

## Safety notes

## CAUTION!

- »» Only for use by children over 10 years of age. Not suitable for children under 10.
- »» To be used solely under the strict supervision of adults who have studied the precautions given in the experimental set.
- »» Contains some chemicals which are classified as safety hazards.
- »» Read the instructions before use, follow them, and keep them for reference.
- »» Do not allow chemicals to come into contact with any part of the body, particularly the mouth and eyes.
- »» Keep young children and pets away from experiments.
- »» Store the chemistry kit out of reach of young children.
- »» Eye protection for supervising adults is not included.

Save the packaging and instructions, as they contain important information.

## First aid in case of accidents

**Important:** In case of injury, seek immediate medical help.

When conducting experiments with chemicals:

- »» In case of contact with the eye: Wash out eye with plenty of water, holding eye open if necessary. Rinse from the nose outward. Seek immediate medical advice.
- »» In case of swallowing: Wash out mouth with water, and drink some fresh water. Do not induce vomiting. Seek immediate medical advice.
- »» In case of inhalation: Move person into fresh air, for example, into another room with open windows or outside.
- »» In case of contact with the skin or in case of burns: Wash affected area with plenty of water for five minutes. Cover burns with a bandage. Never apply oil, powder, or flour to the wound. Do not lance blisters. For larger burns, seek immediate medical help.
- »» In case of cuts: Do not touch or rinse with water. Do not apply any ointments, powders, or the like. Dress the wound with a germ-free, dry first-aid bandage. Foreign objects such as glass splinters should only be removed from the wound by a doctor. Seek the advice of a doctor if you feel a sharp or throbbing pain.

When in doubt, seek medical advice without delay. For accidents involving chemicals, always take the chemical with its container to the doctor or tell the doctor the name of the chemical.

## Advice for supervising adults

## Dear Parents,

With this crystal-growing chemistry experiment kit, you and your child will be able to produce some extraordinary crystals. You will be able to display and view your "magical" crystals in the lockable display cases.

It is natural to have questions about the safety of a kit that contains chemicals. The experimental equipment in this kit meets U.S. and European Safety Standards, which specify safety requirements for chemistry experiment kits. These standards impose obligations on the manufacturer, such as forbidding the use of any particularly dangerous substances. The standards also stipulate that adults should assist their children with advice and assistance in their new hobby.

**So please read and follow these instructions as well as the safety advice, the first aid information, the safety rules, and the information about handling the crystal salts and disposing of them in an environmentally responsible manner. Always keep the safety information on hand for reference.**

Emphasize to your child the importance of following all of this information, and the importance of performing only those experiments that are described in this manual. **Only carry out those experiments which are listed in the instructions. The incorrect use of chemicals can cause injury and damage health.** Inform your child, but do not frighten him or her — there's no need for that.

**This experiment kit is for use only by children over 10 years. Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which experiments are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.**

You should carefully review the experiments and select only those that you consider appropriate for your child/children.

**Before starting the experiments, discuss all the safety information with your child or children!**

The supervising adult should discuss the warnings and safety information with the child or children before commencing the experiments. Particular attention should be paid to the safe handling of acids, alkalies, and flammable liquids.

Hot water is used to dissolve the crystal salts. You should devote special care to handling it safely and assist your child when help is needed. Please ensure adequate fire safety when heating water on the kitchen stove!

When performing the experiments, please be sure not to let the alum and red prussiate crystal salts come into contact with your skin, eyes, or mouth. It is also important to prevent the crystal salts, their solutions, and especially the completed crystals from getting into the hands of young children. They might mistake the crystals for candy and put them into their mouths.

**Please be careful not to let the chemicals get into the hands of young children.**

**The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit and ventilated and close to a water supply. A solid table with a heat resistant top should be provided.**

The work area should not be in the kitchen, as chemicals should be kept strictly separate from foods and kitchen equipment. A cool basement room would be ideal. Do not use any containers or tools in the kitchen after you have used them for growing crystals.

Always get any required equipment and chemicals ready before beginning an experiment. The safety glasses are particularly important!

**We wish you and your child a lot of fun with your color-changing crystals!**

## Poison Control Centers

The following resources are available day and night to provide information on measures that should be taken in all cases of poisoning:

## Poison Control Centers (United States)

In case of emergency, your nearest poison control center can be reached everywhere in the United States by dialing the number:

**1-800-222-1222**

## Local Hospital or Poison Centre (Europe)

Record the telephone number of your local hospital or poison centre here:

Write the number down now so you do not have to search for it in an emergency.

When in doubt, seek medical advice without delay. Bring the chemical and its container with you. In case of injury, always seek medical advice.

## Basic rules for safe experimentation (safety rules)

Before starting the experiments, please read the following information carefully. These rules will make it easy to avoid any possible risks!

