

**GEEK  
& CO.  
SCIENCE!**



PROJECT KIT

Ages  
**8+**

# GLOWING CRYSTAL GEODE



## NOTE!

Please read the safety information, the first aid information, and the poison control center contact information on the inside front cover, the advice for supervising adults on page 1, the safety rules on page 4, and the notes on handling the chemicals and disposing of them in an environmentally responsible manner on page 5.

## 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** — Chemistry Set. 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.

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## Safety and disposal information for the UV Lamp

- Warning. Contains a device that emits ultraviolet radiation.
- The lamp battery should only be inserted or changed by an adult.
- Protect the lamp from moisture.
- You will need one AAA battery (1.5-volt, type LR03), which is not included in the kit due to its limited shelf life.
- The supply terminals are not to be short-circuited. A short circuit could lead to overheating of circuits and battery explosions. Be sure not to bring batteries into contact with coins, key chains, or other metal objects.
- Batteries are to be inserted with the correct polarity. Press it gently into the battery compartment (see page 6).
- Non-rechargeable batteries are not to be recharged. They could explode!
- Rechargeable batteries are only to be charged under adult supervision.
- Rechargeable batteries are to be removed from the toy before being charged.
- Exhausted batteries are to be removed from the toy! (the UV lamp)
- Different types of batteries or new and used batteries are not to be mixed.
- Do not throw used batteries into the household trash. They must be delivered to a local collection station or to a store that accepts used batteries for disposal. That way, they can be disposed of in an environmentally responsible manner.
- Avoid deforming the battery.

*In addition to a certain amount of visible light, the UV lamp mostly emits energy-rich ultraviolet light. Do not shine it into your eyes or into the eyes of any other person or animal!*

### Disposal information for electrical and electronic components

None of the electrical or electronic components in this kit should be thrown into the regular household trash at the end of their lifespan; instead, they must be delivered to a collection location for the recycling of electrical and electronic devices. The symbol on the product, instructions for use, or packaging indicates this. The materials are reusable in accordance with their markings. By reusing or recycling used devices, you are making an important contribution to the protection of the environment. Please consult your local authorities for the appropriate disposal location.



## 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/or product 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.

Keep the packaging and instructions as they contain important information.

## Advice for parents and supervising adults

With this kit, you and your child will be able to grow a crystal geode that glows in the dark. Even though there are no particularly dangerous materials in this experiment kit, you should be prepared to give your child guidance and advice during the crystal-growing projects. So please read the following suggestions 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. For use under adult supervision. Keep this chemical toy set out of reach of children under 8 years old.

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.

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.

Hot water is used when making crystal salt solution. You should devote special care to handling it safely and assist your child when help is needed. Please follow fire safety practices when heating water on the kitchen stove!

While experimenting, please be careful not to let the alum crystal salt come into contact with the skin, eyes, or mouth. It is also important not to let the crystals, crystal solutions, and especially the finished crystals or geodes get into the hands of small children. They could mistake them for candies and put them into their mouth.

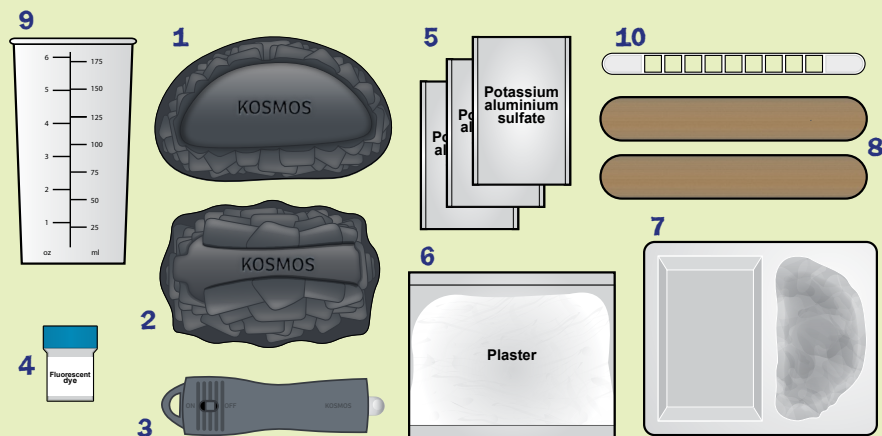
A sturdy table with a washable, heat-resistant top makes a suitable work surface. You will need good lighting, a way to ventilate the area, and a water tap. The working area should be cleaned immediately after carrying out the activity. The surroundings should be free of any obstacles and away from any stored foods. A cool basement room would be ideal. Do not use any containers or tools in the kitchen after they have been used for growing crystals. Your child should wear old clothing during the experiments, since some of the materials may cause stains.

