PROJECT KIT

Ages 8+

GEEK & CO. SCIENCE!

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.

THAMES & KOSMOS

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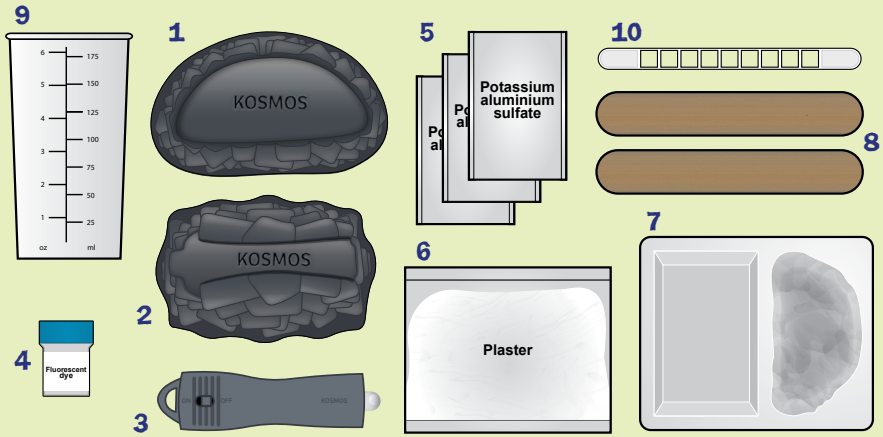
KIT CONTENTS



1	Display stand for geode
2	Lamp holder
3	UV lamp
4	Fluorescent dye (UV–active cosmetic dye), 1.5 g
5	Potassium aluminium sulfate (alum) packets, 50 g (3)
6	Plaster packet, 200 g
7	Geode mold
8	Wooden spatulas (2)
9	Measuring cup, 200 mL
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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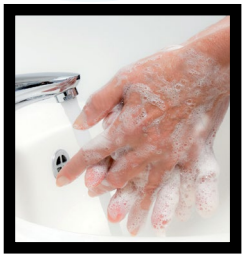
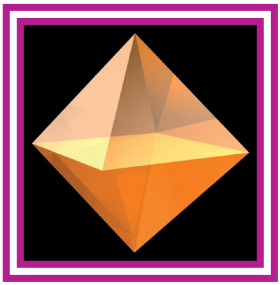




Hey Geode Geeks!

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!

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*

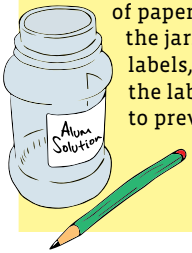
Here's how:

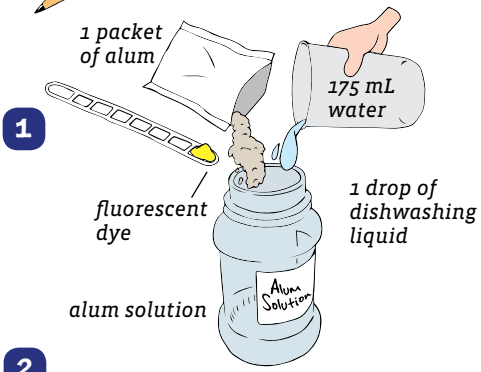
1. Cover your work surface with old newspaper. Pour the entire packet of alum (potassium aluminium sulfate) into a labeled jelly jar. Then use the measuring spoon to add a portion of fluorescent dye about the size of a pea, and follow with 175 mL (distilled) water. Stir everything with the wooden spatula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

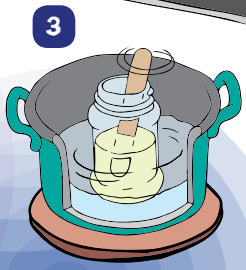
2. Now place the trivet on your work surface. Fill the old pot with about 3 cm of tap water and bring the water to a boil on the stove. Then carefully carry the pot to your work area and set it on the trivet.

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.

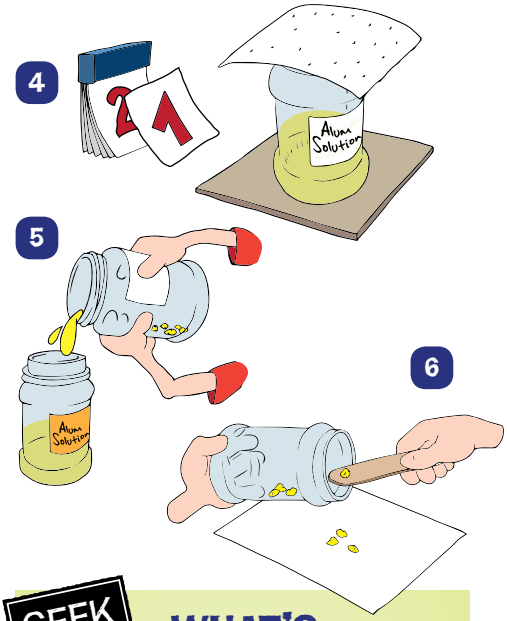
3 Set the filled jelly jar in the pot and stir with the wooden spatula until all the alum is dissolved. Then take the jar out of the pot with the hot pads and dry the outside of the jar with a paper towel. Caution, it is hot!

