for it caused
the Big Thompson River to overflow, wash away the only road down the canyon (U.S. Route 34) and carry off cars, campers and homes, but then something worse happened.

In a narrow turn in the canyon, the flood debris backed up. Water built up behind them like a dam. Then in one moment the debris gave way and a 20-foot wall of water rushed down the rest of the canyon. Some of the people lost in the flood were in this lower end of the canyon where no rain had fallen at all.

It was a sad and unusual flash flood, but there is no telling if it will happen again. No one can change the fact of the narrow river canyon that funnels water in this way. All they need is the right combination of wind, thunderclouds and rain for another dangerous flood to occur. Now, when you drive up the Big Thompson Canyon, there are warning signs along the sides of the road all the way up. They say “If the river is flooding, leave your car, hike up hill as quickly as possible.” Hopefully next time, they will be better prepared.

**Quick Storm Facts**

1) Thunderstorms can be broken down into 2 types – ordinary cell thunderstorms and supercell thunderstorms.
2) When a cold front is moving into an area, a row of thunderstorms can form along its leading edge, called a squall line. Squall lines can stretch out hundreds of miles.
3) Thunderstorms are convection storms. That mean they form when warm, wet air rises and meets the cold, dry air above it.
4) A cumulus cloud can rise into a thunderhead in just a few minutes.
5) As clouds rise into the colder atmosphere, the water droplets come together and get bigger, finally falling and pulling air with them. This is called a downdraft.
6) Once a thundercloud has both updraft and downdraft going on, it is a mature thunderstorm cell.
7) Mature thunderstorm cells can rise so high that they reach the stratosphere, where the anvil-shaped top forms.
8) Ordinary thunderstorm cells can be several miles wide at the base and extend more than 7 miles (12 km) into the sky.
9) Supercell thunderstorms can rise 11 miles (18 km) into the atmosphere.
10) A supercell thunderstorm can be one big spiral updraft. Some make heavy rain and some don’t, but all can create hail and even spin off tornadoes.
11) The thunderstorm downdraft can bring a gust of cool air to the Earth’s surface. This is called a gust front.
12) Rain can fall so hard (torrential), during a severe thunderstorm, that flash floods can appear suddenly, with no warning.
13) Severe thunderstorms can also produce lightning - a giant electrical charge that forms in a thunderhead.
14) Only about 1 in 5 lightning bolts form between the cloud and the ground (most stay up in the cloud itself).
15) Lightning is hot – about 54,000°F. That’s 5 times as hot as the sun!
16) The burst of heat from a lightning strike expands the air in a shock wave that emits a sound wave boom – thunder.
17) Because light travels faster than sound, we see lightning before we hear it.
18) The sound of lightning travels about 1,000 feet per second, so it takes roughly 5 seconds for the sound of thunder to travel a mile.
THE GROWTH OF A THUNDERCLOUD

Stratosphere

23,000 ft (7,000 m)

Mature Phase - Cumulonimbus Cloud
- Cooling air begins to fall as a downdraft.
- The top of the cloud may reach the stratosphere - 7 miles high.
- The top may take on the anvil shape.
- Lightning may form.
- Heavy rain or hail may fall.
- Cool air flows along the ground in front of the storm - the gust front.
- The cloud is now a thunderstorm cell.

Cumulus Congestus Stage
- As the cloud builds, water vapor turns to water droplets.
- This releases heat.
- Heat drives the rising air and the cloud grows very quickly.

6,500 ft (2,000 m)

Cumulus or Growth Stage
- Warm, humid air rises and hits cool dry air layer.
- Water moisture in air condenses into clouds.
- This happens so fast that no rain falls and no lightning forms.

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