Please supervise your child during operation of the UV lamp, especially when opening it with a small Phillips head screwdriver and to ensure the correct polarity when inserting the 1.5-volt AAA battery.

Since ultraviolet light contains more energy than visible light, your child should never shine it into his or her own eyes or into the eyes of anyone else.

**We wish you and your child a lot of fun making the glowing crystal geodes!**

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| 3 | UV lamp  | 8  | Wooden spatulas (2)   |
| 4 | Fluorescent dye (UV-active cosmetic dye), 1.5 g      | 9  | Measuring cup, 200 mL |
| 5 | Potassium aluminium sulfate (alum) packets, 50 g (3) | 10 | White measuring spoon |

## YOU WILL ALSO NEED:

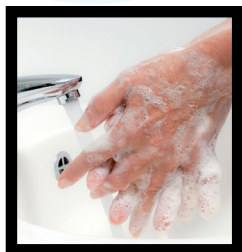
For the UV lamp: *1.5-volt type LR03 (AAA) battery; small Phillips head screwdriver*

For growing the crystals (Experiments 1 to 4): *about 1 liter of distilled water, adhesive labels, pencil, transparent tape, paper towels, trivet, hot pads, small beat-up cooking pot (20 centimeters in diameter), burner, 3 or more empty jelly jars with lids (200 mL), dishwashing liquid, old newspapers, 2 empty yogurt containers (250 mL), scissors, piece of cardboard*

For your research with the UV lamp: *various household items such as paper money, postage stamps, white paper or white clothing, reflective strips or safety vests, adhesive stickers, your teeth, or glow-in-the-dark toys*

**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.*

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Make two sparkling crystal geodes with the crystal salts, fluorescent dye, and plaster

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Take your UV lamp on a hunt in the dark.

## Hey Geode Geeks!

Are you ready to make an awesome crystal geode that glows in the dark? A geode is a round rock with a crystal-filled cavity inside. With this kit, you can cast a plaster geode shell in a mold and fill it with a crystal-growing alum salt solution. The crystal solution contains an ultraviolet-luminous pigment that gets incorporated into the crystals as they form, resulting in a geode that glows in ultraviolet light. Let's get started! Quartz the Geeker will be your guide!



# Safety rules

Read this before starting any experiments

Before starting the experiments, please read the following information carefully. That way, you can easily avoid any possible dangers.

1. Read these instructions before use, follow them and keep them for reference. Pay special attention to the specified quantities and the sequence of individual steps. Only perform the experiments described or suggested in this manual.

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 and the finished crystal geodes.

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. Clean your workplace.

7. Do not use any equipment which has not been supplied with the set or recommended in the instructions for use. Keep all work equipment separate from kitchen utensils (such as cutlery and tableware) in order to prevent any mix-ups.

8. Do not eat or drink in the experimental area. And also do not smoke.

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

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

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

12. Take care while handling with hot water and hot solutions. Do not inhale hot vapors. 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.

14. When handling plaster, please note:

- › Do not place the material in the mouth.
- › Do not inhale dust or powder.
- › Do not apply to the body.

Also, pay attention to the information provided on the crystal salt packets, the plaster packet, and the fluorescent dye, as well as the notes on handling the chemicals. In the case of any additionally-required materials such as the all-purpose glue, pay attention to the warnings on their packaging as well.





## Notes on handling the chemicals: crystal salt, fluorescent dye, and plaster

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

### **Potassium aluminium sulfate (alum):**

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

### **Calcium sulfate (gypsum or plaster powder):**

Avoid breathing dust. Do not get in eyes, into the mouth, or on skin. Do not apply to the body. Do not ingest.

**Fluorescent dye (UV-active cosmetic dye):** Avoid breathing dust. Do not get in eyes or on skin.

**WARNING!** The following applies to all chemicals:

**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 chemicals that inadvertently get onto skin should be rinsed off immediately under running water. Be careful not to inhale dust and powder of the substances while experimenting.

### **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 harmless chemicals in this kit, you can just wash liquid waste down the sink with plenty of water. Rinse the sink well afterwards. Solid waste, such as still-soft or hardened plaster or residues, can go into the household garbage.

### **Opening the packets**

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 also make no difference.

After use, re-close the plaster packet with a clip or a piece of tape.