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 way — 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)*

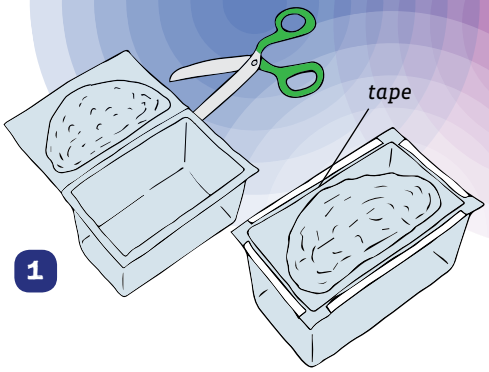
Here's how:

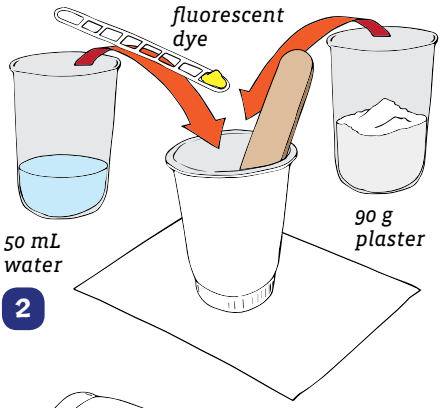
1. Cover your work surface with old newspaper. Use the scissors to separate the geode mold pieces. Set the mold for the geode's hollow portion in its holder and apply tape around the edges.

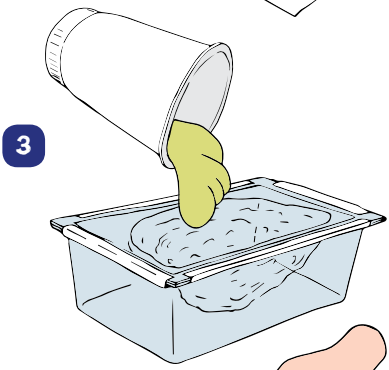
2. Fill the measuring cup with plaster up to the 100-mL mark (about 90 g) and then pour the plaster into the yogurt container. Use the measuring spoon to add a pea-sized portion of fluorescent dye and stir everything together. Now measure 50 mL of water into the measuring cup and add this to the plaster.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

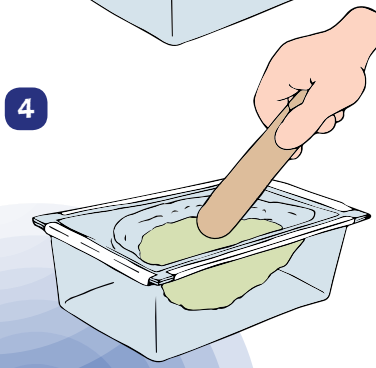
3. Pour the plaster mixture into the geode mold. It will not quite fill the mold.

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





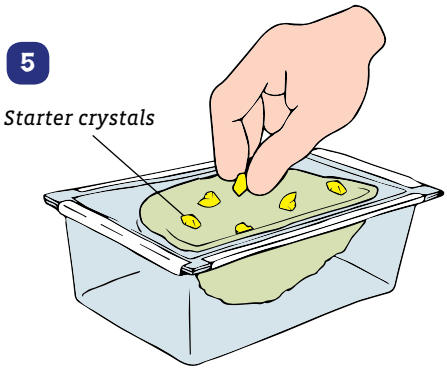




mold once the mixture begins to harden after a few minutes. Then dig a cavity in the center. You will have to work quickly. Make sure not to spread the plaster too thinly on the walls (or you risk it breaking!)

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.

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.

GEEK OUT!

