

**GEEK
& CO.
SCIENCE!**



PROJECT KIT **Ages
8+**

GLOW STICK LAB



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. Eye protection for supervising adults is not included.

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.

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Safety information

WARNING.

Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled.

Keep the packaging and instructions as they contain important information.

Read the notes on experimenting with batteries on the inside back cover.

First aid information

Advice in case any accidents should happen during experimentation.

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

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

3. In case of inhalation: Remove person to fresh air.

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

5. In case of doubt, seek medical advice without delay. Take the chemical and its container with you.

6. In case of injury always seek medical advice.

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 Center

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

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

Notes on disposal of electrical components



None of the electrical or electronic components in this kit should be disposed of in the regular household trash when you have finished using them. 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 will indicate this. The materials are reusable in accordance with their designation. 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.

Advice for parents and supervising adults

With this kit, you will be helping your child perform fun, simple chemistry experiments. It is natural to have questions about the safety of a kit that contains chemicals. The experimental equipment in this kit complies with safety standards that specify the safety requirements for chemistry sets. These standards impose obligations on the manufacturer, such as forbidding the use of any particularly dangerous substances. The standards also stipulate that adults should assist their children with advice and assistance in their new hobby.

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 acids and alkalis (bases).

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.

Due to practical considerations, some of the materials, such as cooking oil, turmeric, tonic water, and dishwashing soap, could not be included in the kit and must be acquired separately. Please have these materials ready before the experiments and provide them in small portions, which will be easier for your child to handle and will avoid the risk of anything getting into the original container.

If foodstuffs are used in the experiments, they should obviously not be eaten or drunk. There should be no eating or drinking during the experiments to avoid mix-ups.

We suggest that all liquids be poured down the drain immediately following the experiments, and that all the kit components be washed by hand, dried, and returned to the box.

The LED light should be protected from moisture, and we ask you to please help your child replace the batteries when necessary.

Have fun with your 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.*

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 out of reach of children under 8 years of age.
4. Clean all equipment after use.
5. Ensure that all empty containers and/or non-reclosable packaging are disposed of properly.
6. Wash hands after carrying out experiments.
7. Do not use any equipment which has not been supplied with the set or recommended in the instructions for use.
8. Do not eat or drink in the experimental area.
9. Do not allow chemicals to come into contact with the eyes or mouth.
10. Do not replace foodstuffs in original container. Dispose of immediately.
11. Do not use any eating, drinking, or other kitchen utensils for your experiments. Any containers or equipment used in your experiments should not be used in the kitchen afterward.
12. If chemicals should come in contact with eyes, mouth, or skin, follow the first aid advice (inside front cover of this manual) and contact a doctor if necessary.
13. Never work alone. An adult should always be present. Pay attention to the information on the chemical labels, the “Information about hazardous substances” below, and the information provided with each experiment.
14. Pay special attention to the quantity specifications and the sequence of the individual steps. Only perform experiments that are described in this instruction manual.

Information about hazardous substances

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

Strontium aluminate (green and blue glow-in-the-dark powders):

Causes skin irritation.

Causes serious eye irritation.

May cause respiratory irritation.

Avoid breathing dust.

IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do — continue rinsing.



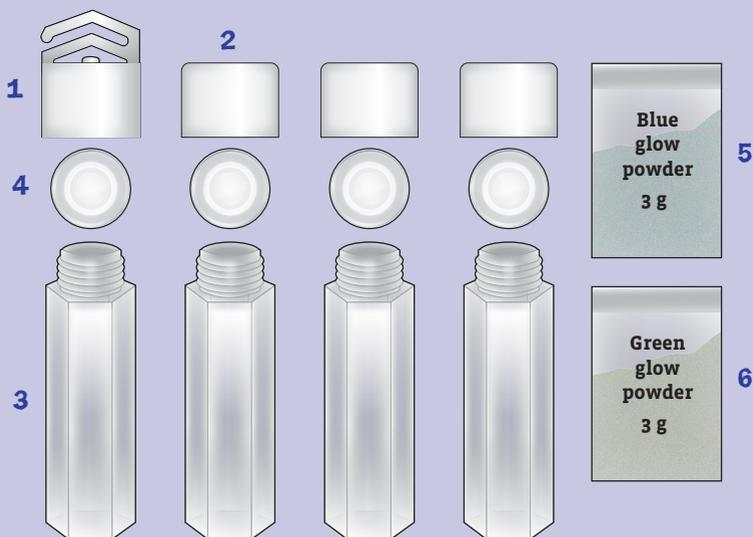
WARNING

Warning. The following applies to all chemicals: Store locked up. Keep out of reach of children.

This primarily applies to young children, but also to older children who — unlike the experimenter — have not been appropriately instructed by adults. Also follow this precautionary statement: IF SWALLOWED: Get immediate medical advice/attention and have product container or label of chemical substance at hand.

If any chemicals inadvertently get onto the skin, rinse off immediately under running water. Always be careful not to inhale chemical dust or powder when experimenting.

