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# Snow in Japan: Its Essence of Characteristics

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**J**apan is among the snowiest countries in the world and has many sightseeing locations where visitors can view snowy winter landscapes. Professor Emeritus Furukawa Yoshinori of Hokkaido University shares a range of facts associated with snow, a phenomenon so familiar, yet with so many features that remain unknown.

**Japan is among the snowiest countries in the world. To begin with, why is it that snow falls in the winter?**

While located at a relatively southern latitude, Japan receives one of the highest amounts of snowfall in the world. Its geographical features have a lot to do with that. To the west of the Japanese islands lies the Sea of Japan, and beyond it, the Asian continent extends beyond it. In winter, winds bring masses of extremely cold, dry air to Japan across the Sea of Japan from the northern reaches of the continent. As this air blows across the Sea of Japan, it takes on water vapor that rises from the warmer seawater. As it reaches the Japanese islands, cold northern winds blowing in the tall mountain ranges of Japan cause the air in the upper sky to drop to temperatures around  $-15\text{ }^{\circ}\text{C}$  to  $-20\text{ }^{\circ}\text{C}$ . This cools the water vapor, causing it to cluster

together and fall as snow.

**Why does Japan have so many areas of heavy snowfall? Also, is there anything particularly unique about Japan's snow?**

Geographical features and temperatures influence amounts of snowfall. Snow is made up of water to begin with, so above  $0\text{ }^{\circ}\text{C}$ , it melts. This means that the snow that generated by clouds high in the sky will fall as snow in areas where the temperature near the ground surface is below  $0\text{ }^{\circ}\text{C}$ . Yet in warmer locations like Tokyo, it might melt by the time it reaches the ground and fall as rain. In areas of northern Japan like Hokkaido, Tohoku, and Hokuriku, where temperatures are lower, it falls as snow, and can really pile up.

Also, lately you may hear skiers and snowboarders from overseas referring to the snow that falls in Hokkaido as

“Japow” — Japanese powder snow. Hokkaido is located in the far north of Japan and has many tall mountains. The low temperatures here cause the snow crystals that form from the water vapor to fall as dry flakes of snow as they reach the ground, and this makes for extremely light, fluffy powder snow. If you ski down through freshly fallen snow like this on the slopes in places like Niseko, the snow is so soft and light that it can come up into the air and cover you like down feathers. One could say that the geographical conditions and specific climate of Hokkaido give it some of the most specially textured powder snow in the world.

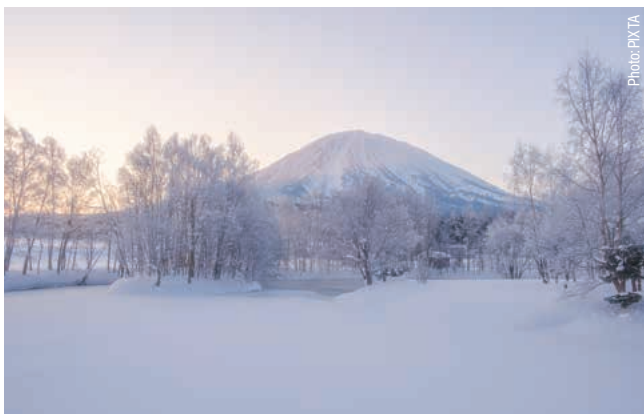
**In northern lands, they see snow crystals in the winter. What causes snowflakes to come in so many different shapes?**

With the way you can see snowflakes featured in old *ukiyo-e* woodblock prints, as patterns in kimono, and so on, it seems that the Japanese have long had special



**Furukawa Yoshinori**  
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He has also held posts including director of Institute of Low Temperature Science, Hokkaido University and oversaw experiments on ice crystal growth in outer space on JAXA's “Kibo” Japanese Experiment Module.



Soft, fluffy snow on the ground in Niseko, Hokkaido



Source: National Diet Library "The Landmarks of Edo in Color Woodblock Prints" (<https://www.ndl.go.jp/landmarks/>)

feelings about snow crystals.

The shapes of snowflakes are determined by the temperature when the crystals form and the amount of water vapor the air contains. So, different conditions in the clouds in the sky where the snow forms will cause different shapes of crystals to develop.

