

Periodic Graphics

A collaboration between C&EN and
Andy Brunning, author of the popular
graphics blog *Compound Interest*

More
online

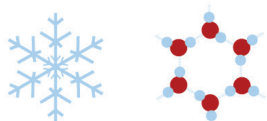
To see more of
Bunning's work, go to
compoundchem.com.
To see all of C&EN's
Periodic Graphics,
visit **cenm.ag/**
periodicgraphics.

THE CHEMISTRY OF SNOW AND ICE

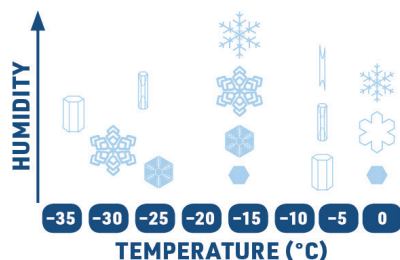
Why do snowflakes have six sides? Why does ice float on water? Is every snowflake unique? Here we take a look at the answers to these questions and more.

SNOWFLAKE FORMATION

Snowflakes form around mineral or organic particles in the atmosphere. Each water molecule can form hydrogen bonds to four other water molecules. This creates a hexagonal structure, which is why snowflakes are six sided.



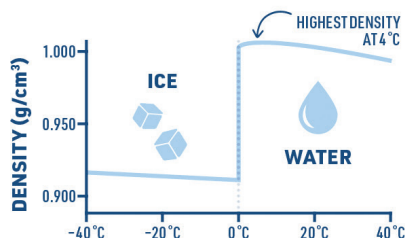
TYPES OF SNOWFLAKES



A snowflake's shape depends on the humidity and temperature when it forms. As of 2013, researchers had identified 121 categories of snowflakes, although individual flakes remain unique at a molecular level.



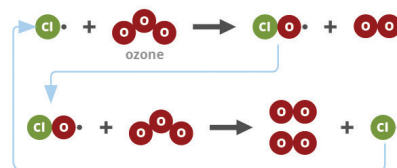
ICE AND DENSITY



Water is unusual in that its solid form, ice, is less dense than its liquid form. The fixed hydrogen bonds in ice hold the water molecules farther apart than in the liquid phase. Researchers recently discovered that the smallest number of water molecules that can form an ice crystal is approximately $90 (\pm 10)$.

ICY CHEMISTRY

During the dark winter in Antarctica, polar stratospheric clouds that contain ice crystals form; the crystals are perfect sites for photochemical reactions. As spring begins and sunlight appears, these reactions release radicals from chlorine trapped in the air. The radicals deplete ozone, which is why the ozone hole appears over Antarctica.



TYPICAL OZONE-DEPLETING REACTION

Ice cores drilled in Antarctica and Greenland give us information about Earth's past, including temperatures and carbon dioxide concentrations. The oldest core, drilled in Antarctica in 2015, contains ice that is over 2 million years old.



OXYGEN ISOTOPES

Ratio of isotopes is used to estimate past temperatures



CARBON DIOXIDE

Concentrations can be linked to past temperatures