Probing Question: Why doesn't it thunderstorm in the winter?

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Some parents tell their children that thunderstorms occur when God goes bowling, but an observant youngster might wonder why The Big Guy only bowls in the summertime.

The short answer? "In the summer there's a lot more moisture in the air," said Yvette Richardson, assistant professor of meteorology at Penn State.

"Any thunderstorm requires moisture, instability and some mechanism for lifting, such as a front," Richardson continued. "It is harder to get all of these to come together in the winter."

Thunderstorms literally begin at the ground level: The sun's rays are absorbed by the Earth, which warms the air above it. As these updrafts of heated air rise, they carry along water vapor, which -- as the warm air ascends and cools -- condenses into liquid, releasing latent heat.

This heat further warms the air, ultimately creating low hanging cumulus clouds -- the clouds that resemble fluffy cotton balls. Explained Richardson, "The warmed air in the cloud is less dense than the surrounding air, making it buoyant."

This buoyant air rises quickly, starting the formation of the thunderstorm. As the cumulus cloud grows higher and bigger, the moist air inside of it accelerates upward until it reaches a level where it is colder than the surrounding air. Heavy droplets of water and ice particles darken the cloud and spread out horizontally to transform the fluffy

cumulus shape into a cumulonimbus -- or "anvil-cloud," so named for its typical shape, flattened at its top with a heavy base.

Most importantly, hailstones and ice particles collide with each other, transferring charge in the process. The hailstones fall to the lower portion of the cloud, giving it a negative charge. The ice crystals rise upward, carrying a positive electric charge to the cloud's upper end. This "charge separation" grows more intense with each collision inside the cloud -- so intense, in fact, that the negative charge at the cloud's lower end actually repels electrons at the Earth's surface deeper into the planet. Consequently, the ground becomes positively charged and the electric field cuts a conductive path between the cloud and the Earth. The result? A high voltage surge of electrons, otherwise known as lightning.

The accompanying boom, called thunder, comes from sound waves created when the air is heated suddenly by the lightning and then cools rapidly.

Typically, after about an hour the storm becomes dominated by downward motion and an ordinary storm ends, said Richardson. Although thunderstorms are a summertime phenomenon, she noted, in some rare situations a winter thundersnow can occur. This happens most often near the Great Lakes and other large bodies of water, when a cold front passes over a warm surface, causing the instability needed for a thunderstorm. If the temperature is cold enough, snow falls instead of rain.

In February 2004, thundersnows occurred in association with the blizzard dubbed White Juan, which struck Halifax, Nova Scotia, just months after Hurricane Juan had destroyed parts of that city. A low-pressure storm formed off the east coast of the United States, intensifying as it moved north. High-gusting winds and record snowfalls blanketed the whole Atlantic Canadian region. The winds, temperatures

and low-pressure areas made for a perfect unstable environment.

During thundersnows, the snow dampens the thunder so it sounds like a muffled timpani drum rather than the loud cracking and booming of a summer thunderstorm. Bolts of lightning slice through the sky, creating an eerie look.

"It's kind of neat. It's not what you expect," explained Richardson who witnessed thundersnow in Wisconsin. "You can see lightning and hear thunder just like a regular thunderstorm."

Source: Research Penn State