- »» 1. Read these instructions before use, follow them, and keep them for reference. Pay special attention to the quantity specifications and the sequence of the individual steps. Only perform experiments that are described in this instruction manual.
- »» 2. Keep young children, pets, and those not wearing eye protection away from the experimental area.
- »» 3. Always wear eye protection. If you wear corrective eyeglasses, you will need protective goggles for those who wear corrective eyeglasses. When working, wear appropriate protective clothing, like an old smock and smooth gloves.
- »» 4. Store experimental sets, finished crystal(s), and other substances out of reach of young children, such as in a lockable cabinet.
- »» 5. Clean all equipment after use.
- »» 6. Make sure that all containers are fully closed and properly stored after use. Carefully close the chemical vials after use and return them to their places in the experiment kit.
- »» 7. Be sure to properly dispose of all empty containers (chemical vials).

- »» 8. Wash your hands after carrying out the experiments. Chemicals that accidentally get onto your skin must be rinsed off immediately under running water.

- »» 9. Do not use any equipment which has not been supplied with the set, or that you are not specifically asked to obtain for a particular experiment.

- »» 10. Do not eat, drink, or smoke in the experiment area.

- »» 11. Do not allow chemicals to come into contact with eyes or mouth.

- »» 12. Do not allow any substances or solutions to get onto your body.

- »» 13. Do not grow crystals in any rooms where people will be eating, drinking, or sleeping.

- »» 14. Be careful when handling hot water and hot solutions. Be particularly careful with hot burners, and don't forget to turn them off after use! Do not inhale any hot vapors!

- »» 15. Make sure that the container with the liquid is out of the reach of children under 10 years of age while you are growing your crystals. All filled containers should have a label indicating what they contain.

Also, note the information on the chemical vial labels and the information about handling the crystal salts.

## Instructions for using the safety glasses (item no. 052297)

**Use** The safety glasses are only to be used with the experiment kit. No other type of application is permitted. Wear the glasses in such a way that the eye area is protected. If necessary, adjust the elastic band to the head circumference of the child. The safety glasses should be used together with contact lenses. Wearers of corrective eyeglasses need special safety glasses for people who wear glasses.

**Duration of use** Always wear the safety glasses while performing your experiments. Not intended for long-term use. The duration of use should not exceed the time of the experiment. **Storage** Store safety glasses at room temperature in a dry room. After the experiment, return them to their place in the kit box, to keep them from being scratched.

**Cleaning** Do not clean the safety glasses when they are dry. Clean them with plain water and, if necessary, with a mild household liquid detergent, and dry them off with a soft cloth.

**Maintenance** In case of defective safety glasses or scratched lenses, exchange the glasses for an equivalently constructed pair.

**Inspection** Check the safety glasses to make sure they are in good condition, and replace them if they are damaged.

**Warning** Some extremely sensitive individuals may under certain circumstances experience an allergic reaction to skin contact with some substances.

**Replacement** These safety glasses are available as a replacement part.

The safety glasses are tested per EC guideline 89/686/EWG (personal protective equipment) and EN 71-4.

Test center: Certification center 0197 · TÜV Rheinland Product Safety GmbH · Am Grauen Stein · D-51105 Köln, Germany

Franckh-Kosmos Verlags-GmbH & Co. KG · Pfisterstraße 5-7 · 70184 Stuttgart, Germany

## Information on handling the chemicals

Please note the following risk and safety information for the potassium aluminium sulfate (potassium alum) and potassium hexacyanoferrate(III) (red prussiate) salts included in this kit.

**Potassium aluminium sulfate (potassium alum):** Avoid inhaling dust. Do not allow chemical to get into eyes or on skin. **Potassium hexacyanoferrate(III) (red prussiate):** Avoid release into the environment.

**NOTE!** The following applies to both chemicals: **Keep them locked away. Do not let them get into the hands of children.** This primarily applies to young children, but also to older children who — unlike the experimenter — have not been appropriately instructed by adults.

Also follow this safety guideline: **IF A CHEMICAL IS SWALLOWED: Immediately seek medical advice and/or attention and be ready to provide the chemical packaging label.**

If chemicals come into contact with skin, rinse the skin with running water immediately. Do not inhale the dust and powder of the chemicals.

## OPENING THE CHEMICAL VIALS:

1. Sometimes a portion of the chemical will stick to the lid of the chemical vial. To prevent any from falling onto your hand, bang the bottom of the vial several times against the work surface before opening it.

2. Then open the chemical vial with the lid opener. Close the vial again immediately after use!

**Tip!** You might sometimes need a little extra force to open and close the containers. Have an adult help you.

If the chemicals have formed clumps, it's not a sign of poor quality, but simply means that moisture — from the air mostly — has gotten inside the container. That will not affect their function. The age of your chemicals will also make no difference.