## Safety information

### Heating the crystal solutions

You will be using clean, empty jelly jars for these experiments. **Ordinary glass containers would crack and break, and plastic containers would melt.** Never, however, set your jelly jars directly onto a burner or a gas flame. Instead, get an old cooking pot with a diameter of about 20 cm, and fill it with a few centimeters of tap water. The water level should always be slightly lower than the level of liquid in the crystal growing jar. Heat the water on the stove to just under the boiling point. Carefully carry the pot to your work place (it is best to have a grown-up help you with this) and set it on a trivet or hot pad. Then set the jar in the pot and stir its contents with the wooden spatula. The water will warm the contents of the jar and dissolve the crystal salt, which will eventually disappear. If it doesn't dissolve well, take the jar out of the pot with a hot pad and reheat the water on the stove before trying again by following the same steps.

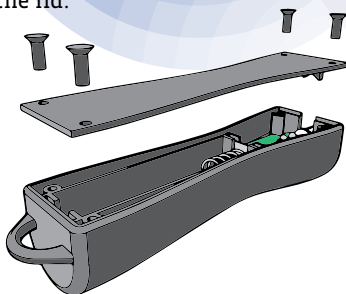
**Caution!** Do not burn yourself with the hot water or on the pot, and do not forget to turn off the stove afterwards! When heating water or solutions, always have an adult help you. Do not work alone. Do not inhale vapors produced when heating the crystal salt solutions. Also, be especially careful not to burn yourself or scald yourself with hot water, and do not spill any crystal salt solutions.

### The UV lamp

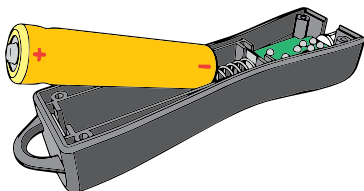
The light from this little lamp will make things that look boring in daylight light up in the dark. It does this by emitting invisible ultraviolet light (UV light for short) in addition to some visible light. To operate the lamp, you will need one 1.5-volt type LR03 (AAA, micro) battery and a small Phillips-head screwdriver.

### How to insert the battery:

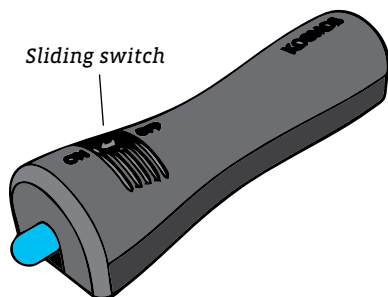
1. Use a screwdriver to loosen the four little screws underneath the lamp and lift off the lid.



2. Insert the battery into the battery compartment in the correct polarity direction and screw the lid back on again.



3. To turn it on, push the small sliding switch forward. Now, the lamp will shine with a blue light.



If the lamp only shines weakly or doesn't shine at all, the battery may be used up. In that case, switch it out for a new one as described before. If you anticipate not using the UV lamp for a long period of time (more than a month), take out the battery first (as described).



**GEEK  
OUT!**

# ARTIFICIAL CRYSTAL GEODES

Crystals can form in large or small hollows in rock. This kind of crystal-filled rock or cavity is known as a “geode” or “druse” — from a Slavic word meaning “teeth,” because the rows of pointed crystals were believed to resemble rows of little teeth. With this kit, you will be able to make your very own geodes, which will even glow under the light of an ultraviolet lamp. Begin by growing the starter crystals, then embed them in the plaster shell, and soon you will have a sparkling crystal coating inside your very own crystal cavern.

These are the steps for growing your glowing crystal geodes:

## **Glowing starter crystals**

Time required for the experiment: about 30 minutes

Time needed to grow the starter crystals: overnight to 1 day

Drying time for the starter crystals: about 12 hours

## **Making the plaster geode shell**

Time required for the experiment: about 30 minutes

Drying time for the damp plaster: 1 day

## **Growing crystals in the plaster shell**

Time required to grow the crystal coating in the geode:  
from 3 days up to 5 days

Drying time for the crystal-filled geode in the mold: 1 day

Drying time for the finished geode (without mold): 1 day

The material included in the kit is enough for making  
two geodes at different times.