KIT CONTENTS



- 1 | UV LED cap with hook
- 2 | Cap without led (3)
- 3 | Hexagonal bottle (4)
- 4 | Clear stopper (4)

- 5 | Blue glow powder (Strontium aluminate, 3 grams)
- 6 | Green glow powder (Strontium aluminate, 3 grams)

YOU WILL ALSO NEED: *Water, dark room (or nighttime), light-colored vegetable oil, clear or light-colored dish soap or detergent, filter paper or coffee filter, turmeric powder, rubbing alcohol (denatured alcohol), tablespoon, measuring cup, jar, liquid laundry detergent (e.g., Tide®, Gain®, or All®), tonic water (or bitter lemon drink), small Phillips head (cross-head) screwdriver*

TO REPLACE THE BATTERIES: *3 button cell batteries (1.5 volt, 7.9 mm wide by 3.6 mm high; common names: LR41, SR41, 192, 384, 392, AG3, SG3, G3-A)*

Hey Glow Geeks!

Want to make some awesome glow sticks that shine in cool colors under UV lights and that glow in the dark? With this kit, you can make five different glowing concoctions using the included materials and materials from around your house. Then, learn why they glow! Erle the Geeker will be your guide!

Hi! I'm Erle!



PART 1

PHOSPHORESCENT GLOW STICKS

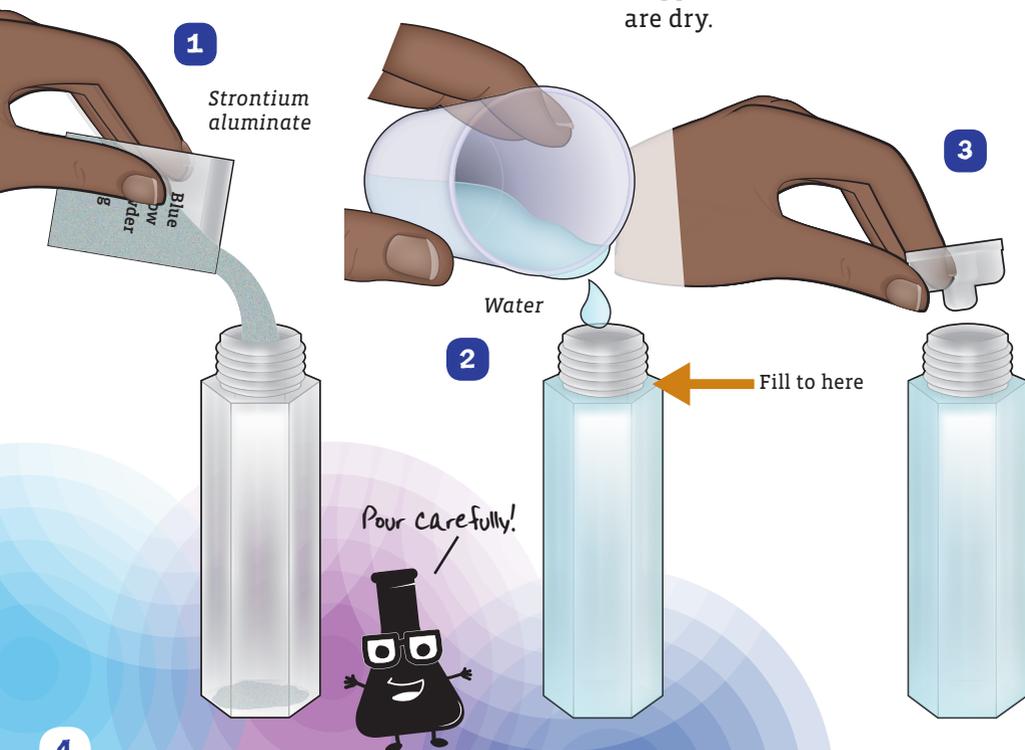
Glow-in-the-dark powder in water

You will need:

UV LED cap with hook, cap without led, hexagonal bottle, clear stopper, glow powder (blue or green, 3 grams), water, dark room (or do this at night)

Here's how:

- 1 Pour 3 grams of glow powder into the hexagonal bottle.
- 2 Fill the bottle up to the bottom of the threaded stopper, neck with water.
- 3 Insert the clear stopper and press it tightly into the bottle's opening. Make sure the top of the stopper and outer bottle threads are dry.



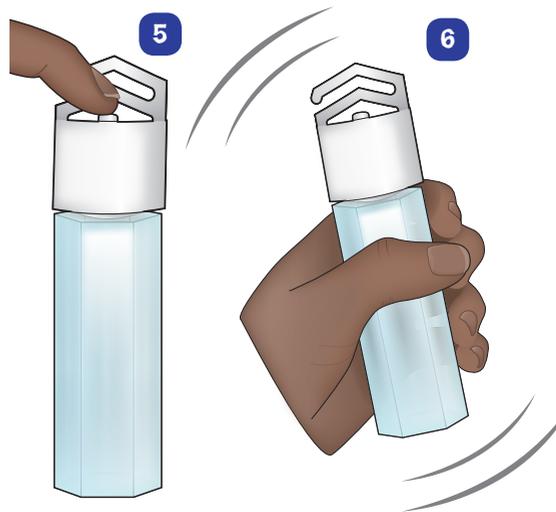
4 Screw on the LED cap tightly and your first glow stick is ready!

