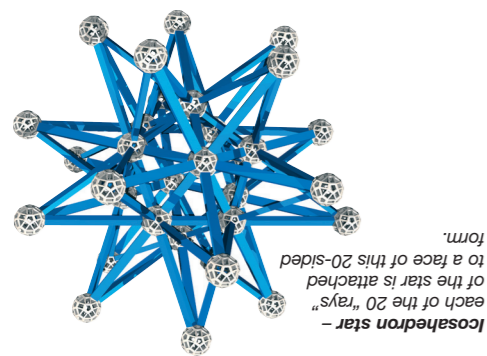


3



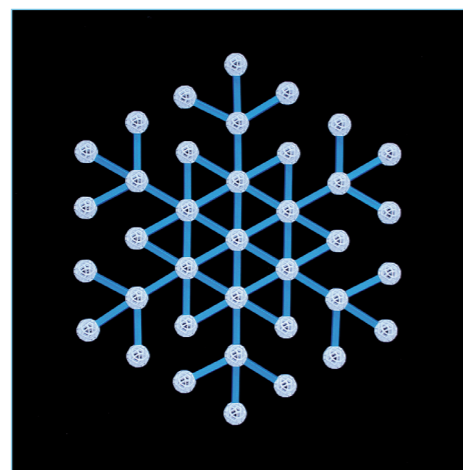
You can create interesting shadows with the 3-dimensional models.



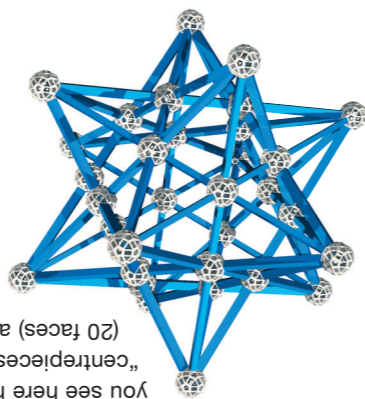
icosahedron star - each of the 20 "rays" of the star is attached to a face of this 20-sided form.

If you would like to build more models, we recommend "Creator 1" with 246 Zometool struts and balls.

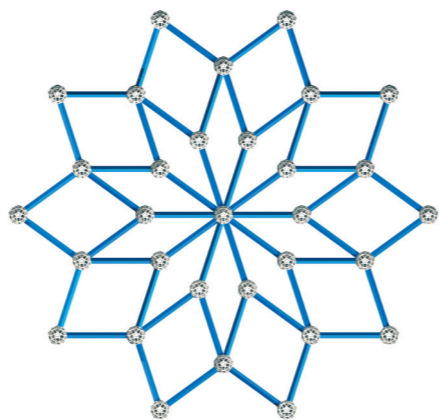
Maybe your ice crystal will develop into a beautiful star? Use two Ice Crystals sets to continue building in 3-D. The stars you see here have two different "centrepieces": an icosahedron (20 faces) and a dodecahedron (12 faces).



Dodecahedron star - in the middle we have a regular Platonic solid, a dodecahedron. We can attach the 12 "rays" of the star onto this centrepiece.



Use the blue struts to create 2-D crystals, making sure to note the position of the Zometool ball, with either a rectangle, a pentagon or a triangle pointing upwards:



We can build 2-dimensional ice crystals and observe the sixfold symmetries which occur.

Building crystals



Apropos the universe: Don't the ray-shaped "arms" of an ice crystal remind you of stars?

The movement of the ice crystals through the air causes them to melt and recrystallise again and again, which leads to the "growth" of increasingly complex hybrid forms. This growth only comes to a halt when the ice crystals have reached a point about 100 m above the ground, with temperatures of around 0° C. The wind whirles the many ice crystals through the air and they collide with each other, causing their "arms" to get tangled and stick together. A snowflake is born!



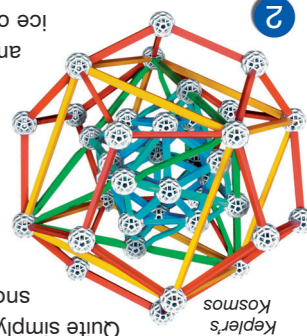
Therefore we can see that snowflakes are not frozen drops of water. Of course, some drops of water do freeze as they fall to earth - these are called ice pellets, or sleet and have no particular symmetry.

Ice crystals

When we observe ice crystals closely, we become aware of the unbelievable beauty of their structures - all falling from the sky. Their development is determined by temperature and humidity: the greater the humidity, the more delicate the "arms" of each crystal.

In picture a, each red ball represents a hydrogen atom and the white struts depict the oxygen atoms. There are always two hydrogen atoms to each oxygen atom, thus giving us the chemical formula H_2O . The symmetry of an ice crystal develops from the sixfold symmetry of an (ice) crystal lattice and this is the reason why the basic structure of an ice crystal is always six-sided.