Still, I think the snowflakes we view here near the ground surface often tend to be those pretty ones with six branches called dendrite ("tree-like") crystals. As a scientific knowledge, these form within a narrow temperature range right around  $-15\text{ }^{\circ}\text{C}$ . Dendrite crystals have fine branches with tips spreading out from the center. These ones feature more rapid growth

in their sizes than crystals formed at other temperatures. In this region where we live, surface temperatures rarely fall below  $-15\text{ }^{\circ}\text{C}$ , but this temperature range around  $-15\text{ }^{\circ}\text{C}$  will definitely be found in the clouds high in the sky. As the snowflakes fall to the ground, they will pass through that temperature range, and when dendrite crystals happen, they rapidly develop tree branch-like forms. That is the reason we so often observe snowflakes with these six-pointed dendrite crystals.

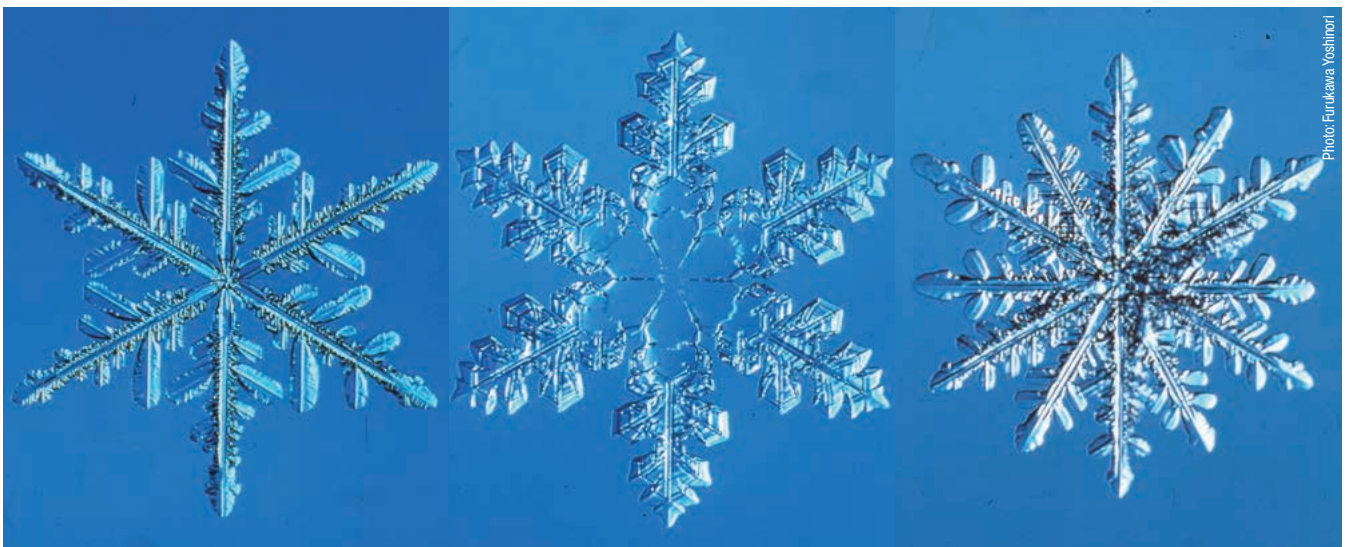


Photo: Furukawa Yoshinori

Snow crystals with hexagonal forms

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So, why then do the crystals have hexagonal (six-sided) forms? Crystals are materials in which the atoms or molecules that make them up are three-dimensionally arranged in highly ordered structures. The specific way they are arranged will be reflected in their external forms. Snow crystals are formed from water molecules, and these molecules are basically arranged in hexagonal structures. Because of this, snowflakes of the size we typically observe with our eyes have generally hexagonal forms, as those structures are reflected in their external forms.

**Can you describe ways snow is being made use of recently, or potential powers snow might have from a scientific point of view?**

Snow has long been used in Japan in a wide range of ways. Obvious examples would include winter sports and events featuring *kamakura* snow domes, as well as using snow to keep winter vegetables cold. Recently, research on snow and ice is viewed as having potential applications in a range of different fields in relation to global environmental issues and more.

My own specialty is in crystal growth: researching how crystals develop. Research on ice and snow has contributed a lot to this field, as well. As a specific example, I have been overseeing experiments with growing ice crystals on the Kibo space station since 2008.