## **HAVE FUN!**

# PART 1

## CREATING YOUR CRYSTAL GEODE

### 1. Growing starter crystals

#### You will need:

50-g packet of alum (potassium aluminium sulfate), fluorescent dye, measuring cup, wooden spatula, white measuring spoon, UV lamp, 2 clean empty jelly jars (one with a lid), dishwashing liquid, paper, pen, tape, cardboard, tap water, distilled water, old pot, trivet, hot pads, paper towels, old newspaper

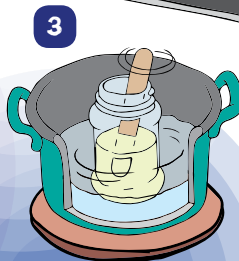
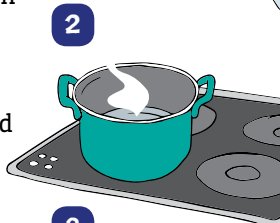
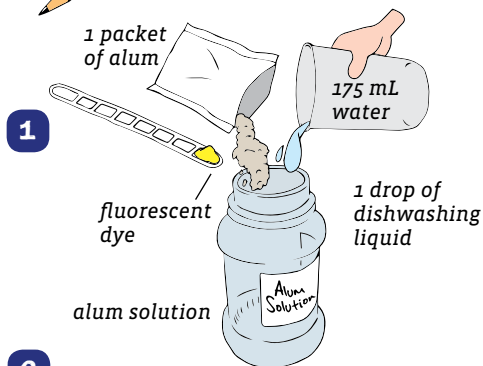
#### Here's how:

**1** Cover your work surface with old newspaper. Pour the entire packet of alum (potassium aluminium sulfate) into a labeled jelly jar. Then use the measuring spoon to add a portion of fluorescent dye about the size of a pea, and follow with 175 mL (distilled) water. Stir everything with the wooden spatula and add a drop of dishwashing liquid.

**2** Now place the trivet on your work surface. Fill the old pot with about 3 cm of tap water and bring the water to a boil on the stove. Then carefully carry the pot to your work area and set it on the trivet.

#### TIP!

This is how to label the jars holding the solutions: Write "alum solution" with a pencil or ballpoint pen on a narrow strip of paper, and tape the paper to the jar. If you use self-adhesive labels, you should still cover the label with a strip of tape to prevent the writing from smearing or the label from falling off due to moisture.



#### CAUTION!

Have a grown-up help you! Be careful not to burn yourself on the hot pot, and don't forget to turn off the stove afterwards! Do not inhale the hot vapors.

## TIP!

If not all of the alum dissolves, lift the jar out of the pot with the hot pads and reheat the water on the stove. If there are still some small crumbs of crystal left, you can add a few milliliters of (distilled) water.

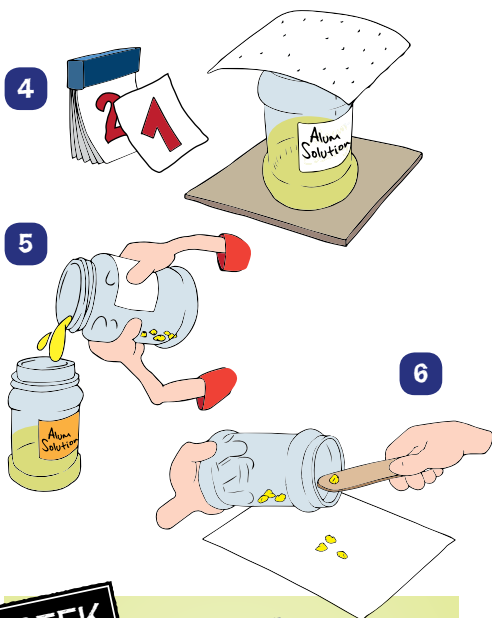
**3** Set the filled jelly jar in the pot and stir with the wooden spatula until all the alum is dissolved. Then take the jar out of the pot with the hot pads and dry the outside of the jar with a paper towel. Caution, it is hot!

**4** Find an out-of-the-way location where your parents won't mind you experimenting (such as a cool basement room) and set the jar there, using the piece of cardboard as a saucer. Cover the jar with a paper towel so no dust falls in. Take a look inside the jar from time to time and watch what happens. Ideally, let the jar stand overnight.

**5** When crystals about 5 mm in size have formed, pour the rest of the alum solution into a second labeled jar and close the jar with a lid. Don't throw it away — you will need it for Experiment 3! If you can't find any crystals, let the jar sit a while longer.

**6** Use the spatula to transfer the crystals onto a double layer of paper towels and let them dry about 12 hours. You will need them in the next experiment.

**7** Now see what happens when you shine the UV lamp on the crystals in the dark. WOW!



**GEEK  
OUT!**

## WHAT'S HAPPENING?

The hot water in the pot warms the liquid in the jelly jar. That quickly dissolves the alum crystal salt and the fluorescent dye. The warm crystal salt solution is now supersaturated with alum. As the solution cools, transparent angular shapes form in the jar. The salt crystallizes out and grows into pretty **octahedron-shaped** crystals, which is the typical shape for alum (potassium aluminium sulfate). That's because the salt particles are always arranged in a rigid pattern known as a **crystal lattice**. The yellow fluorescent dye inserts itself into this lattice, making the starter crystals glow brightly under the black light. That's because the dye absorbs the UV light and converts it into visible light. This is a phenomenon known as **fluorescence**. So what you've made here are **fluorescent crystals**.



