GEEK & CO. SCIENCE!

PROJECT KIT

Ages 8+

HOT ICE CRYSTALS

NOTE!

Please read the safety information, the advice for supervising adults, the safety rules, the first aid information, and the information on handling the crystal salt and disposing of it in an environmentally responsible manner.

Warning.

Not suitable for children under 8 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 8 years old.

WARNING — This set contains chemicals and/or 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.

THAMES & KOSMOS

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Safety information

WARNING!
This kit contains functional sharp edges or points. Do not injury yourself!
Keep the packaging and instructions as they contain important information.

First aid information

Advice in case any accidents should happen during experimentation.

- → **In case of eye contact:** Wash out eye with plenty of water, holding eye open if necessary. Seek immediate medical advice.
- → **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 water for at least 10 minutes.
- → **In case of doubt, seek medical advice without delay.** Take the chemical and its container with you.
- → **In case of injury always seek medical advice.**
- → **In case of cuts:** Do not touch or rinse with water. 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.**

Poison control

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.

Advice for parents and supervising adults

With this kit, you and your child will be able to grow animals and castles made of sodium acetate in a matter of seconds. The **sodium acetate** chemical contained in this kit is **non-toxic** and is also used as a **food additive (E262a).** Nevertheless, the safety standard for crystal growing sets stipulates that parents should provide their children with help and advice. So please read the following advice carefully:

A. Read and follow these instructions, the safety rules and the first aid information, and keep them for reference.

B. The incorrect use of chemicals can cause injury and damage to health. Only carry out those experiments which are listed in the instructions.

C. This experimental set is for use only by children over 8 years.

D. 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.

E. 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 crystal growing chemical and its solution, and the use of the kitchen stove.

F. 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.

G. Substances in non-reclosable packaging should be used up (completely) during the course of one experiment, i.e. after opening the package.

Accompany your child during the experiments and provide help when needed. Make sure there is no fire risk when heating water on the kitchen stove! And be careful to prevent the sodium acetate crystal salt from coming into contact with the skin, eyes, or mouth while experimenting.

It is also important to keep the sodium acetate powder, solutions made from it, and especially the finished crystals from getting into the hands of small children. They might mistake them for candies and put them in their mouth.

The finished crystals should be stored in a cool, dark place. Direct sun and warm heated air could melt them.

The blue dye will color things very intensely and may cause stains that can't be washed out of clothing. Keep all tablecloths, curtains, and carpets away from the experimental area.

The work area should not be in the kitchen — chemicals should be kept strictly segregated from foodstuffs and kitchen appliances. None of the containers or equipment used for growing the crystals should be used in the kitchen afterwards. Please be sure to get all necessary materials ready before starting the experiments.

We wish you and your child a lot of fun growing crystals!

Safety rules

Read this before starting any experiments

1. Read these instructions before use, follow them and keep them for reference.

2. Keep young children and animals away from the experimental area.

3. Store this experimental set and the final crystal(s) out of reach of children under 8 years of age. The same applies to any additionally required materials.

4. Clean all equipment after use.

5. Ensure that all empty containers and/or non-reclosable packaging (crystal salt packets) are disposed of properly.

6. Wash hands after carrying out experiments.

7. Do not eat or drink in the experimental area.

8. Do not allow chemicals to come into contact with the eyes or mouth.

9. Do not apply any substances or solutions to the body.

10. Do not grow crystals where food or drink is handled or in bedrooms.

11. Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.

12. Take care while handling hot water and hot solutions. Be particularly careful with hot burners, and don't forget to turn them off after use!

13. Ensure that during growing of the crystal the container with the liquid is out of reach of children under 8 years of age. All filled containers should have a label indicating what they contain.

Also note the information on the crystal salt packet, along with the information on handling the crystal salt (sodium acetate) and the safety information accompanying the individual experiments.

NOTE! *The additionally required items are highlighted in italic script in the individual experiments. Before starting the experiments, carefully read through everything that will be required and make sure to have all the materials ready.*

Information on handling the crystal salt (sodium acetate)

Please note the following hazard and precautionary statements for the chemical contained in this kit:

SODIUM ACETATE:
Avoid breathing dust. Do not get in eyes or on skin.

