Science MAD!

crystal Growing Kit

WARNING! Do not view the sun through the magnifying glass as this can cause serious damage to the eyes.
The magnifying glass should always be used under adult supervision.

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Item No. SM21

Please retain the information in this manual for future reference.
Colour, designs and decorations may vary from those shown in the photographs.
Printed in China.

AGES 10 AND UP

Science MAD!

crystal Growing Kit

14 experiments all safety tested

Instructions

WARNING! Not suitable for children under 10 years. For use under adult supervision. Contains some chemicals which present a hazard to health. 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 small children and animals away from experiments. Keep the experimental set out of reach of children under 10 years old.

Contents

Includes:

- Monoammonium phosphate
- Aluminium potassium sulphate
- 3 petri dishes
- 5 plastic containers with lids
- 2 plastic moulds
- 1 large measuring cup with lid
- 1 small measuring cup with lid
- 2 measuring spoons
- Tweezers
- Plastic funnel
- Eyedropper
- Thread
- 15 granite base rocks
- Magnifying glass
- Display stand
- 15 blank labels
- Goggles (Goggles for supervising adults are not included)

You will also need plaster of paris (not included)

Crystal Growing Chemicals:

Frosty diamond	150g	Orange citrine	40g
Rama quartz	150g	Pink quartz	40g
Red ruby geode	110g	Emerald green	40g
Pink frost	110g	Marine blue	40g
Yellow geode	110g	Lilac geode	40g
Moss geode	110g		

Table of Contents

Advice For Supervising Adults

- Read and follow the instructions, the safety rules and the first aid information, and keep them for future reference.
- The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments that are listed in the instructions.
- This crystal growing kit is for use only by children over 10 years of age.
- Because children's abilities vary so much, even within age groups, supervising adults should exercise discretion as to which preparations are suitable and safe for them. The instructions should enable supervisors to assess any experiment to establish its suitability for a particular child.
- The supervising adult should discuss the warnings and safety information with the children before commencing the experiments. Particular attention should be paid to the safe handling of the materials in the bottles and all chemical preparations made in the activities.
- The area surrounding the experiment should be kept clear of any obstructions and away from the storage of food. It should be well lit, ventilated and close to a water supply. A solid table with a heat resistant top should be provided.
- A separate tin or bucket should be used for the disposal of solid waste materials. Any wasted solution should be poured down a drain but never into a sink.
- Crystal growing is a slow process and requires patience to get good results. **TO AVOID DISAPPOINTMENT, PLEASE NOTE:** You should wait a minimum of 12 hours for crystals to grow, but better results can be obtained by waiting for up to a week.

Important Telephone Numbers

Adults – please complete this section before using the kit.

Doctor:	
Hospital:	

First Aid Advice – Chemicals

Chemicals supplied in this kit:

- Monoammonium phosphate mixed with food colouring
- Aluminium potassium sulphate mixed with food colouring

In case of eye contact: Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.

In case of skin contact and burns: Wash affected area with plenty of cold water for at least 10 minutes.

If swallowed: Wash out mouth with water, drink some fresh water. Do not induce vomiting. Seek immediate medical advice.

In case of inhalation: Remove person to fresh air.

In case of skin contact and burns: Wash affected area with plenty of cold water for at least 10 minutes.

In case of doubt seek medical advice without delay. Take the chemical together with the container with you.

In case of injury always seek medical advice.

NOTE: First aid information may also be found in the instructions for carrying out the experiment.

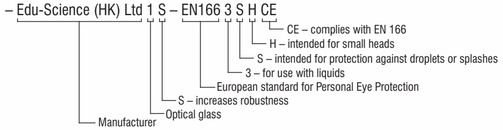
Safety Goggles

Instructions for use, storage and maintenance

- Hold goggles with one hand, if possible without touching the lens. Pull the elastic head band over the back of your head, just above the ears so that the goggles sit on your forehead. Carefully pull the goggles down over the eyes and adjust the strap for a snug and comfortable fit. Ensure the goggles are kept clean and dry, and cannot come into contact with loose chemicals or sharp objects.

Safety Goggles continued...