## 2. Making the plaster geode shell

### You will need:

Plaster, fluorescent dye, measuring cup, wooden spatula, white measuring spoon, geode mold, half of the starter crystals you made in Experiment 1, 2 large empty yogurt container (250 mL), scissors, tap water, old newspapers, tape, all-purpose glue (optionally)

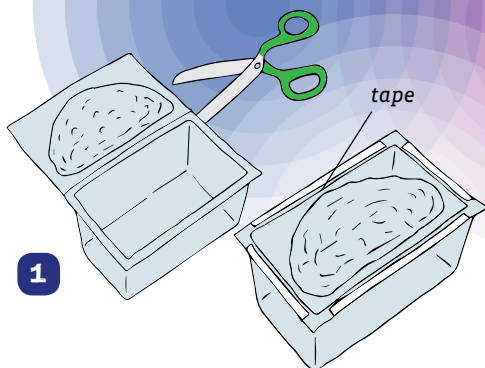
### Here's how:

**1** Cover your work surface with old newspaper. Use the scissors to separate the geode mold pieces. Set the mold for the geode's hollow portion in its holder and apply tape around the edges.

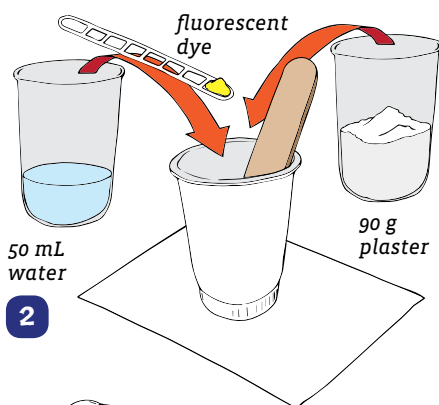
**2** Fill the measuring cup with plaster up to the 100-mL mark (about 90 g) and then pour the plaster into the yogurt container. Use the measuring spoon to add a pea-sized portion of fluorescent dye and stir everything together. Now measure 50 mL of water into the measuring cup and add this to the plaster. Stir the mixture with the wooden spatula until it is free of any clumps.

**3** Pour the plaster mixture into the geode mold. It will not quite fill the mold.

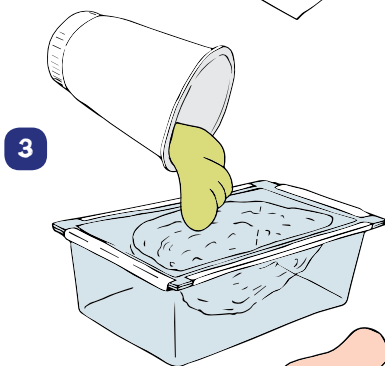
**4** To make the geode wall, use the wooden spatula to spread the mixture up along the walls of the



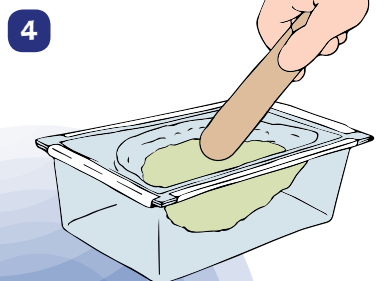
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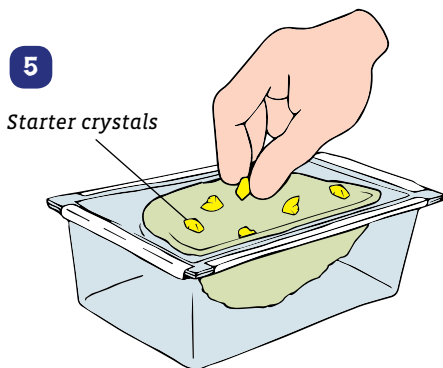
mold once the mixture begins to harden after a few minutes. Then dig a cavity in the center. You will have to work quickly. Make sure not to spread the plaster too thinly on the walls (or you risk it breaking!)

**5** Before the plaster hardens completely, spread the starter crystals evenly over the inside walls of the geode and press them gently into the plaster. Later on, these crystals will help the newly-formed crystals to adhere to the plaster surface. Let your geode dry for a day. Do not remove it from the mold!