WARNING! The following applies to **sodium acetate:**
Store locked up. Keep out of reach of children. This applies to all children except for the experimenting child who is being instructed and supervised by an adult.

In addition, the following applies:
IF SWALLOWED: Get immediate medical advice/attention and have product container or label of chemical substance at hand.

Any crystal salt that inadvertently gets onto skin should be rinsed off immediately under running water. Be careful not to inhale crystal salt dust or powder while experimenting.

OPENING THE SODIUM ACETATE PACKET: Cut the packet open at one corner with a pair of scissors. Never use your teeth. Be sure that the printing on the packet remains legible.

If the crystal salt has formed clumps, it does not mean there is anything wrong with the quality of the contents. Rather, it just means that some moisture (from the air, for example) has gotten in. This will not affect its function. The age of your crystal salt will likewise make no difference.

OPENING AND STORAGE OF THE BLUE DYE:
Cut the blue dye packet open at one corner with a pair of scissors. After use, fold over the top of the bag and close it with a clip. Store the partially used bag in your experimental kit.

CLEANING AND DISPOSING OF WASTE: Cleanliness is especially important in chemistry, so always clean up any used containers and your workplace immediately after finishing the experiments. Then wash the containers with clean water and dry them with a paper towel, which you should then throw into the trash. Since you will only be working with small amounts of a harmless chemical, you can just wash liquid waste down the sink with plenty of water. Solid waste can go into the household garbage.

SAVING THE CRYSTALS: Keep your finished crystals in the petri dish and the matching lid on your home-made surface made of aluminum foil (see tip on page 9) or on the castle base. Make sure to protect them from direct sunlight and heated air. That would melt the crystals. Keep the finished crystals out of the reach of children and animals.

KIT CONTENTS

Please start by checking the labels on the sodium acetate packets to make sure you have the correct chemicals.

1	Packets of crystal salt, sodium acetate, approx. 30 g each, Item no. 775 017, EC no. 204-823-8 (7)	4	Seal and polar bear mold
2	Measuring cup	5	Plastic castle base
3	Wooden spatula	6	Blue dye packet, Item no. 705725
		7	Wooden stick
		8	Petri dish with lid

YOU WILL ALSO NEED: *Distilled water (from the supermarket, for example), 2 small, empty and clean jelly jars with lids, scissors, old pot and trivet, 2 pot-holders, piece of heavy cardboard (about 150 x 200 mm), aluminum foil, paper, pencil and tape, paper towels*

Hey Crystal Makers!

Are you ready to try some amazing crystal growing experiments? With this kit, you can make crystals form instantly out of a sodium acetate solution. They look like ice but they release heat upon formation. We'll use the solution to mold crystalline polar bears and seals, and create an elegant crystal castle with shimmering spires. You can learn about the chemical reaction that makes this happen. Let's get started! Krystal the Geeker will be your guide!

PART 1

HOT ICE CRYSTAL ANIMALS

1. Disappearing crystal salt

You will need:

1 packet crystal salt (sodium acetate), measuring cup, petri dish, wooden spatula,
clean jelly jar with lid, distilled water, pot, trivet, and pot-holder, scissors, paper label, pencil and tape

Here's how:

1. Fill an old pot to a depth of 3 cm with water and set it on the burner to heat. Get a trivet and a pot-holder ready at your work station.

2. Cut off one corner of the crystal salt packet with the scissors and pour the contents into the empty jelly jar. But be sure to save a few sodium acetate crystals in the closed petri dish for the next experiment.

   Use the measuring cup to measure **4 mL of water** and add it to the jelly jar.

TIP!
You will have to work very carefully! If dirt gets into the crystal salt solution or if the cup is shaken while cooling, the crystals will form too quickly.

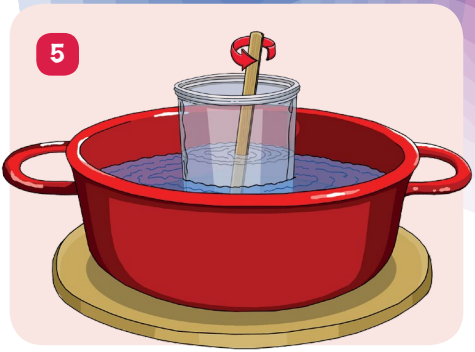
CAUTION!
Have a grownup help you! Be careful not to burn yourself on the hot pot, and don't forget to turn the burner off afterwards!

