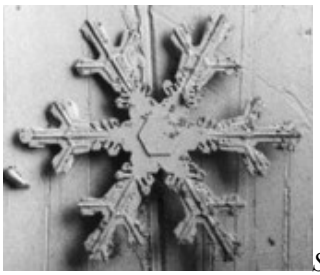
The chemistry of snowflakes!


Snowflake electronmicrograph

Have you ever looked at a snowflake and wondered how it formed or why it looks different from other snow you might have seen?

Snowflakes are a particular form of water ice. Snowflakes form in clouds, which consist of water vapor. When the temperature is 0° C or colder, water changes from its liquid form into ice. Several factors affect snowflake formation. Temperature, air currents, and humidity all influence shape and size. Dirt and dust particles can get mixed up in the water and affect crystal weight and durability. The dirt particles make the snowflake heavier, and can cause cracks and breaks in the crystal and make it easier to melt. Snowflake formation is a dynamic process. A snowflake may encounter many different environmental conditions, sometimes melting it, sometimes causing growth, always changing its structure.

What are common snowflake shapes?

Generally, six-sided hexagonal crystals are shaped in high clouds; needles or flat six-sided crystals are shaped in middle height clouds; and a wide variety of six-sided shapes are formed in low clouds. Colder temperatures produce snowflakes with sharper tips on the sides of the crystals and may lead to branching of the snowflake arms (dendrites). Snowflakes that grow under warmer conditions grow more slowly, resulting in smoother, less intricate shapes.

- 0 to -4° C - Thin hexagonal plates
- -4 to -6° C - Needles
- -6 to -10° C - Hollow columns
- -10 to -12 ° C - Sector plates (hexagons with indentations)
- -12 to -16° C - Dendrites (lacy hexagonal shapes)

Why are snowflakes symmetrical (same on all sides)?


Low temperature SEM of snowflake

First, not all snowflakes are the same on all sides. Uneven temperatures, presence of dirt, and other factors may cause a snowflake to be lop-sided. Yet it is true that many snowflakes are symmetrical and intricate. This is because a snowflake's shape reflects the internal order of the water molecules. Water molecules in the solid state, such as in ice and snow, form weak bonds (called hydrogen bonds) with one another. These ordered arrangements result in the symmetrical, hexagonal shape of the snowflake. During crystallization, the water molecules align themselves to maximize attractive forces and minimize repulsive forces. Consequently, water molecules arrange themselves in predetermined spaces and in a specific arrangement. Water molecules simply arrange themselves to fit the spaces and maintain symmetry.

Source: http://chemistry.about.com/od/moleculescompounds/a/snowflake.htm

Is it true that no two snowflakes are identical?

Yes and no. No two snowflakes are *exactly* identical, down to the precise number of water molecules, spin of electrons, isotope abundance of hydrogen and oxygen, etc. On the other hand, it is possible for two snowflakes to look exactly alike and any given snowflake probably has had a good match at some point in history. Since so many factors affect the structure of a snowflake and since a snowflake's structure is constantly changing in response to environmental conditions, it is improbable that anyone would see two identical snowflakes.

If water and ice are clear, then why does snow look white?

The short answer is that snowflakes have so many light-reflecting surfaces they scatter the light into all of its colors, so snow appears white. The longer answer has to do with the way the human eye perceives color. Even though the light source might not be truly 'white' light (e.g., sunlight, fluorescent, and incandescent all have a particular color), the human brain compensates for a light source. Thus, even though sunlight is yellow and scattered light from snow is yellow, the brain sees snow as white because the whole picture received by the brain has a yellow tint that is automatically subtracted.

Have a great holiday and Happy New Year!

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