**6** If you can, immediately clean the yogurt container and other materials under running water and dry everything off. You will need the container again when you make your second geode.

## TIP!

If the individual crystals do not adhere well to the plaster, you can always attach them with all-purpose glue once the plaster has hardened.



## WHAT'S HAPPENING?

When plaster powder is mixed together with water, it quickly forms lots of tiny needle-shaped crystals that grow together and form an interlocking mat. The plaster hardens and “sets.” That releases energy in the form of heat, which you can feel with your hand.

This solid plaster cavity forms the “rock wall” of your home-grown geode. The starter crystals and the edges of the hardened plaster create footholds for the crystals growing on the inside. This is the crystal coating that you will be creating in the next experiment.



### 3. Growing crystals in the plaster shell

#### You will need:

Hollow plaster shell (from Experiment 2), measuring cup, wooden spatula, white measuring spoon, 50-g packet of alum (potassium aluminium sulfate), fluorescent dye, half of the alum solution you made in Experiment 1, distilled water or tap water, 2 empty jelly jars, pot of hot water (no longer boiling) as described in step 2 of Experiment 1, paper towels, hot pads, trivet, old newspapers, piece of cardboard, scissors

#### Here's how:

**1** Cover your work surface with old newspaper. Add half the alum solution (about 90 mL) to the measuring cup and fill with (distilled) water up to the 175-mL mark.

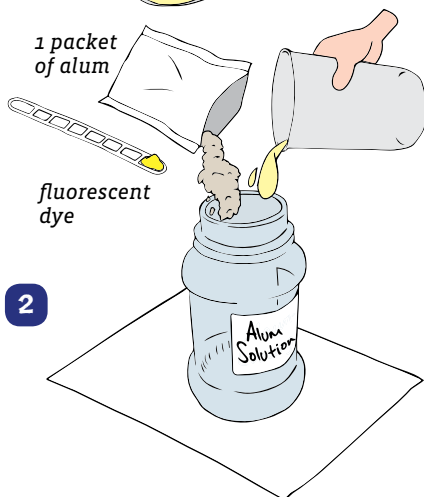
**2** Transfer the entire packet of alum and a pea-sized portion of fluorescent dye to a jelly jar and add the solution from the measuring cup.

**3** Set the jelly jar in the pot of hot water and stir with the wooden spatula until everything is completely dissolved.

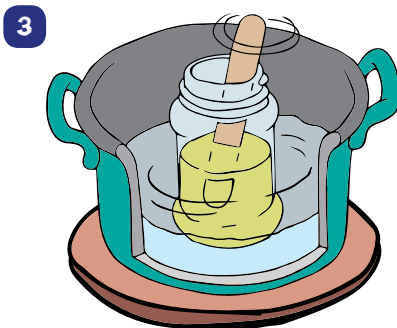
**4** Set the jar in an out-of-the-way location (such as a cool basement room) on top of a piece of cardboard. Make sure it is stable and doesn't tip over.



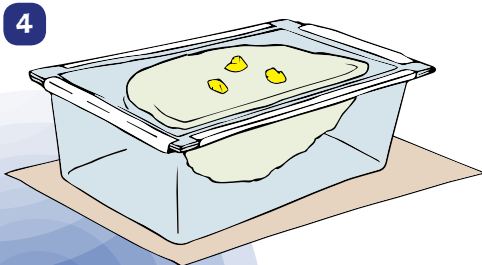
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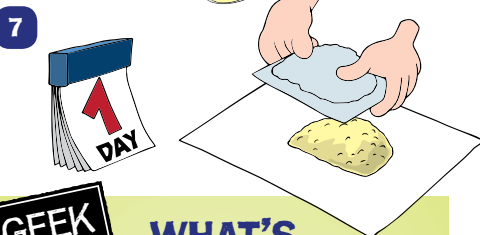
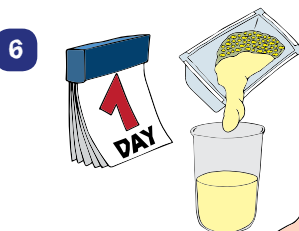
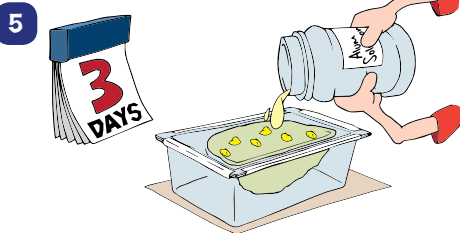


**5** Once the solution has cooled, pour it into the plaster cavity up to the rim. You probably won't be able to prevent some of the liquid from seeping between the plaster and the plastic mold, but that won't do any harm. Try to spill as little of the liquid as possible, though. Save the remaining solution to refill the geode as soon as you notice that the level has dropped due to evaporation.