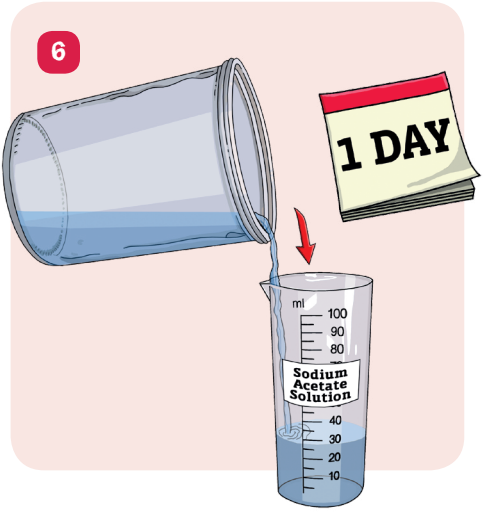
4 Label the clean measuring cup with “sodium acetate solution,” using a piece of paper and a pencil and then affixing the label to the outside of the cup with a strip of tape.

5 Remove the pot from the burner just before it comes to a boil, set it on the trivet, and place the jar with the crystal salt in the hot water bath. **Be careful not to burn yourself!** Stir with the wooden spatula until the crystals are completely dissolved in the liquid.

6 Slowly pour the solution into the labeled measuring cup, cover the cup with the jelly jar lid, and let it cool **overnight in an undisturbed, out-of-the way location.** Now you can start growing crystals!

Continue to Experiment 2.





GEEK OUT!

WHAT’S HAPPENING?

Sodium acetate, the sodium salt of acetic acid, looks like coarse sugar and has a slight vinegary odor. It is non-toxic and is used in a lot of foods as a preservative. The crystal salt dissolves completely in the hot water bath. Just a small amount of liquid is enough, since the sodium acetate crystals store water inside themselves. At 58 °C, they release their water of crystallization and “melt,” yielding a clear, colorless solution. If you let the solution cool, it becomes supersaturated. That means that the heating dissolved a lot more crystal salt than you would have been able to stir into cold water.

2. Creating crystals in a flash

You will need:

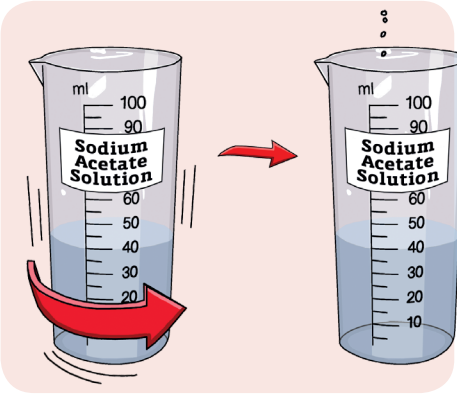
Cooled crystal salt solution from Experiment 1, petri dish with sodium acetate crystals left over from Experiment 1

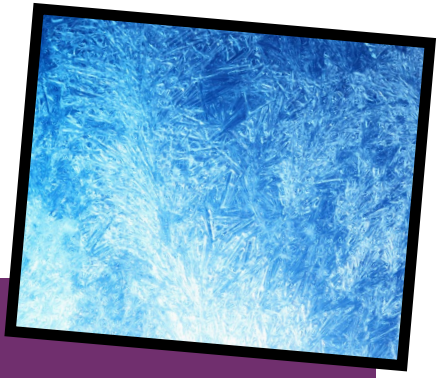
Here's how:

1. The next day, take a look into the cooled crystal salt solution. If you did your work carefully, you will see nothing but a transparent liquid with no crystals in it.
2. Remove the lid, pick up the measuring cup, and gently swirl the liquid. Does something happen?
3. Sprinkle the leftover crystals into the cup. What happens?
4. Save the crystallized solution for the next experiment.

TIP!

By reheating the crystallized solution and adding a few drops of water, you can keep growing new crystals. Just don't let the solution become contaminated.





GEEK OUT!

WHAT'S HAPPENING?