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 toeholds 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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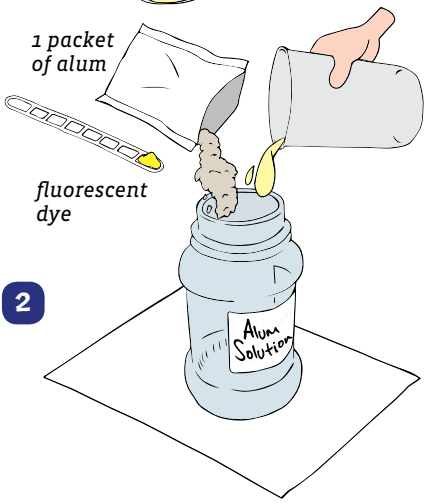

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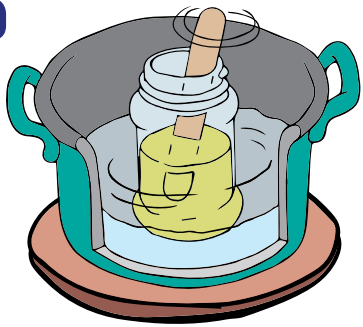

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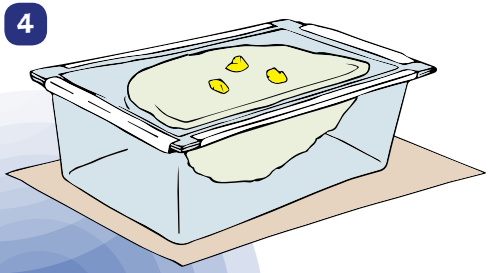


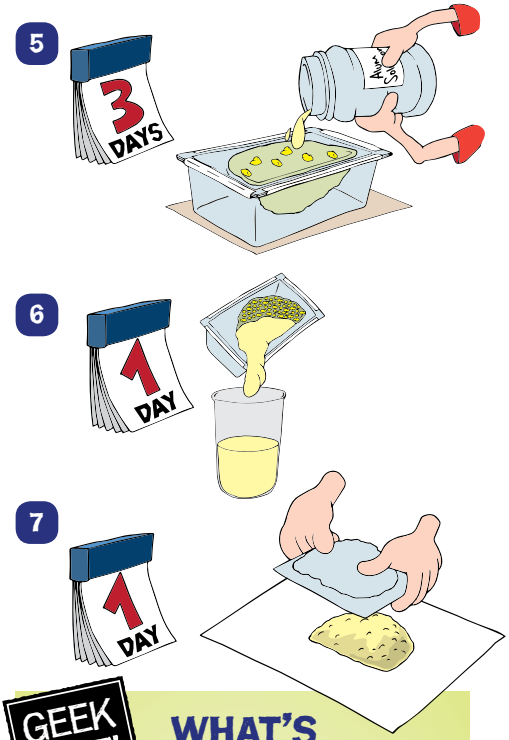
4

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:

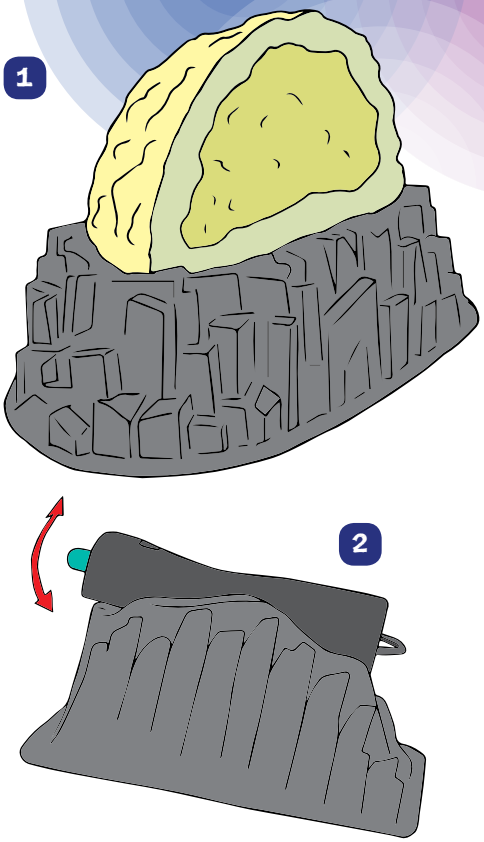
Completed geode, display stand, lamp holder, UV lamp

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.



GEEK OUT!

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.

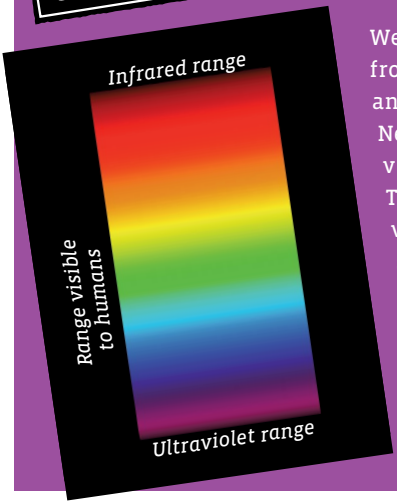
GEEK OUT!

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.

GEEK OUT!

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.