**6** Let the crystals grow in the geode for three days. Then, carefully pour the alum solution out of the geode into the measuring cup and take a look inside the geode. Careful — it will still be dripping! If you want to grow even larger crystals, you can pour the liquid back in and let it sit a few more days. Otherwise, dilute the liquid with plenty of water and pour it down the drain!

**7** Leave the crystal geode to dry for a day. Then cut the tape with the scissors and lift the mold out of its holder.

**8** Then you can carefully lift the geode out of the mold by loosening the edges a little and pushing from the bottom. It's best to do this over a sheet of old newspaper. The bits of plaster that fall out in the process can be disposed of in the household garbage along with the newspaper. Place the geode, which will still be slightly damp, on some paper towels and let it dry for one more day.



**GEEK  
OUT!**

## WHAT'S HAPPENING?

Crystals will grow on the starter crystals embedded in the plaster and on the sharp plaster edges, creating a glittering crystalline coating that will cover the entire inner surface, just like in a real geode. In nature, geodes form in a similar manner: When hollows or cavities underground, such as in volcanic rock, become filled with hot, mineral-containing water and this water cools, minerals will crystallize on the walls of the cavity. This is exactly the way the alum crystallizes in your experiments when the temperature of the crystal salt solution drops and the water evaporates.

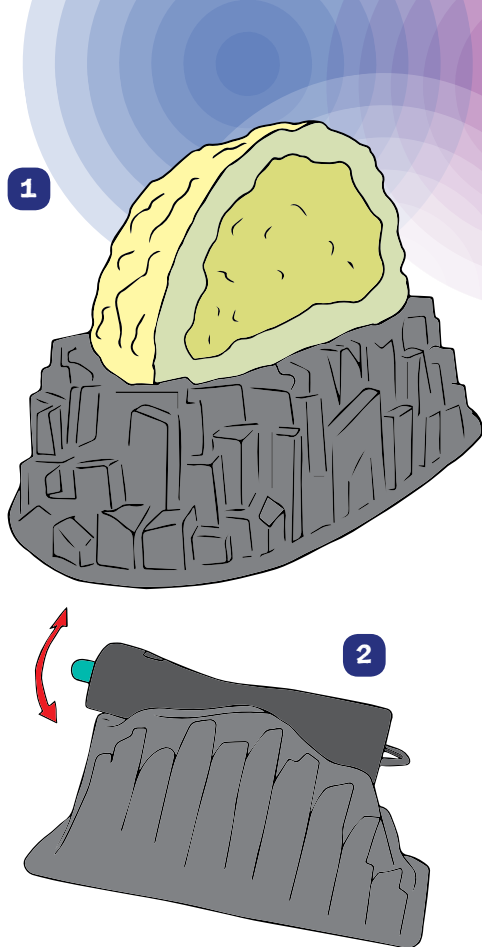
## 4. Lighting up the geode

### You will need:

Completed geode, display stand, lamp holder, UV lamp

### Here's how:

- 1 Set the completed geode on its display stand.
- 2 Push the lamp into the lamp bracket. The bracket has a pivot in the center that lets you rotate the lamp up and down in order to direct the ray of light to a specific location.
- 3 Now try shining the UV light on the geode in the dark. Experiment with various distances and angles to get the best lighting for displaying the beautiful glittering crystals at their finest.



## WHAT'S HAPPENING?

The crystal layer inside the geode shines brightly when you illuminate it with the UV light. This effect is caused by the fluorescent dye that you embedded in the crystals when you grew them. In daylight, your geode's dye gives off a yellowish light. The crystals' special structure is what is responsible for the sparkling and glittering effect. But it isn't until you get the geode into the dark and illuminate it with the black light that the fluorescent geode really shows its magical glow — a truly eye-catching light show for your bedroom.



## 5. Research with UV light

### You will need:

UV lamp, various household items: paper money, stamps, white paper or white clothing, reflective strips (for example, on schoolbags, bicycle gear, or safety vests), adhesive labels, your teeth, or a glow-in-the-dark toy

### Here's how:

- 1 View these everyday items under the UV light in a dark room of your house.
- 2 Try taking your lamp on a UV detective expedition. You are sure to find at least a few things that will glow mysteriously under the black light.