Even after cooling, no crystals will have grown in the solution even though it is highly supersaturated. This state is known as "metastable." Only once the liquid is disturbed will the crystal salt reveal itself again in dramatic fashion. You have done that here by adding a few granules of sodium acetate, which stimulate crystallization by acting as so-called seed crystals. The solution from Experiment 1 quickly hardens and lots of needle-shaped crystals will spread out. If you touch the container, you can feel how it gets warmer. Sometimes, even just a little shaking will be enough to make a metastable solution crystallize.

3. Making sparkling crystal animals

You will need:

1 packet crystal salt (sodium acetate), crystallized solution from Experiment 2, wooden spatula, seal and polar bear mold, petri dish, *2 clean jelly jars with lids, distilled water, pot, trivet, and pot-holder, scissors, paper label, pencil and tape, paper towels, piece of cardboard (about 150 x 200 mm), aluminum foil*

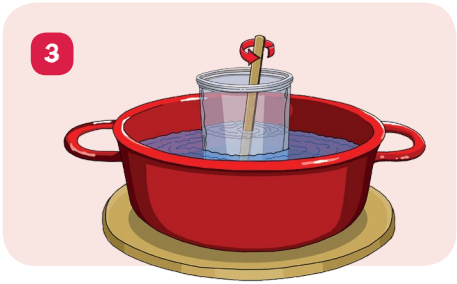
Here's how:

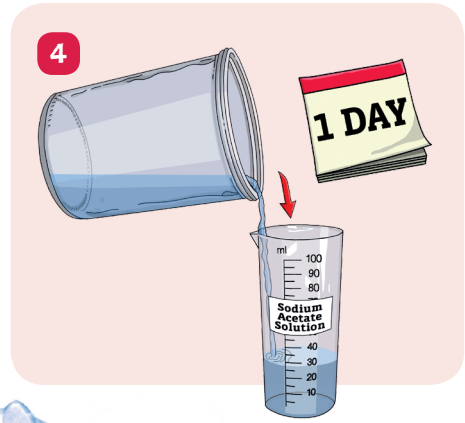
1. Pour the crystallized solution from the last experiment back into a clean jelly jar and clean the measuring cup.

2. Add **one more packet of crystal salt to the jelly jar along with 4 mL of water.** Save a few seed crystals in the closed petri dish.

3. Heat the solution in a water bath as described in Experiment 1, and stir until the solution is completely clear and you can no longer see any crystal granules.

4. Carefully pour the warm solution into the clean, labeled measuring cup. Let it sit **overnight in an undisturbed location,** placing the jelly jar lid on top to protect it.

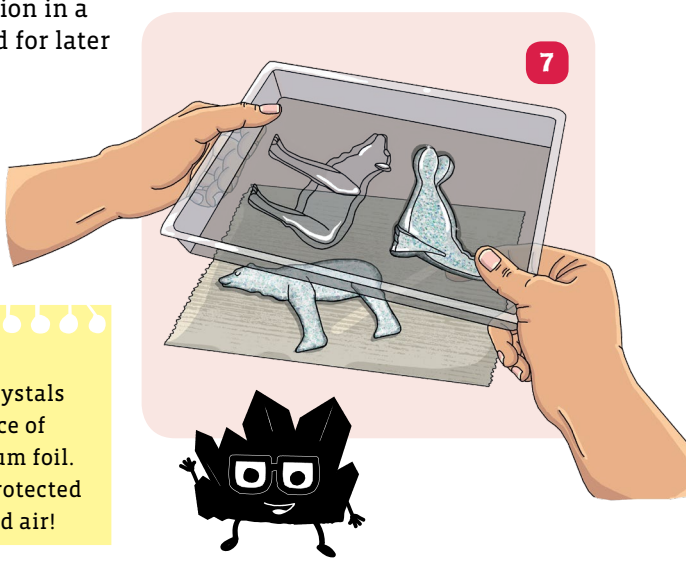




5 The next day, slowly pour the cooled solution into the seal or polar bear mold and drop the seed crystals into it. Watch what happens!

6 Save the rest of the solution in a labeled jelly jar with a lid for later experiments.

7 Let the crystal animals dry for one day before removing them from the mold. To remove them, turn the mold upside-down over a paper towel and gently press the figures out of it.