- Wash with warm soapy water, rinse and dry with a soft cloth.
- These goggles are only to be used with the contents and instructions supplied. If goggles become damaged, do not attempt to repair; discard immediately.
- Materials which may come into contact with the wearer's skin could cause allergic reactions to susceptible individuals.
- Goggle markings



Safety Rules

- Read and follow these instructions before use, follow them and keep them for reference.
- Keep young children and animals away from the experimental area.
- Store this experimental set and final crystals out of reach of children under 10 years of age.
- Clean all equipment after use.
- Wash hands after carrying out experiments.
- Do not eat or drink in the experimental area.
- Do not allow chemicals to come into contact with the eyes or mouth.
- Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
- Make sure that all containers are fully closed and properly stored after use.
- Ensure that all empty containers and non-reclosable packaging are disposed of properly.
- Do not apply any substances or solutions to the body.
- Do not grow crystals where food and drink is handled or in bedrooms.
- Take care when handling with hot water and hot solutions.
- Ensure that during growth of the crystal the container with the liquid is out of reach of children under 10 years of age.

Introduction To Crystal Growing

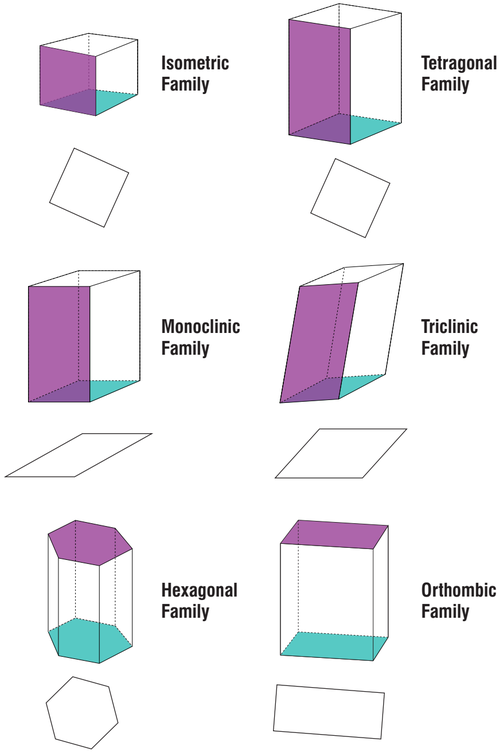
In this kit, we show you how to make crystals of different shapes, sizes, and colours. By experimenting and developing the basic methods, you can create a range of beautiful crystals. However, before we begin, we need to explain what crystals are.

Millions of years ago, the Earth was not as we know it now, but a mass of constantly moving hot gases. At some point in time, the gases cooled and formed liquids, some of which cooled further to become solid materials.

Crystals are solid materials with atoms or molecules that are arranged in orderly, repeating patterns extending in all three dimensions. Non-crystalline (or amorphous) materials don't have this orderly structure. A fundamental property of crystals is their geometric symmetry. There are 6 different symmetrical shapes used to classify crystals:

- **Cubic** – all sides are equal and at right angles to one another
- **Tetragonal** – this is a cube that has been stretched in one dimension, so the base is square, but the sides are rectangular
- **Monoclinic** – the base is a parallelogram instead of square, but the sides are rectangular
- **Triclinic** – both the sides and base are formed from parallelograms
- **Hexagonal** – the base is a hexagon and the sides are rectangular
- **Orthombic** – similar to a cubic lattice, but one that has been stretched in two dimensions, so the length, width and height are all different

Our kit uses two types of chemicals for growing chemicals: monoammonium phosphate, which forms tetragonal crystals, and aluminium potassium sulphate, which forms monoclinic crystals.



Please note: drawings underneath show the shape of the base of the crystals.

We've included a table on page 12 that you can use to record the results of your experiments. Doing this is a good way of remembering the experiments that worked well, or those that didn't, and the reasons why.

ACTIVITY 1 – Ice Crystals

You will need:

- Petri dish
- Water

Method:

Pour a small amount of water into the petri dish and place this in the freezer compartment of a fridge/freezer. Check regularly for the formation of ice crystals in the dish. Look closely with your magnifying glass – they should look just like snowflakes!

Salt crystals growing on string

ACTIVITY 2 – Other Common Crystals

You will need:

- Table salt
- Epsom salts
- Clean jam jar
- Pencil
- Paper clip
- Cotton thread

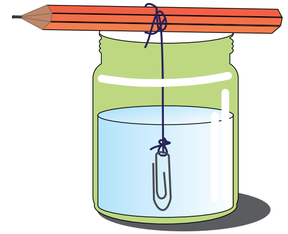
Recipes for salt solutions:

Table salt: 5 tablespoons of salt to 6 tablespoons of water
Epsom salts: 5 tablespoons of Espsom salts to 6 tablespoons of water

Method:

Use a jam jar to prepare one of the two solutions. Add the correct amount of hot water from the tap to the jar, and then gradually add the table salt or Epsom salts. Add the salt etc. gradually, stirring well each time, and waiting until it has disappeared before adding more. Keep adding it until it is not possible to dissolve any more salt in the water, and there is a small amount left in the bottom of the jar. You have made a saturated solution, from which you can grow crystals.

