



Crystal Clear Science

Growing Amazing Crystals & Exploring the Hidden World of Crystallography

An Exciting STEM Journey for Secondary School Students

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Introduction: Discover the Secret World of Crystals!

Hey future scientists! Have you ever picked up a sparkling rock, or looked closely at table salt and wondered what makes it so perfectly shaped? Well, you've been looking at **crystals**!

Crystals are truly fascinating natural marvels. They are solids whose tiny building blocks – called **atoms**, **ions**, or **molecules** – are arranged in a super-organized, repeating pattern that extends in all directions, like a perfect 3D LEGO structure. This repeating pattern is called a **Unit Cell**.

What is Crystallography?

Crystallography is the cool branch of science dedicated to studying crystal structures and properties. By understanding crystals, we unlock secrets of the world around us and even build new technologies!

Why Are Crystals So Important?

Geology

Crystals are the very heart of rocks! Geoscientists use special Zircon crystals to tell the age of rocks.

Medicine

Most medicines are made of molecular crystals! The crystal structure affects how quickly medicine dissolves and works in your body.

Materials Science

Semiconductors in computers are made from crystalline silicon. Crystals help design stronger alloys and better solar panels.

Drug Discovery

By analyzing crystal structures using X-ray diffraction, scientists can design better medicines.

Molecular Biology

Researchers grow crystals of proteins and viruses to map their 3D structures for disease treatment.

Environmental Science

Zeolites (porous crystals) are used in pollution control and water purification.

Food Science

The texture of chocolate depends on crystal formation! The "snap" and gloss come from cocoa butter crystals.

LCD Displays

Liquid crystals make modern flat-screen technology possible by controlling light in displays.

The Golden Rules for Happy Crystals

Growing a big, beautiful, single crystal is a bit like tending a garden – it takes **patience** and **perseverance**. The process of forming solid crystals is called **crystallization**.

What is Supersaturation?

Crystallization happens when the concentration of a substance (solute) in a liquid (solvent) is higher than it normally can hold. This special state is called supersaturation. The trick is to achieve and maintain this while your crystal slowly forms.

1 Purity is Key

Your starting material should be as pure as possible, ideally 80-90% pure. Always use clear, filtered solutions to avoid unwanted "dust parties"!

2 Location, Location, Location

Choose a quiet spot, away from drafts, dust, vibrations, direct sunlight, and big temperature changes. Consistency is critical!

3 Cleanliness is Next to Crystalliness

Thoroughly clean all your tools and containers. Even tiny bits of dust can act as nucleation sites where many tiny crystals compete with your main crystal.

4 Hands Off!

Your crystals are delicate! Never touch them with bare fingers as this can leave oils or cause etching on their surfaces. Use tweezers or tissues.

5 Patience is a Virtue

Growing large, good quality crystals takes time – sometimes weeks or even months. Slow and steady wins the crystal race!

6 Label Everything!

Keep a logbook and mark your containers with the date and solution level. You'll want to remember what worked!

Crystal Growing Techniques

1. Growing a Seed Crystal (The Baby Crystal)

You can't grow a giant crystal without a perfect little "seed" crystal to start with!

1. Warm about 50 mL of water and dissolve enough of your substance to make a saturated solution.
2. Pour it into a shallow dish (like a Petri dish) and let it cool undisturbed overnight.
3. After 12 hours, you should see a layer of tiny crystals at the bottom.
4. Carefully pick out a nice, solid, transparent single crystal – this is your seed!

Pro Tip: If no crystals form, add a tiny bit of the original powder and let it sit.

2. Preparing the Supersaturated Solution

Method 1: Slow Cooling (The Classic)

1. Start with clean glassware.
2. Dissolve roughly twice the amount that would normally dissolve at room temperature.
3. Stir while gently warming (don't boil!) until all is dissolved and clear.
4. Remove from heat and allow to cool slowly (use a Styrofoam box to slow cooling).

Method 2: Slow Evaporation (The Patient Way)

1. Prepare a saturated solution at room temperature.
2. Let the solvent (water) slowly evaporate over time.
3. Cover loosely to allow evaporation but keep out dust.

3. Growing Your Large Crystal (The Main Event!)

1. Attach your seed crystal to a thin thread or fishing line.
2. Tie the other end to a pencil or popsicle stick.
3. Suspend your seed crystal in the middle of the solution – don't let it touch the sides or bottom!
4. Cover loosely and observe daily. Mark liquid level and date in your logbook.
5. When growth slows, "feed" by preparing fresh supersaturated solution.

Troubleshooting: What Can Go Wrong?

"My crystal disappeared!"

The solution became under-saturated and your crystal dissolved back. This often happens if room temperature increases.

Fix: Make the solution supersaturated again. Move to a more temperature-stable spot.

"My crystal looks cloudy/has bumps!"

Tiny bits of solution dried on the surface, or extra growth formed bumps.

Fix: Rinse with clean water when removing, pat dry immediately. Remove extra "buds".

"Lots of tiny crystals, not one big one!"

Too many nucleation sites (dust!) or too rapid cooling/evaporation.

Fix: Ensure extreme cleanliness. Slow down the cooling or evaporation process.

Experiment 1: Copper Sulfate Crystals

Formula: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

Safety First! Copper sulfate is harmful if swallowed and can irritate skin. Wash hands thoroughly after handling.

Materials Needed:

- Copper sulfate powder
- Hot water (adult supervision)
- Clean jars, wooden spatula
- Saucer or shallow dish
- Thin string or dental floss
- Popsicle stick, tweezers, tissues

Steps:

1. **Make Saturated Solution:** Stir copper sulfate into very hot water until no more dissolves.
2. **Grow a Seed:** Pour solution into a saucer. Leave overnight for crystals to form. Select the best one.
3. **Grow Large Crystal:** Suspend seed in remaining solution. Don't let it touch sides or bottom!
4. **Maintain:** Check daily, remove competing crystals. Store finished crystal in airtight container.

Experiment 2: Rock Candy (Sucrose Crystals)

Formula: $C_{12}H_{22}O_{11}$

Safe to eat! But adult supervision needed for hot water.

Materials:

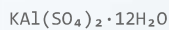
- Refined sugar (about 32g per 160mL water)
- Hot water, tall jar, wooden stir stick

Steps:

1. Dissolve sugar in hot water until clear.
2. Dip wooden stick in water, then in sugar crystals to "seed" it.
3. Suspend in solution. Wait 1 week to 1 month for growth!

Other Crystals to Try!

Alum



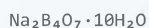
Forms transparent octahedral crystals. Very popular for beginners!

Table Salt



Forms cubic crystals. Use slow evaporation method.

Borax



Forms beautiful crystals quickly. Great for beginners!

Epsom Salt



Grows needle-like crystals. Very soluble in water.

Quiz: Test Your Knowledge!

1. What is a crystal made of, and what is the repeating pattern called?

Answer: Atoms, ions, or molecules arranged in a Unit Cell.

2. Why is supersaturation critical for crystal growth?

Answer: It provides excess material for the crystal to grow.

3. Why shouldn't you touch crystals with bare fingers?

Answer: Oils can cause etching/fogging and crystals may break.