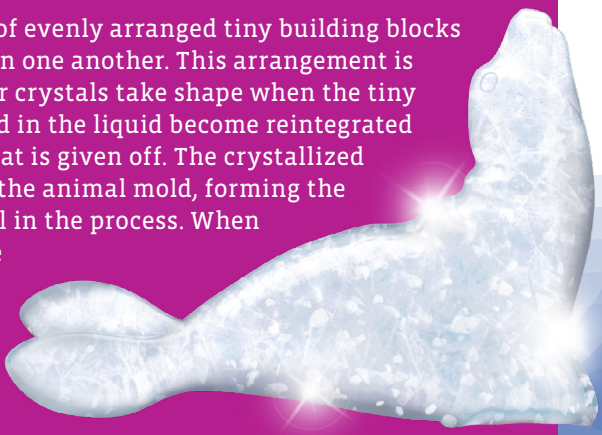
TIP!

You can display the finished crystals in the petri dish lid or on a piece of cardboard wrapped in aluminum foil. Be sure that the crystals are protected from direct sunlight and heated air!

GEEK OUT!

WHAT'S HAPPENING?

Crystals are made of evenly arranged tiny building blocks that exert an attractive force on one another. This arrangement is known as a crystal lattice. Your crystals take shape when the tiny building blocks floating around in the liquid become reintegrated into the crystal lattice after heat is given off. The crystallized solution hardens as it cools in the animal mold, forming the shape of a polar bear and a seal in the process. When the process is reversed and the crystal lattice is broken up into sodium acetate on heating, the crystals dissolve again.



PART 2

CRYSTAL TOWERS, FLOWERS, & CASTLES

4. Pouring colorful crystal columns

You will need:

1 packet crystal salt (sodium acetate), wooden spatula, petri dish, blue dye, *clean jelly jar with lid, distilled water, pot, trivet, and pot-holder, scissors, paper label, pencil and tape*

Here's how:

1. Measure 4 mL of water and stir a few granules of blue dye into the water. Then pour the colored water into an empty jelly jar.
2. Add 1 packet of crystal salt. Save a few seed crystals in the petri dish for later.
3. Make a crystal salt solution in a water bath as described in Experiment 1. The dye might change color in the process.
4. Pour the solution into a clean, labeled measuring cup and let the cup sit overnight in an undisturbed location with a jelly jar lid on top.
5. Carefully pour the cooled solution over the remaining crystals in the petri dish, and watch as a column gradually grows. Can you also get it to grow to the side?

GEEK OUT!

WHAT'S HAPPENING?

If you slowly pour the colored liquid over the remaining crystals in the petri dish, the solution quickly crystallizes out again. Soon you will see a column of crystals rising up. The color shows you that the water of crystallization is integrated back into the crystals — along with the dye.

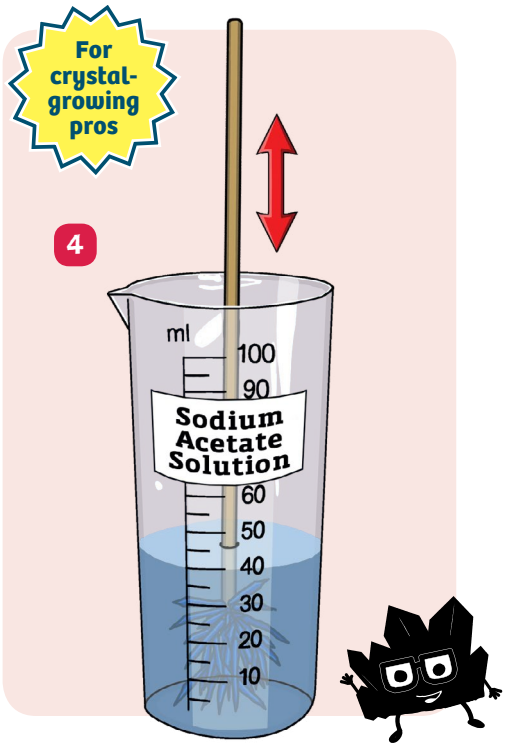
5. Growing crystal flowers in seconds

You will need:

1 packet crystal salt (sodium acetate), wooden stick, petri dish, blue dye, *clean jelly jar with lid, distilled water, pot, trivet, and pot-holder, scissors, paper label, pencil and tape*

Here's how:

1. For this experiment, you can re-dissolve the column from Experiment 4 in a water bath or you can make a colorful solution with a new packet of crystal salt, as described in Experiment 4.
2. Then pour the warm solution from the jelly jar into the clean, labeled measuring cup, cover the cup with the jelly jar lid, and leave it overnight in an undisturbed location to cool.
3. Now you will have to display a little skill. Poke the wooden stick slowly into the solution.
4. Pull the stick right out again before the needles of crystal arrive at the edge of the cup or get too heavy.
5. If the crystallization doesn't happen, repeat the last two steps.
6. Insert a paper towel into the cleaned measuring cup and set your flowers into the cup with their heads pointed up.



GEEK OUT!

WHAT'S HAPPENING?

The "disturbance" (that is, the friction) caused by the wooden stick makes the crystals grow. Before, the crystallization of the supersaturated solution was triggered by shaking or the addition of seed crystals. You can easily recognize the needle-like shape of the sodium acetate crystals in the flowers. Your animal shapes and the columns from Experiments 3 and 4, then, were also made from lots of intermeshing crystal needles rather than one big crystal.

6. Glittery crystal castles

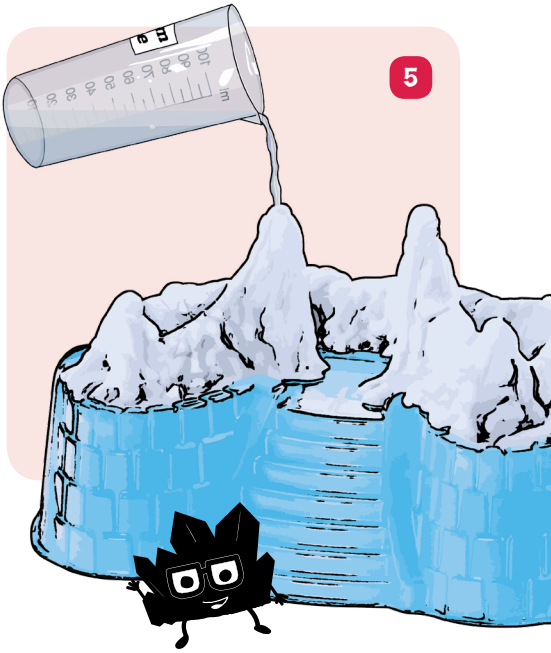
For this experiment, we recommend you use all of the crystal salt included in the kit, which includes reusing previously used crystal salts.

You will need:

Up to 7 packets of crystal salt (sodium acetate), wooden spatula, castle base, blue dye (optional), *clean jelly jar with lid, distilled water, pot, trivet, and pot-holder, scissors, paper label, pencil and tape*

Here's how:

1. Measure 4 mL of water per packet of crystal salt. You can color the water with some of the dye if you want. Then pour the colored water into an empty jelly jar.
2. Add all of the crystal salt. Save a few seed crystals on the castle base for later.
3. Make a crystal salt solution in a water bath as described in Experiment 1.
4. Pour the solution into a clean, labeled measuring cup and let the cup sit overnight in an undisturbed location with a jelly jar lid on top.
5. Carefully pour the cooled solution over the seed crystals on the castle base. Can you grow a crystal castle with a tower, gate, or turret?



GEEK OUT!

WHAT'S HAPPENING?

As in the previous experiments, when you slowly pour the liquid over the seed crystals, the solution quickly crystallizes out again. Soon you will have your own crystal castle.

GEEK OUT!

SODIUM ACETATE AS HEAT RESERVOIR

Solid, liquid, and gas:
Materials can take any one of these three forms, also known as states of matter. The state depends on the material itself, temperature, and pressure. Any material consists of lots of little particles known as atoms. In a **solid state,** the particles are tight together and hardly move. In **liquids,** the particles "slip" through the little gaps formed by their neighbors. In a **gas,** the atoms move at a higher speed.

The state of matter changes due to the **release or absorption of energy.**

When you heat the sodium acetate in order to dissolve it, energy is added and makes the particles move faster. After crystallization is triggered, the added energy is given off again in the form of heat. The crystal solidifies as the atoms remain stuck in their positions in the crystal lattice. Until the crystallization is activated, the sodium acetate solution stores the energy even after it has cooled off.