Take the pencil and tie a piece of cotton to it, and then attach a paper clip to the free end of the cotton to hold it down in the solution. Balance the pencil on the rim of the jam jar with the paper clip immersed in the solution and cover. Allow to cool and leave undisturbed for a day or two. Watch the formation of crystals on the cotton and check the shape of the crystals with your magnifying glass.



ACTIVITY 3 – Preparing a Monoammonium Phosphate Solution

You will need:

- Orange citrine, Pink quartz, Emerald green, Marine blue, Lilac geode or Rama quartz salts
- Small/large measuring cup
- Clean jam jar

Recipes for salt solutions:

The proportions are:

7cc salt powder to 20cc water (small measuring cup)
22cc salt powder to 80cc water (large measuring cup)

Method:

Measure the correct amount of water into the jam jar, and add the corresponding amount of salt. Heat the solution using either a microwave oven or by placing the jar in a pan of hot water (the level of the water should be the same as in the jar). DO NOT LET THE SOLUTION BOIL – gradually heat and stir the solution until the salt is fully dissolved. Allow the solution to cool.

Examples:

Emerald Green Crystal

Orange Citrine Crystal

Lilac Geode Crystal

ACTIVITY 4 – Preparing an Aluminium Potassium Sulphate Solution

You will need:

- Frosty diamond, Red ruby geode, Pink frost, Yellow geode or Moss geode
- Small/large measuring cup
- Clean jam jar

Recipes for salt solutions:

The proportions are:

6cc salt to 20cc water
30cc salt to 100cc water

Method:

Measure the correct amount of water into the jam jar, and add the corresponding amount of salt. Heat the solution using either a microwave oven or by placing the jar in a pan of hot water (the level of the water should be the same as in the jar). DO NOT LET THE SOLUTION BOIL – gradually heat and stir the solution until the salt is fully dissolved. Allow the solution to cool.

Examples:

Moss Geode Crystal

Frosty Diamond Crystal

Red Ruby Geode Crystal

ACTIVITY 5 – Growing a Crystal From a Seed Crystal

You will need:

- Prepared salt solution (from activity 3 or 4)
- Thread
- Pencil
- Plastic container
- Tweezers
- Clean jam jar

Method:

Pour some of the prepared salt solution into one of the petri dishes from the kit, cover and leave for at least 24 hours. Some crystals should have formed. Using your tweezers, very carefully pick up one of the larger crystals, dry it on a paper towel and tie it to a thread. You can do this by making a loop at the end of a piece of cotton and gently catching the crystal in the loop. You will use this “seed” crystal as a starting point for growing a larger crystal.

Prepare another solution of the same type of salt but a different colour. Attach the other end of the thread to a pencil and immerse the seed crystal in the solution, with the pencil balanced on the rim of the jar. Adjust the length of the thread so the crystal is under the solution but does not touch the walls of the jar. Cover the jar and leave for 12 to 24 hours – you should see that the crystal is growing.

ACTIVITY 6 – Growing Crystals On a Pebble

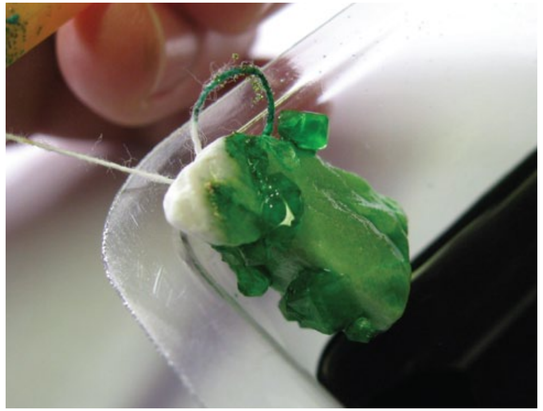
You will need:

- Prepared salt solution (from activity 3 or 4)
- Granite base stone
- Thread
- Pencil

Method:

Prepare a solution in a jam jar, as detailed in activity 3 or 4. Suspend the granite base stone in the solution using the thread and pencil. Instead of growing around another seed crystal, the crystals will grow on the granite base stone.

You may find that crystals form in the bottom of the jar as well as on the pebble. If this happens, remove the pebble and re-heat the solution until the crystals dissolve. Allow to cool, then put the pebble back into the jar.