The zero gravity in outer space makes it an ideal place to investigate the processes involved with crystal growth. Crystals are important core industrial materials in modern industries involving LEDs, semiconductors, and so on. Understandings related to crystal growth made clear through research on ice

have been helpful in creating crystals like these used as industrial materials as well. Also, there are forms of crystals called clathrate hydrates<sup>1</sup> that are attracting attention as next-generation energy sources, and they are similar in structure to ice with highly ordered arrangements of water molecules. Understanding how to make them could help provide solutions to energy-related issues.

At the same time, large quantities of snow and ice are found in cold regions like the Arctic and Antarctic, and they are considered relevant to issues related to various forms of climate change around the world, including global warming. More clearly understanding various properties of snow and ice could potentially help us find solutions to such environmental issues.

**What are some places you particularly recommend for viewing snowy landscapes in Japan?**

In Japan, with its firmly rooted tradition of venerating nature, snow has been associated with mysterious powers. For this reason, a variety of Shinto rituals are held throughout Japan during snowy seasons. If you are in Japan at the right time of year, I highly recommend traveling to experience related phenomena and events, such as *Omiwatari*<sup>2</sup> at Lake Suwa in Nagano Prefecture, where a natural phenomenon is interpreted as the crossing of the lake's ice by a local deity, and the traditional measuring of a large icicle at Taroshi Falls in Hanamaki City, Iwate Prefecture, which is done to predict how the harvests will be in the year ahead. Another is the Hirosaki Castle Snow Lantern Festival held in Hirosaki City, Aomori Prefecture, where rows of around 150 snow lanterns and other snow sculptures softly illuminate the snow-covered castle — a wonderfully magical sight for visitors to enjoy.

Hokkaido has a range of events of its own, as well, such as the Sapporo Snow Festival. You get the sense that these really reflect the hopes of local residents to find more cheer in the long, harsh winters of this northern region.

If you have a chance, I recommend you to visit the Museum of Snow and Ice, where I serve as director. It was established in memory of the achievements of Nakaya Ukichiro, who pioneered a number of new research fields and built the foundations of glaciology — the science of snow, ice, and glaciers. The museum



Photo: Furukawa Yoshinori

Experiments with crystals conducted in outer space



Snow lanterns create a magical scene in the Hirosaki Castle Snow Lantern Festival.


Photo: PATA



Photo: Ushirozu Tamotsu

Above: Nakaya Ukichiro Museum of Snow and Ice, Ishikawa Prefecture  
 Below: A permanent installation in the inner garden of the Museum of Snow and Ice, Greenland Glacial Moraine Garden: Fog Garden #47704, a fog sculpture designed by Nakaya Fujiko

has some fascinating exhibits, including a fog sculpture made by Nakaya's second daughter, Nakaya Fujiko,<sup>3</sup> a world-renowned artist whose work is also found in collections such as the Museum of Modern Art (MoMA) in New York City. Visitors will find a range of direct experiences involving snow and ice to enjoy.

Nakaya Ukichiro famously once said, "Snowflakes are letters sent from the heaven." I feel this includes the idea that reading these "letters" and understanding them can help us find solutions to various issues here on the earth, and also that snow is truly a gift from the heaven. If you have a chance to visit Japan in winter, please enjoy the snow here. 

1. A crystallized material in which water molecules form cage structures trapping substances other than water inside. Many of the substances trapped in them are gases such as methane, nitrogen, and carbon dioxide (CO<sub>2</sub>) with hydrophobic properties — meaning that they have low affinity for water, do not dissolve easily in water, and do not mix easily with water. It is attracting attention as a technique for solidifying gases.
2. A phenomenon in which ice on frozen lakes and wetlands forms crested ridges. It is most famously associated with Nagano Prefecture's Lake Suwa, where factors such as differences between daytime and nighttime temperatures cause the lake's ice to crack and form a ridge from 30 cm to 1 m 80 cm in height. The way the ice cracks all the way across the surface of the lake has given it the name *Omiwatari*, interpreting it as a local deity's path from one side to the other.
3. A sculptural work Nakaya Fujiko first exhibited at the Japan World Exposition in Osaka (1970). It is designed to create fog artificially using special nozzles that spray water drops out at high pressure. The work envelops the surrounding area in drifting white fog that visitors can even step into themselves.