Growing color-changing crystals

EXPERIMENT 1

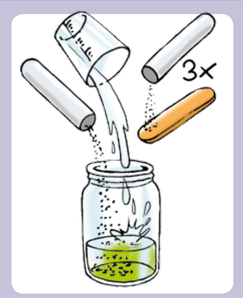
YOU WILL NEED:

› Safety glasses, potassium alum, lid remover, potassium hexacyanoferrate(III), measuring cup, wooden spatula, *water, old cooking pot, trivet, pot holder, clean, empty jelly jar (without lid), paper towels*

››› First, put on your safety glasses and get a trivet or hot pad ready for your work area.

››› Use the lid remover to open the chemical vial with the potassium alum (potassium aluminium sulfate), and empty the entire contents into the jelly jar.

››› Using the wooden spatula, add 3 to 4 scoops of the potassium hexacyanoferrate(III). You can use all of it except for a little bit, which you will need later for the chemical analysis.



››› Use the measuring cup to measure 50 ml of water (1 x 20 ml and 1 x 30 ml) and add the water to the two chemicals in the jar. Stir everything well with the spatula.

Caution! Have an adult help you! Be very careful not to burn yourself on the hot pot, and don't forget to turn off the stove!

››› Fill the pot about 2 cm deep with water. Bring the water to a boil on the stove. Then turn off the stove and set the pot carefully on the trivet or hot pad.

››› Now place the jelly jar holding your chemical mixture in the pot and stir it with the wooden spatula. The hot water will warm the contents of the jar, and the two salts will gradually dissolve. If you can still see some alum granules, remove the jar from the pot with a pot holder. Bring the water in the pot to a boil again and repeat the process.

Tip! You will want to be absolutely sure that the salts are completely dissolved — that way, you will have the best chance of growing nice crystals.

››› Label the jar and set it in a safe place. Now you just have to wait! But after a few hours, you will find transparent angular shapes on the bottom of the jar, which will keep forming with time. After about two days, your crystals will be "all grown up."

››› Use the wooden spatula to carefully remove the crystals and place them on a paper towel to dry. Depending on how warm or cool it was when the crystals were growing, they will have turned yellow or yellowish green. Pour the leftover solution down the drain with lots of water, and rinse thoroughly.

WHAT'S HAPPENING? The granules of salt crystal will dissolve in warm water and eventually turn invisible, since you can't see their smallest components — called ions — with the naked eye. When the water cools, the ions gather into a very specific shape, which eventually turns visible again — a crystal has taken form!

"Magical" transformation

EXPERIMENT 2

YOU WILL NEED:

› 2 display cases, *scissors, tape, small screwdriver*

››› Divide the crystals between the two display cases. Cut the yellow and blue labels out of this instruction manual and clamp them in place between the lid and the bottom of the two cases. If they don't stay in place, secure them with a little tape.

Caution! Make sure that nobody, particularly any young children, can get into the crystal display cases!

››› Ideally, place one of the display cases in a dark closet and the other one on a bright window ledge. Compare the colors of the crystals every three days or so.

Tip! You can lock the case by squeezing it tightly shut. To open it, insert a small screwdriver into the slot on the side and turn it carefully.

Which crystals change the most quickly? Do the crystals kept in the dark change color too?

	Color Bright crystal	Color Dark crystal
Day 1		
Day 3		
Day 6		
Day 9		
Day 12		

WHAT'S HAPPENING

There's a chemical reaction that takes place in the crystals, as you will learn in greater detail in Experiment 3. Because the reaction happens more quickly under the influence of light, the crystals change their color faster in a bright location than in a dark location.

Bright Crystals | **Dark Crystals**

Chemical analysis

EXPERIMENT 3

YOU WILL NEED:

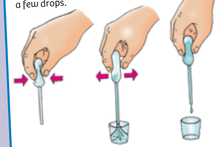
› Safety glasses, remaining potassium hexacyanoferrate(III), 2 measuring cups, pipette, *household white vinegar, iron nail, water*

››› Pour some household white vinegar into the measuring cup. Place the nail in it and set the cup in a safe place for a few days. The vinegar will gradually dissolve some of the iron, which will show itself as a brown coloration.