GEEK OUT!

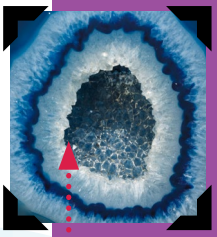
CAN ICE MAKE YOU WARMER?

You probably know about **hand warmers.** You press a disk floating in the crystal salt solution and the solution is set into rapid motion, crystallizes, and heats up — a phenomenon known as **heat of crystallization.** The chemical reaction is **exothermic** — from Greek "exo," meaning outside of, and "therme," meaning heat.

In most of these heating pads, the same chemical is used that you used in your own experiments. But ice produces heat of crystallization, too.

This has an important role to play in **fruit cultivation,** for example. To keep the tender buds and flowers from freezing early in the year, they are constantly sprayed with water. The water gradually forms a coating of ice on the plant, which releases heat of crystallization. This acts as a protective "cap" for the plants, preventing the temperature from dropping much below zero degrees Celsius. Fine droplets of water in the air crystallize and release heat, too.

HOW DO CRYSTALS FORM?



Like **sugar** and salt, our chemical consists of small granules of crystal. Crystals are solid objects with **uniformly arranged building blocks,** or atoms. They grow as their building blocks attract each other and gradually organize themselves into a **crystal lattice.**

A lot of crystallized minerals can be found in rocks in the mountains, which formed as the mountain was created millions of years ago. Hot water that dissolved minerals in the rocks under high pressure forced its way to the surface and cooled in crevices and **cavities.** When it cooled, crystals formed on the walls of the crevices. One of the most common minerals is **quartz,** which often appears in the form of beautiful, ice-clear **quartz crystals.**

GEEK OUT!

HOW DO CRYSTALS "KNOW" HOW TO GROW?

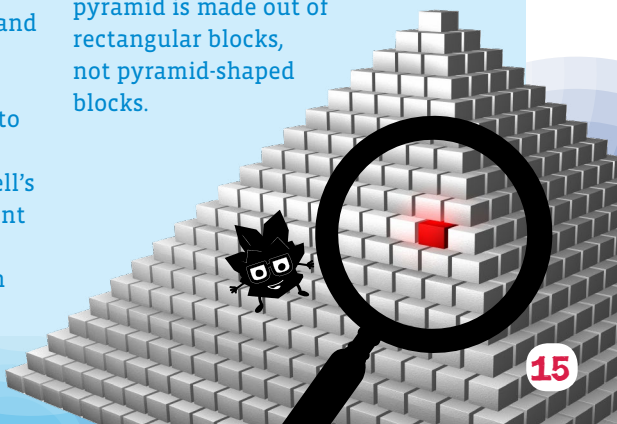
Let's imagine an Egyptian pyramid to illustrate how crystals grow. The Great Pyramid of Giza, for example, is made of over two million rectangular blocks that are layered on top of one another to form a pyramid shape.

This is much like how a crystal is built up, except that its building blocks are extremely tiny. They are not much bigger than atoms. Those crystal building blocks are called **unit cells**. Some units cells are **molecules** — groups of atoms put together in specific patterns. An example of this would be the sugar crystals in rock candy. Other unit cells may simply be **identical atoms** (for example, diamond crystals are made of carbon atoms). And then there are unit cells made out of **ions** — electrically charged atoms or groups of atoms.

There are positively and negatively charged ions, which attract each other and stick together like the north and south poles of magnets. Materials made out of ions are called **salts**. Examples include table salt and the sodium acetate in this kit.

Each unit cell has a shape unique to the material that composes it. The shape is determined by the unit cell's component parts, their arrangement relative to one another, and the strength of the forces of attraction holding them together. Some are cube-shaped, others rectangular or rhomboid. All the components always strive to pack together as tightly as possible and to use as much of the available space as they can — a result of the strong forces of attraction between them.

Just like the pyramid with its millions of blocks, crystals grow through the accumulation of these unit cells. Of course, if a unit cell has the shape of a cube, it does not necessarily mean that the resulting crystal will also be cube-shaped. After all, a pyramid is made out of rectangular blocks, not pyramid-shaped blocks.



GEEK OUT!

AMAZING CRYSTAL FACTS!

