

STEAM Subject: Geology and Chemistry

Lab: Growing Crystals

Grades: 5-8

Learning objective: Students will develop a model of a crystal and describe what are they made of.

ENGAGE:

Ask students the following questions:

- How do crystals form in nature?
- What are crystals made of?

EXPLORE:

Have you ever wondered what crystals are made of and how they form? With this do-it-yourself crystal science experiment, you will create conditions for crystal growth all on your own! Crystals are made up of atoms of elements that form in three-dimensional patterns. Crystals are commonly made from silica (Si) or calcium (Ca). Our experiment will use borax that, much like salt, is naturally formed in evaporated lake conditions. Store-bought borax is white, powdered, and is made up of soft crystals that dissolve in water.

Materials needed per student:

- Medium to large cup or jar*
- Pipe cleaners
- Up to 2 cups of hot water**
- ½ cup Borax
- Food coloring (optional)
- Stirring stick
- String
- Popsicle stick or pencil



Activity: Students will grow crystals at home using pipe cleaners.

using borax and

Procedure:

1. Make a 3-D shape out of pipe cleaners (cube, heart, diamond, etc.)
2. Boil water and pour it into a medium to large container**.
3. Pour ½ cup of borax into the container.
4. Stir until the borax is dissolved.
5. Add several drops of food coloring (if using) and stir.
6. Tie a string to the pipe cleaner shape and attach it to a popsicle stick/pencil.
7. Submerge the pipe cleaner shape so it is below the waterline. The crystal should not touch the bottom of the container.
8. Let the container sit in a dark place (cabinet or closet) for 1-3 days, as the mixture cools, the borax will begin to crystallize onto the pipe cleaner***.

Notes:

*Crystals will also form on the bottom of the cup/jar. If you plan to clean the cup/jar after use, microwave the solution to re-dissolve crystals, then wash with warm soapy water.

**Use extreme caution when pouring hot water into the container. Students should wear protective pot holders at all times when handling hot water.

***Do not eat borax crystals.

EXPLAIN:

- In this experiment, we created a saturated solution. As the solution slowly cooled, the crystals formed on the pipe cleaner shape.
- Crystals form in areas where liquids cool slowly and then harden. Crystals usually form from slowly cooled molten rock and in moist cave environments.
- Did you know that the common household usually contains an abundance of crystals? These crystals are table salt or sodium chloride (NaCl)!
- Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).
- The scientific study of crystals and crystal formation is known as crystallography.

Review STEM Vocabulary

- **Atom:** The basic unit of an element.
- **Crystal:** A solid material composed of atoms arranged in a uniform and repeating pattern. The color of the crystal depends on the minerals it is made from.
- **Element:** A pure substance that is made from a single type of atom (see the Periodic Table of the Elements)
- **Molten:** Liquid rock, or magma that has melted from high heat. Magma is found deep underground and is associated with volcanoes or lava plumes.
- **Saturated Solution:** A solution that reaches the point where it cannot dissolve any more solute (ex. borax) into it.

ELABORATE:

- Try this experiment with several cups/jars and different shaped pipe cleaners.
 - Which shapes worked best?
- Have students familiarize themselves with the periodic table of elements. Image: https://upload.wikimedia.org/wikipedia/commons/thumb/4/4d/Periodic_table_large.svg/2000px-Periodic_table_large.svg.png
- Using the periodic table, find the elements found in borax crystals.
 - $(\text{Na}_2 [\text{B}_4 \text{O}_5 (\text{OH})_4] \cdot 8\text{H}_2 \text{O})$ - Sodium, Boron, Oxygen, and Hydrogen.
- Read this article in National Geographic “These human-size crystals formed in especially strange ways” and find out more about crystals < <https://www.nationalgeographic.com/science/2019/10/giant-crystals-formed-in-strange-ways-climate-chemistry-pulpi-geode/>>.

EVALUATE:

- What is the chemical composition of a crystal?
- In our experiment, what happened to our “crystal” after 1-3 days? Why?
- Describe how crystals are formed in the environment.
- Give two examples of your favorite crystals.

Periodic Table of the Elements

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| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 | Group 8 | Group 9 | Group 10 | Group 11 | Group 12 | Group 13 | Group 14 | Group 15 | Group 16 | Group 17 | Group 18 | | |
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standard atomic weight in most stable mass number
1st ionization energy in kJ/mol

55.845 26
6.94 58.93 238

chemical symbol
Fe

name
Iron

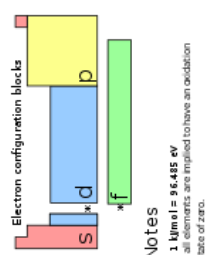
electron configuration
[Ar] 3d⁶ 4s²

oxidation states most common are bold
+2 +3

atomic number
26

electronegativity
1.83

radioactive elements have masses in parentheses



- alkali metals
- alkaline earth metals
- lanthanides
- actinides
- transition metals
- unknown properties
- post-transition metals
- metalloids
- reactive nonmetals
- noble gases

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