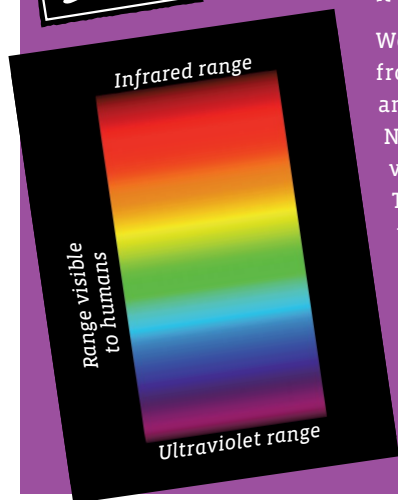


### WHAT'S HAPPENING?

A lot of objects will glow especially brightly under a UV lamp due to fluorescent or day-glow paint or ink. They capture the ultraviolet and violet daylight and convert it to red, yellow, or green light. That's why they have such a brilliant appearance and work so well in reflective markers and safety vests. In fact, they are even more effective at dusk or in overcast weather, when the daylight contains more blue. White paper and washing detergent also contain so-called optical brighteners to make white laundry or white paper look even whiter. Nowadays, paper money contains UV-reflective features to guard against forgery. Large-denomination bills have design elements printed in UV ink that are invisible under normal daylight but that show up when viewed under a black light. Some postage stamps also have features like this. In their case, the markings are used in fully-automated sorting facilities to check that the postage affixed on the letters and packages is correct. Glow-in-the-dark plastic toys will glow longer and brighter if they have been illuminated with energy-rich UV light rather than normal light.

## IS THERE SUCH A THING AS INVISIBLE LIGHT?

We humans can only see the colors of the rainbow: from red through orange, yellow, green, to blue and violet. But the sun also emits invisible light. Next to red, there is infrared light, and beyond violet lies the range of ultraviolet, or UV, light. This end of the spectrum is richer in energy than visible light and produces fluorescence, as you saw when illuminating your crystals with it. Unlike humans, many bird and insect species, including bees, are able to see UV light. That's why many flowers only reveal certain striking color patterns under UV light — while they are invisible to our eyes, they are there to attract the insects that pollinate them.



## FLUORESCENT MINERALS

There are fluorescent materials in nature too. The term fluorescence is derived from a fluorescent mineral called **fluorite**, which is where this luminous effect was first observed. Just as with your geode, the mineral emits visible light when it is illuminated with ultraviolet light, which is invisible to our eyes. This mineral fluorescence arises when foreign particles are integrated into the crystal as it grows. It only happens when certain particles are unavailable and are replaced with others. This kind of “contamination” of the crystal lattice is thus the cause of various fluorescent colors in minerals, which can look quite beautiful.

## DID YOU KNOW?

**Alum** consists of several particles assembled into its characteristic octahedron-shaped crystals. These particles contain the chemical elements potassium, aluminium, and sulfur. Its chemical name is therefore **potassium aluminium sulfate**. It also contains oxygen and hydrogen.

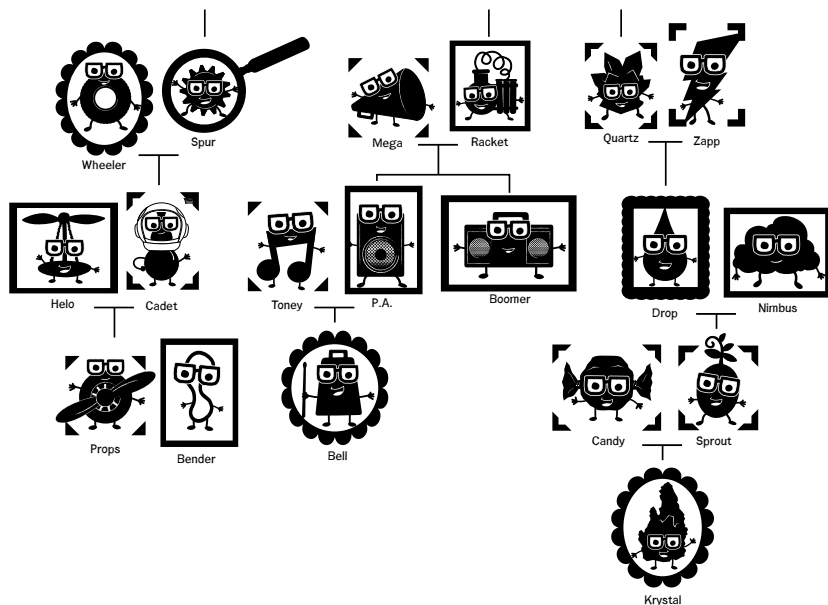




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# THE GEEKER FAMILY TREE!



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