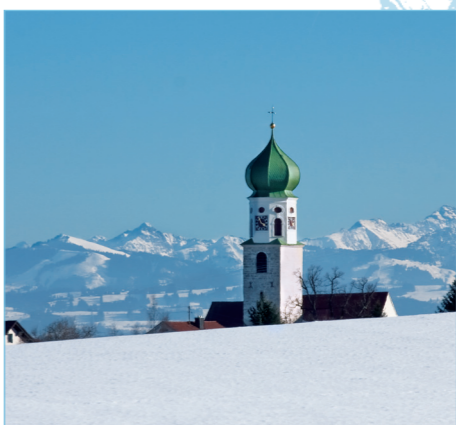
Quite simply, snowflakes and snow crystals are made of ice: a snow crystal comprises only one single ice crystal, whereas a snowflake is made up of an amalgamation of ice crystals.



Almost 500 years ago, Johannes Kepler (1571-1630) wrote a paper on the symmetry of snowflakes, in which he described the fact that a snowflake always looks the same when rotated 60° (sixfold symmetry). The Zometool kit "Kepler's Cosmos", explores Kepler's view of the planets and their orbits.

and humidity influence how each crystal develops. If it is very cold, with a high level of humidity, six-sided hollow columns will form - if the weather is warmer, six-sided stars will appear. Each and every crystal follows its own particular path on its way downwards and the tiniest fluctuations in temperature and humidity will have an effect on its appearance.

Snow

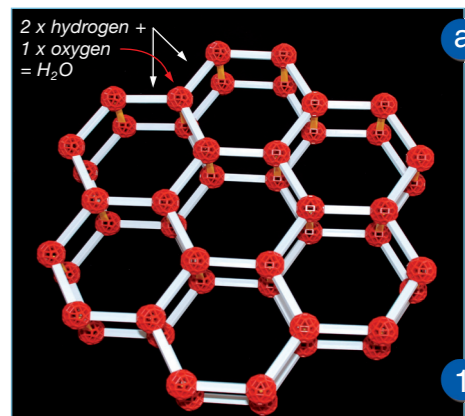


When we see a beautiful winter landscape, with white mountain tops and ski slopes, we know that snow has fallen. But what is snow?

Snow is "solid" rain. It forms when fine drops of very cold water attach themselves to dust particles or to bacteria and then freeze. This situation occurs within clouds, at or below -12° Celcius. The minute ice crystals become heavier and heavier and begin to fall. The surrounding temperature

The Hexagon

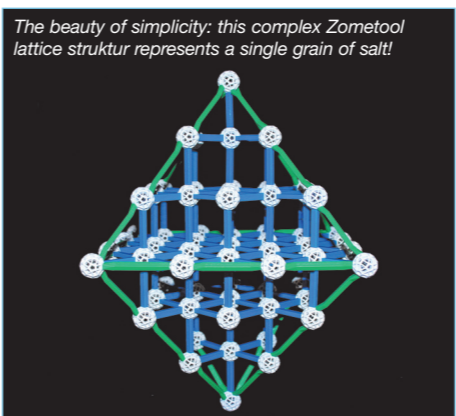
The water molecules in an ice crystal form themselves into a six-sided lattice, as in the Zometool model below:



Crystals

In our day to day life, we are surrounded by crystals. For example, well-known types of crystals are sugar, salt - and, of course, snow - but more about that later.

The atoms or molecules in a crystal are not randomly arranged, in fact, they always follow regular patterns: so-called crystal lattices. These are 3-dimensional patterns of (mathematical) points, whose sub-unit is called a "unit cell". There are about 1.25×10^{18} unit cells in a single grain of salt. We can depict these structures with Zometool:



The beauty of simplicity: this complex Zometool lattice struktur represents a single grain of salt!

START HERE!

Parts: 90	
18	30
30	
12	



Ice Crystals and Stars

Discover • Marvel • Create

Discover art and science at play with Zometool; the intelligence-building toy made for kids and used by Nobel-Prize winners!

- * Guaranteed for life
- * All components are inter compatible.
- * More parts = more fun!

"The mind, once stretched by a new idea, never regains it's original dimensions." - Oliver Wendell Holmes

Snow is made up of a limitless number of tiny frozen works of art - crystals! Each crystal is unique in itself. Ice crystals form different structures, depending on the surrounding temperature. With this Zometool kit, you can discover

- that ice crystals have a six-sided basic structure, **marvel**
- that, due to the composition of water molecules, only angles of 60° und 120° are possible and **create**:
- elegant stars, crystals and hybrid forms of many crystal structures. With Zometool, you'll experience these sparkling works of art in a completely new way.

MADE IN USA from kid-safe materials



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WARNING: CHOKING HAZARD This produkt contains small parts, which could be swallowed. NOT for children under 3 years.

art and science at play ZOMETOOL