Certain crystals will vibrate when electric current passes through them. Many clocks use **quartz** A crystals to ensure the watch keeps accurate time. Early radio transmitters used different types of crystals to create the frequencies to transmit signals.

Quartz is the most commonly found crystal on earth.

Crystals are often used in jewelry. There are four types that are considered the most valuable and commercially referred to as precious stones. These are **diamonds** B, **emeralds** C, **rubies** D, and **sapphires** E.

When we think of crystals we often think of beautiful gems. But did you know that **snowflakes, sugar, sand,** and **salt** are also crystals?

Colombia is the world's largest producer of **emeralds**, providing more than 50% of the world's production.

A diamond needs only one building block to form: **carbon** atoms. Diamonds are typically made deep inside Earth by carbon atoms being pushed together with amazing amounts of pressure and high temperatures.

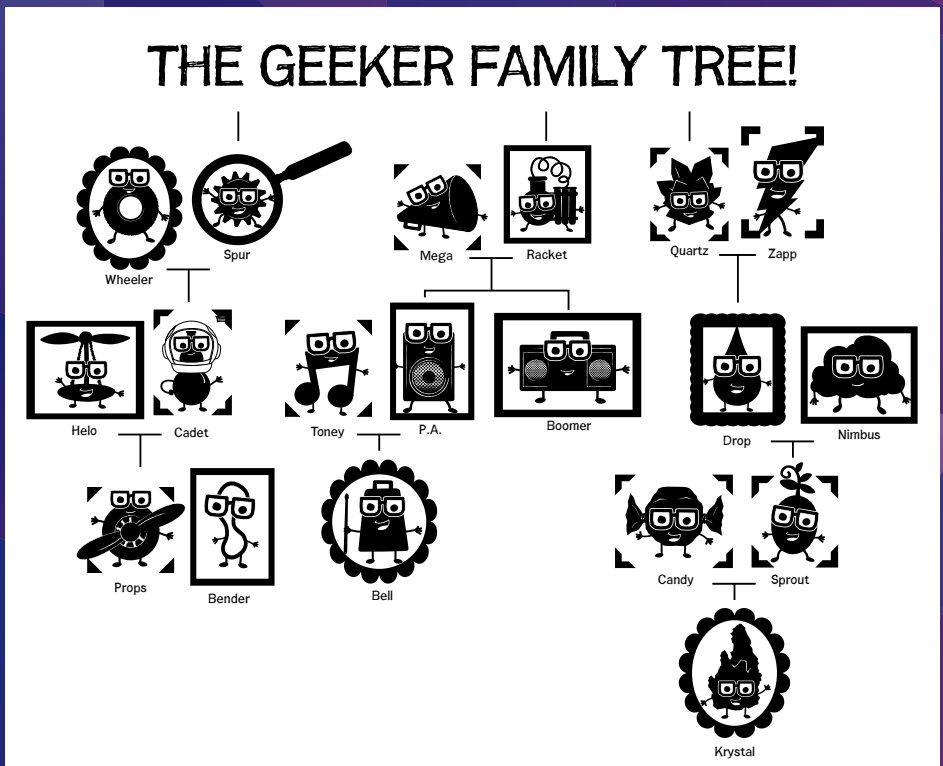
Some of the largest crystals ever found are in a cave in Mexico called the *Cueva de los Cristales* (Cave of the Crystals) F. This cave is filled with **gypsum** crystals that are up to 36 feet long.

Diamonds are the hardest natural material on Earth and are often used for cutting other stones or in polishing tools.

Most minerals occur naturally as crystals. Many minerals are actually colorless but if there are impurities present when the crystal is forming they can form in different colors. Quartz traditionally is clear, but if iron or manganese impurities are present during the quartz formation you will get a purple quartz called **amethyst** G.

Kosmos Quality and Safety

More than one hundred years of expertise in publishing science experiment kits stand behind every product that bears the Kosmos name. Kosmos experiment kits are designed by an experienced team of specialists and tested with the utmost care during development and production. With regard to product safety, these experiment kits follow European and US safety standards, as well as our own refined proprietary safety guidelines. By working closely with our manufacturing partners and safety testing labs, we are able to control all stages of production. While the majority of our products are made in Germany, all of our products, regardless of origin, follow the same rigid quality standards.



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