



CURIOSITY ZONE™
•EVER WONDER?•

WONDER WIRE™

December 2004

ideas to inspire curious children

Vol. 1 No. 4

EVER WONDER . . . HOW CRYSTALS ARE FORMED?

C-ZONE NEWS

Grand Opening January 8!

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wonderwire](http://www.curiosityzone.com/wonderwire)

EXPLORE. Ever wonder what crystals are – and how they are formed? Scientifically speaking, a crystal is “a body that is formed by the solidification of a chemical element, a compound, or a mixture and has a regularly repeating internal arrangement of its atoms and often external plane faces.” *Merriam-Webster Medical Dictionary* (2002). Basically, crystals are solids whose atomic structure has a very specific order; the structure of other solids is far more random. Sugars, salts, snowflakes and silicon are all examples of crystals. Take some time this month to explore the crystals inside and outside your house!



DISCOVER. Make a crystal ornament. Use this experiment to learn about crystals while making ornaments, sun-catchers, or sparkly doodads to use as gift toppers. Time: 5 minutes to make; let stand overnight. *This experiment involves very hot water, so adult supervision is required!*



Materials: Borax laundry booster (available at the Broadlands Safeway or in the laundry aisle of most grocery stores); water; pipe cleaner; wide-mouth container that can hold hot water; spoon; food coloring (optional). *Tips:* This experiment also works with table salt, Epsom salt, or sugar, but it works best with borax. Any container will work, but if it's a clear container, you'll be able to see your solution better; if it's disposable, you'll decrease cleanup time; and if it's non-metal, you'll be able to microwave it. If you use a non-disposable container and crystals get stuck to it, just heat it up again and the crystals will dissolve.

Directions: Your goal is to make a supersaturated solution using borax and very hot water. “Supersaturated” means you add so much borax to the water that the water molecules can no longer combine with the borax molecules. You'll know your solution is supersaturated when there is white stuff floating on the bottom even after you've stirred and stirred. (The stuff on the bottom is called a “precipitate.”) To make the solution, pour about 1 cup of water into your container and heat in the microwave until the water is close to boiling. Carefully stir in 1 tablespoon of borax. What happens? Add 2 more heaping tablespoons of borax (or a bit more) until the solution is cloudy and white stuff is just beginning to float on the bottom. (The key to this experiment is to stir well, so that the maximum amount of borax is dissolved in the water.) Add food coloring to the solution as desired.

Now form your pipe-cleaner into an ornament, sun-catcher or curlicue form and dangle it into the solution without touching the bottom or sides. (If it touches, it will eventually get stuck.) A great way to do this is to lay a pencil across the top of the container and let your pipe-cleaner hang down from it. Observe what happens as the solution cools off -- after 5 minutes, 30 minutes, an hour. Then allow your ornament to “crystallize” overnight – you'll be amazed in the morning!

Related Experiments. Make the same solution as above, only use cold water instead of hot water. What happens? Why do you think this is? Try putting your hot borax solution in the freezer. Do the crystals form any faster? Try putting an ice cube in the solution. Now what happens? Another great variation on this experiment: make homemade geodes by pouring colored borax solution into washed eggshell halves. (A geode is a rock with a center that is lined with crystals.) Allow to stand for a couple of hours, then pour out the remaining liquid and allow the shells to dry for a day or two.



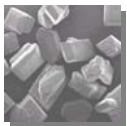
WORD OF THE MONTH: SOLUTION. USE IT IN A SENTENCE AT LEAST ONCE A DAY!

For more experiments using borax, log onto our website at www.curiosityzone.com/experiments.html.

LEARN. A crystal is a solid that has an ordered, definite structure. For example, if you look at salt through a magnifying glass, you will see that the grains are the same shape, with straight edges and flat surfaces. Some mineral crystals, like salt, are created when the mineral precipitates out of a solution and collects into crystal forms. (That's how we formed the crystals in our experiment.)

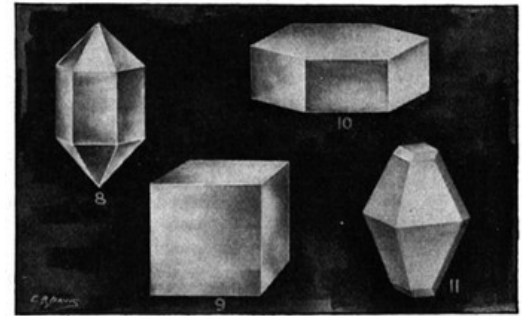


Crystals can take on many shapes: square, hexagonal, oblong, etc. Salt crystals are square, as seen at left under a microscope.



Sugar crystals, like these on the left, also seen under a microscope, are oblong and slanted at both ends.

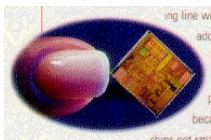
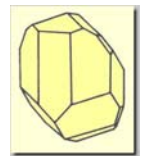
Ice crystals grow directly from condensing water vapor in the air, usually around a particle of dust or some other material in the air. There are two main types of ice crystals: one is flat and symmetrical with six sides, the other is shaped like a column. The type of crystal that forms depends mainly on the temperature and supersaturation level in the cloud where the formation takes place. (Have you ever noticed that snowflakes are tiny when the air is really cold, and huge when the air is warmer?) Because of the complex way snow flakes form, they almost never look exactly the same.



8, ROCK-CRYSTAL; 9, ROCK-SALT; 10, MICA; 11, SULPHUR.

Temperature played a key role in our borax experiment. We heated the water because hot water holds more borax crystals than cold water. This is because heated water molecules move farther apart, making more room for other molecules, like borax. As your solution cooled, the water molecules moved closer together again, squeezing out the borax. The borax crystals then began to build on one another, forming the larger crystals that now decorate your ornament!

For you chemists out there, borax is hydrated sodium borate, or $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$. The basic molecular structure contains chains of interlocking $\text{BO}_2(\text{OH})$ triangles and $\text{BO}_3(\text{OH})$ tetrahedrons bonded to chains of sodium and water octahedrons. Borax crystals are blocky to prismatic, and have a nearly square cross section.



Did you know that the computers we have today would not be possible without crystals? Computers run on a microprocessor, also called a CPU, which is a tiny, enormously powerful, high-speed electronic brain that contains the basic logic, storage and arithmetic functions of a computer. This microprocessor is etched on a single semiconductor chip made from slices or "wafers" of silicon crystals! You might recognize silicon from your summer vacation last year – it is the primary ingredient in beach sand!

Famous Inventors – Two scientists discovered how to make the first computer chip at about the same time – but they didn't know each other! From 1958-59, Jack Kilby and Robert Noyce were both experimenting in America with using semiconductor materials, like silicon, to create a small, integrated circuit that would connect all electronic "wiring" into a single chip. The first chips invented were used in Air Force computers and the Minuteman Missile in 1962. Later, they were used to make the first electronic portable calculators. Now, almost all modern electrical products use microchips – everything from computers to space ships to hearing aids. This invention has literally changed the world! (By the way, Mr. Noyce went on to found a company called Intel – and became a very wealthy man!) Who knew the crystals you find in beach sand could make you rich??

**SECRET SCIENCE AGENTS:
DECEMBER MISSION**

The next time it snows, find five different snowflake shapes and draw them on a piece of paper. Do you see the repeating pattern? How can you cut out a snowflake that looks like the real thing?

COMING IN JANUARY: EVER WONDER HOW QUICKSAND WORKS?

Parents and Teachers: register to receive the Wonder Wire™ by email each month at www.curiosityzone.com/wonderwire.

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