ACTIVITY 7 – Moulded Crystals

You will need:

- Prepared salt solution (from activity 4 or 5)
- Small plastic moulds

Method:

Prepare a solution in a jam jar as detailed in activity 4 or 5. Fill the plastic moulds with the solution and leave for 24 to 36 hours. The crystals will set in the shape of the mould. You will need to top up the mould with solution as the crystals grow and the liquid evaporates. When all of the liquid has evaporated and the crystals are fully formed, gently take the crystals out of the mould and place on your display stand.

Moulds

ACTIVITY 8 – Making Jewellery/Ornaments

You will need:

- Lids from measuring cups
- Plaster of Paris – not included
- Crystals grown from previous experiments
- Cooking oil (for coating the inside of the lid)
- Eyedropper
- Tweezers

Method:

Coat the inside of the lid with a thin layer of cooking oil to prevent the plaster from sticking. Place a tablespoon of plaster powder in a small plastic container and use the eyedropper to gradually add drops of water to the plaster. Use a matchstick to mix the plaster and water until it has the consistency of a thick pudding. Pour the mixture into the lid and spread evenly to make the plaster base. Use your tweezers to place the crystal on to the plaster. Leave for two to three hours until the plaster sets. Gently press the bottom of the lid to release the plaster cast.

ACTIVITY 9 – Making a Crystal Garden

You will need:

- Lids from plastic containers
- Plaster of Paris – not included
- Crystals grown from previous experiments
- Cooking oil (for coating the inside of the lid)
- Eyedropper
- Tweezers

Method:

Prepare a plaster base with one of the lids from the plastic containers. Using your collection of crystals, embed them into the still soft plaster to create a crystal garden. Use adhesive to attach crystals, beads and pebbles to the embedded crystals to add a further dimension to your garden.

Stalactites and Stalagmites

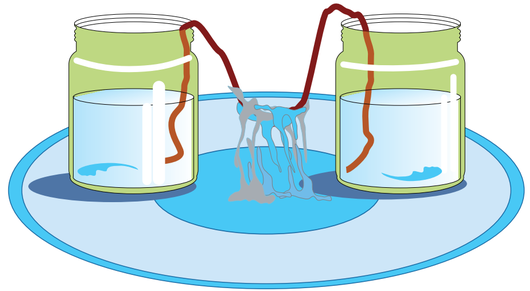
ACTIVITY 10 – Creating Stalactites and Stalagmites

You will need:

- 2 clean jam jars
- Old baking tray or aluminium takeaway dish
- Strip of cotton cloth (preferably terry towelling) 3cm wide x 40cm long
- 12 tablespoons washing soda (sodium carbonate)

Method:

Pour one cup of hot water into each jar and add half of the washing soda to each. Insert the ends of the cloth into each of the jars, making sure that the ends reach the bottom of the jars. Place the jars in the baking tray and move the tray to a warm place, well out of the reach of small children and pets. Wait several days and you will see that the solution starts to drip and a column begins to form.



ACTIVITY 11 – Growing Crystals in a Rapidly Cooled Solution

You will need:

- Prepared salt solution (from activity 4 or 5)
- Granite base stone or seed crystal
- Thread
- Pencil

Method:

Place the container with your solution in a bowl of ice cubes and see what happens. Record your observations.

Example:

Rama Quartz Crystal

ACTIVITY 12 – Growing Crystals in a Slow Cooled Solution

You will need:

- Prepared salt solution (from activity 4 or 5)
- Granite base stone or seed crystal
- Thread
- Pencil

Example:

Method:

Try to make the solution cool slowly. Either place the container with your solution somewhere warm, or place it in an insulated (e.g. polystyrene) container with a lid. Record your observations.

Marine Blue Crystal

ACTIVITY 13 – Growing a Large Crystal

Method:

Try growing as large a crystal as possible by repeatedly immersing a crystal in a new saturated solution.

Example:

Yellow Geode Crystal

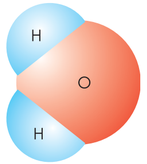
ACTIVITY 14 – Modelling The Structure of a Crystal

You will need:

- Models of water molecules (cut out from last page of manual)

Method:

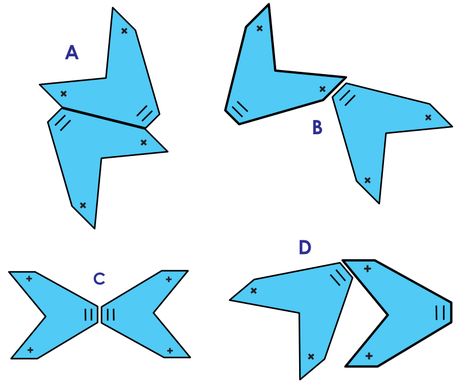
A crystal structure consists of atoms or molecules connected in an organised and repetitive series, packed together as closely as possible. We can illustrate this using the example of the water molecule, which consists of two hydrogen atoms and one oxygen atom, better known by the chemical formula H_20. The water molecule looks like this:



Molecule of water

The oxygen atom has two negative charges, and each hydrogen atom a positive charge – they join together to form a neutral molecule of water. At room temperature, the water molecules move around quite freely, so they are not arranged in any particular way. However, as water is cooled, the molecules move less and less, until they reach the freezing point, when the molecules are packed as closely together as possible. Unfortunately, because the atoms in the molecules have positive and negative charges, they will only fit together in a certain way – remember, like charges repel each other.

Cut out the models of the water molecules and try to fit them together as closely as possible. In figure C opposite, the two ends will not hold together, since both have the same (negative) charge – they would repel. Likewise, in figure D everything is fine at the top (since there are positive and negative charges together), but not at the bottom (there are two positive charges close together). Assemble all of the molecules and check that everything is correct.



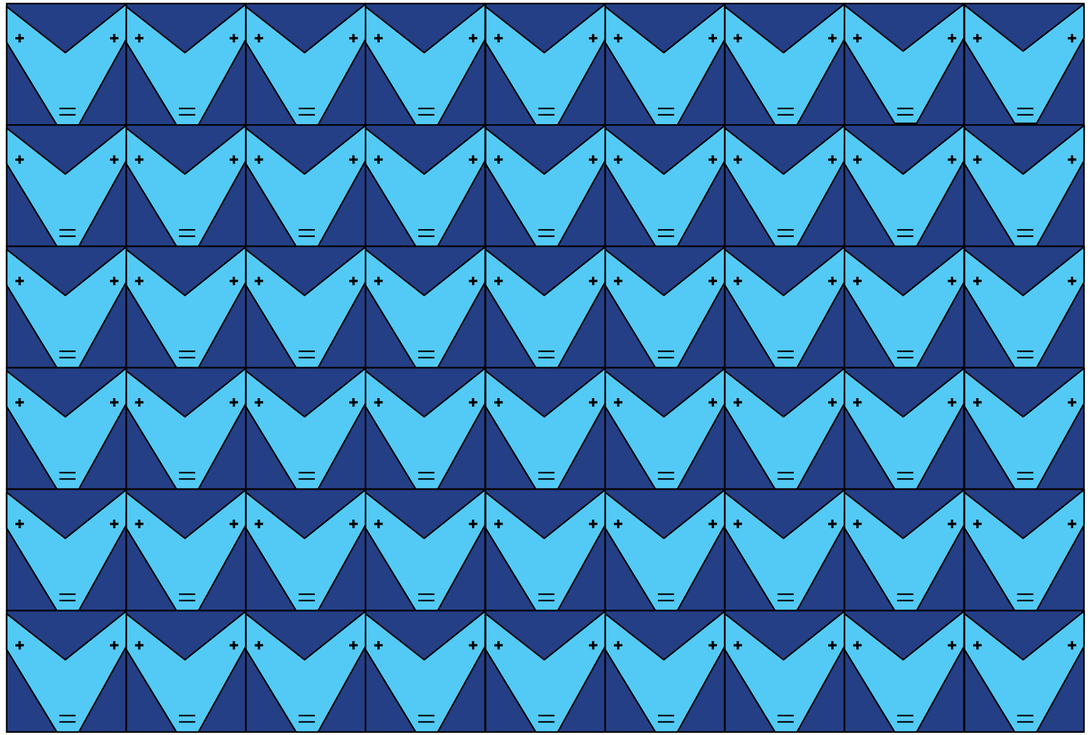
Now get someone else to try. In order to get the molecules as closely together as possible, you will find that they will make a very similar pattern to your own. This is the basis of crystal formation – for any particular atom or molecule, a particular set of rules must be followed in order to get them to fit together.

Hints & Tips Section

- If you are having trouble dissolving the crystal chemical (salt), try adding a small amount of water to the solution.
- If a large number of small crystals have formed in the base of the jar, remove the seed pebble. Reheat the solution and stir until all of the crystals have dissolved. Allow to cool, and put the seed pebble back in the solution.
- If the crystal is not growing, move the solution to a cooler room.

Here is an extra page of notes

Chemical	Grams	ML	Date	Time	Size	Time	Size	Time	Size



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