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Bismuth Crystals

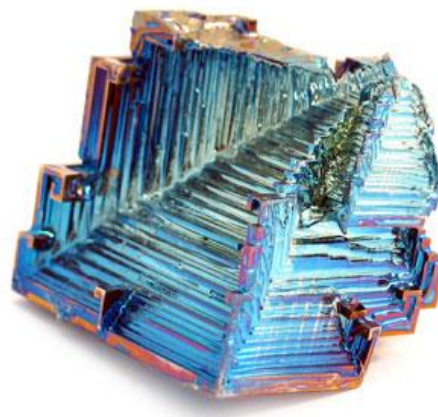
RM-520

What is Bismuth?

Bismuth is a very unusual and rare metal that is solid at room temperature. It is more rare than platinum, ranking number 69 out of the 75 listed rare elements found on Earth's crust.

One very interesting thing about bismuth is that its liquid form is denser than its solid form. So as bismuth crystallizes, its solid form floats above the liquid. This effect is only found in three other cases:

- water
- gallium
- germanium



Bismuth crystals are man-made or man 'grown.' Their growing time is between 5-10 minutes after forming in a supercooled bismuth melt. In its solid form, bismuth is incredibly fragile. However, the crystals form to show perfect cleavage, making it tempting to handle and touch them. The reason the crystal structure is so fragile is because the rapid growth causes hollow forms, called 'hopper crystals.'

The iridescent coloring is due to a thin layer of bismuth oxide that forms on the surface of the crystal as it cools. This is actually interference coloring, similar to the coloring you see on soap bubbles and on oil slicks, and is based on how thick the oxide grows. The brightness and color intensity can vary from sample to sample, depending on the quality and purity of the bismuth used.

Activity Ideas:

- Gather at least five minerals with clear crystalline structures—i.e., calcite, pyrite, salt, etc. Have students study and sketch each mineral.
- Grow your own crystals! See instructions on the next page.

Grow Your Own Crystals

Educational Innovations' Recipe for Growing Crystals

1. Combine:
 - 6 parts **Mrs. Stewart's Liquid Bluing** (item SM-10A on our website)
 - 6 parts water
 - 8 parts salt
 - 1 part ammonia
2. Mix well. There should be undissolved salt remaining on the bottom of the solution.
3. Pour the solution into a shallow bowl or dish. Spoon excess salt into the bowl as well.
4. Place your choice of porous material in solution and set it aside. Good materials include blotter paper, charcoal briquettes, or pieces of sponge.
5. Within a few hours, small crystals should begin to form. These crystals may be colored by placing a drop of food coloring directly on the porous substrate.
6. Within a few days, billowing crystals should form.

Mrs. Stewart's Recipe for the Salt Crystal Garden

Day 1: In a shallow glass or plastic bowl, place some pieces of coal, charcoal, coke, porous brick, tile, cement, or sponge. (A cut-up kitchen sponge works very well.) Over these pieces, pour two tablespoons of water, two tablespoons of salt, two tablespoons of Mrs. Stewart's Liquid Bluing (MSLB), and two tablespoons of household ammonia.

Day 2: The next morning, add two tablespoons of salt.

Day 3: On the third morning, pour into the bottom of the bowl (not directly on the base materials, which should be showing growth by now) two tablespoons *each* of salt, water, MSLB, and ammonia. At this time, you may add a few drops of food coloring or ink to each piece for additional color.

Tips:

A free circulation of air is necessary. The drier the air, the better. To keep your Salt Crystal Garden growing, simply add more MSLB, salt, water, and ammonia from time to time. The coral-like formations are formed by the recrystallization of the salt upon evaporation of the liquid. The base material (sponge) draws the salt-saturated liquid up by capillary action and provides more surface area over which the liquid can evaporate. The microscopic bluing particle acts as a nucleus around which the salt can recrystallize. The rate of growth depends largely on the humidity of the surrounding environment, taking from hours to days to begin.



NGSS Correlations

Our Bismuth Crystals and these lesson ideas will support your students' understanding of these Next Generation Science Standards (NGSS):

Elementary

2-PS1-1

Students can use Bismuth Crystals to plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

5-PS1-3

Students can use Bismuth Crystals to make observations and measurements to identify materials based on their properties.

Middle School

MS-PS1-1

Using Bismuth Crystals, students can develop models to describe the atomic composition of simple molecules and their structures or properties.

MS-PS1-3

Students can investigate Bismuth Crystals in an investigation to describe that synthetic materials come from natural resources and can have an impact on society.

High School

HS-PS1-2

Using Bismuth Crystals, students can construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the Periodic Table, and knowledge of the patterns of chemical properties.

Suggested Science Idea(s)

2-PS1-1 • 5-PS1-3 • MS-PS1-1 • MS-PS1-3

These beautiful, man-made Bismuth Crystals are cubic and iridescent. Students can use them to plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

DCI-HS/PS1.A: Structure and Properties of Matter.

The Periodic Table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

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Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, “*Teachers Serving Teachers*” isn’t just a slogan—it’s our promise to you!

Please visit our website
for more lesson ideas:

[TeacherSource.com/lessons](http://www.TeacherSource.com/lessons)

Check our blog for classroom-tested
teaching plans on dozens of topics:

<http://blog.TeacherSource.com>

To extend your lesson, consider these Educational Innovations products:

Rock Candy Crystal Growing Experiment Kit (RM-100)

While quartz crystals take tens of thousands of years to grow in nature, you can grow crystals of sugar in only a few days! In the process, students learn about saturated and supersaturated solutions, seed crystals, and the rate of crystalline growth. Included are all the materials to grow sugar crystals, along with a study guide. Includes enough pure sucrose and seeded sticks to make five individual-sized candies.



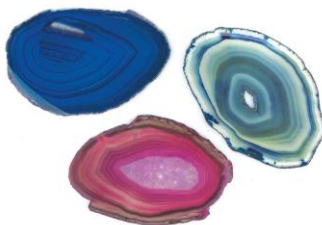
Crystal Growing Dolomite (RM-350)



Sometimes called Popcorn Rocks, these gray Dolomite samples grow beautiful white Aragonite crystals when placed in a small bowl of white vinegar. This experiment is a must for any classroom studying rocks, minerals, crystals or geology. Each set comes with samples crystal growing dolomite along with complete instructions. You simply supply some small plastic bowls and the white vinegar (available at any supermarket). The crystal growing takes approximately one week depending on the temperature and humidity levels in your classroom.

Mica (RM-910)

Everyone loves to pull apart the layers from a specimen of mica. These mica specimens from New England will provide samples for at least 30 students. Sold in one-pound packages.



Geodes Slices (RM-510)

These 1/8 inch thick agate slices are beautifully colored and highly polished. You can clearly see each layer of the different minerals. Approximately 2-3 inches across. Slices are stained to easily show mineral layers. Pack of six. Colors may vary.