**CLEANING AND DISPOSAL OF WASTE:** Cleanliness is especially important in chemistry. Always clean up any used containers and your work area immediately following the experiments. Rinse the containers with clean water and dry them with paper towels, and then dispose of the used paper towels in the trash. Since you will only be dealing with small quantities of harmless chemicals in this experiment kit, you can simply rinse any liquid wastes down the drain with plenty of water. With the "Prussian blue" solution, add a little washing detergent first. Dispose of any solid wastes in the household garbage.

**SAVING THE CRYSTALS:** Always save your finished, dry crystals in the lockable display cases included in the kit!

## COLOR-CHANGING CRYSTALS



**WARNING** — This set contains chemicals and parts that may be harmful if misused. Read cautions on individual containers and in manual carefully. Not to be used by children except under adult supervision.

## Contents



- > Potassium aluminium sulfate (potassium alum) chemical vial, 10 g (item no. 770403)
- > Potassium hexacyanoferrate(III) (red prussiate) chemical vial, 3 g (item no. 773370)
- > Lid remover
- > 2 measuring cups
- > Wooden spatula
- > Pipette
- > Safety glasses
- > 2 crystal display cases

Before you start, check to make sure that the kit contains the right chemical salts, potassium aluminium sulfate (potassium alum) and potassium hexacyanoferrate(III) (red prussiate).

You will also need:  
Tap water or distilled water (from supermarket or drug store), old pot, trivet or hot pad, pot holder, clean, empty jelly jar (without lid), paper towels, scissors, tape, small screwdriver, pencil or pen, household vinegar, iron nail

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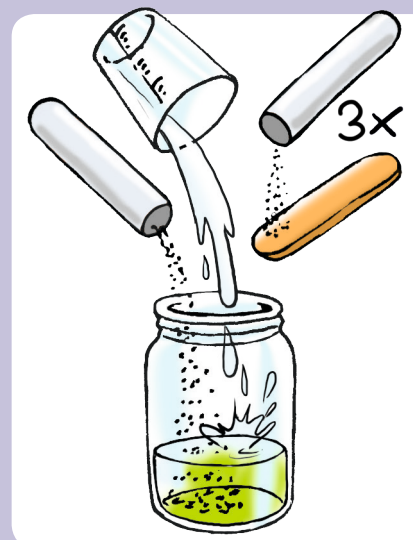
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## Growing color-changing crystals

### 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 left-over 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!



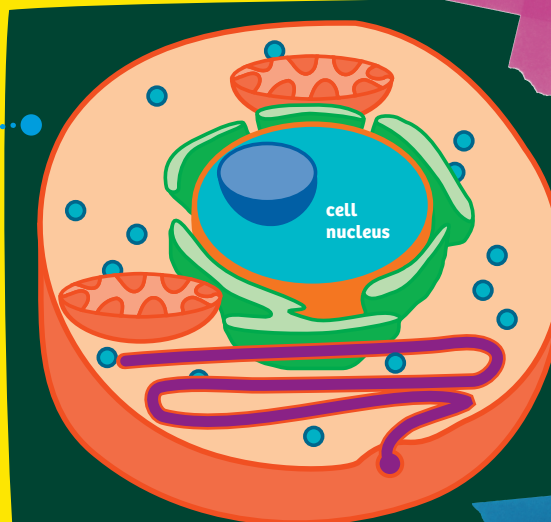
## Check it out

### 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.

## “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.

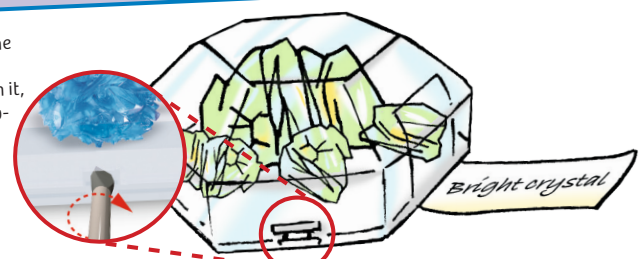
Which crystals change the most quickly? Do the crystals kept in the dark change color too?

	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



**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.

## Chemical analysis

### EXPERIMENT 3

#### YOU WILL NEED:

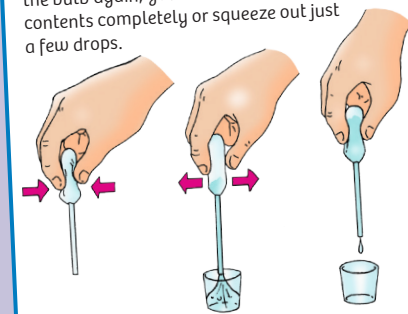
> Safety glasses, remaining potassium hexacyanoferrate(III), 2 measuring cups, pipette, household white vinegar, iron nail, water

>>> 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.

## 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!