››› Add the rest of the potassium hexacyanoferrate(III) to the other measuring cup and dissolve it in a little water.

››› With the pipette, carefully drip a little potassium hexacyanoferrate(III) solution into the measuring cup containing the vinegar.

Tip! This is the right way to use the pipette: Squeeze the upper part of the pipette between thumb and forefinger, and dip the tip of the pipette into the liquid. As soon as you release pressure on the bulb, the liquid will rise up the pipette tube. By applying careful pressure to the bulb again, you can either empty the pipette contents completely or squeeze out just a few drops.



Before filling the pipette with the next chemical, you will have to clean it carefully. To do that, draw some clean water into the pipette, shake, and squeeze it empty. Repeat this procedure several times.

WHAT'S HAPPENING

Right away, you will get a greenish to blue color. You just performed what's called a chemical analysis. You used one substance (the potassium hexacyanoferrate) to test for the presence of another substance (the dissolved iron from the nail). In other words, the two substances reacted with each other chemically and formed a vivid blue dye that serves as a clear indication that the reaction took place. This dye is known as Prussian blue.

This same reaction took place in your crystals. Potassium hexacyanoferrate(III) contains iron as well, although it is so "hidden" inside the crystal that at first no Prussian blue formed. Only with the help of the alum, which gradually decomposes the red salt, does the color appear in the crystals, and the yellow slowly turns to green and then blue.

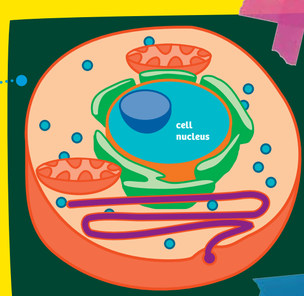
Check it out

CULPRIT NABBED... THANKS TO CHEMICAL ANALYSIS!

When the police get to the scene of a crime, they search for clues. These days, though, it isn't just fingerprints that might lead them to the perpetrator. Chemical analysis of DNA helps them in their investigation too.

DNA is a complex chemical compound that is found in every cell of your body. It can act as a sort of "biological fingerprint" — because no two people have the same DNA. This compound contains all the biological information of an individual, such as height, sex, eye color, and hair color.

But let's get back to the crime scene. The police will look for cells from the perpetrator's body, which may be contained in the roots of a hair or small flakes of skin, for example. The DNA in these cells is analyzed and compared with DNA from the cells of any suspects. This technique has already been used to solve a lot of crimes!



Cells form the smallest building blocks of humans, animals, and plants. Our skin, our bones, and our muscles, for example, are made up of countless cells. They are so tiny that they are only visible under the microscope. The DNA is contained inside the cell nucleus, which is contained inside the cell.

CYANOTYPE

The chemical reaction from Experiment 3 also forms the basis for an unusual photographic process known as cyanotype. In this process, thick paper is painted with a solution of red potassium hexacyanoferrate(III) and a special iron-containing salt that gradually decomposes in the light and then reacts with the red potassium hexacyanoferrate(III).

If this kind of paper is covered with a stencil, for example, and allowed to sit in the sunlight for a little while, only the parts exposed to the light will turn blue.

This process was used by the British botanist and illustrator Anna Atkins, who had a book displaying pictures of various plants that were created by the cyanotype technique.

WHAT IS PRUSSIAN BLUE USED FOR?

This blue dye has been popular for centuries, because it has an intense color and doesn't fade. If you have a set of paints, you might also find this color under the name "Berlin blue." Even today, it is processed into paint dyes and used for the blue color in ink cartridges.

Prussian blue, or Berlin blue, was discovered in 1706 by a paint manufacturer in Berlin, in a region of Germany that used to be known as Prussia — hence the name!