5 Press the button to turn on the LED light. A second push turns it to on-off blinking mode (every 10 seconds). A third push turns it off again.

6 Shake up the glow stick when the powder starts to settle.



7 Take the glow stick into a dark room and you will see it glow! The darker the room, the better you will be able to see the glowing effect.



TIP!

There are enough stoppers and caps so you can keep up to four glow mixtures at a time, and simply move the LED cap from bottle to bottle. When a bottle is not in use, secure it with the cap.

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WHAT'S HAPPENING?

When **strontium aluminate** is **doped** (or treated) with some elements, such as europium, it becomes **phosphorescent**. This means it absorbs light energy and then re-emits light slowly over a period of time. When the UV LED is on, the light “charges” the glow chemical. When the LED is off, the glow chemical is no longer being “charged” and its glow will slowly become dimmer.

Blue Glow Powder



A second glow-in-the-dark solution

In the first experiment, you may have noticed that the glow powder sank to the bottom of the bottle after a little bit of time. This is because the glow powder does not dissolve in the water. Instead, it is just temporarily suspended in the water. This is a mixture called a **suspension**.

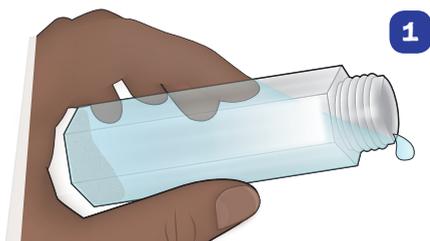
In this experiment, you can make a translucent, longer lasting suspension.

You will need:

Glow stick from the first experiment, light-colored vegetable oil, clear or light-colored dish soap or detergent, dark room (or do this at night)

Here's how:

- 1 Complete the first experiment. Let the glow powder settle and pour about 1 inch of the water off of the top.
- 2 Pour $\frac{3}{4}$ of an inch of vegetable oil and $\frac{1}{4}$ of an inch of clear dish soap into the bottle to fill the empty space.
- 3 Insert the clear stopper and press it tightly into the bottle's opening. Make sure the top of the stopper and outer bottle threads are dry.



2 $\frac{3}{4}$ inch of vegetable oil

$\frac{1}{4}$ inch of clear dish soap

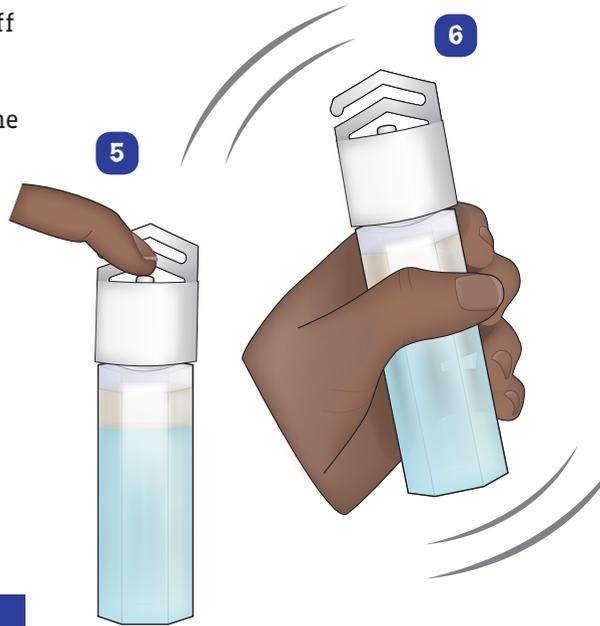
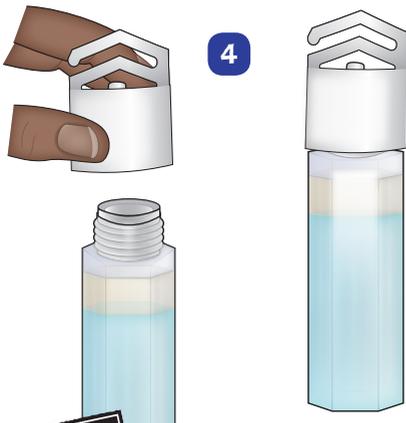


4 Screw on the LED cap tightly and your glow stick is ready!

5 Press the button to turn on the LED light. A second push turns it to on-off blinking mode (every 10 seconds). A third push turns it off again.

6 Shake up the glow stick when the mixture starts to separate.

7 Take the glow stick into a dark room and you will see it glow! The darker the room, the better you will be able to see the glowing effect.



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WHAT'S HAPPENING?

Particles of soap have a water-loving side (**hydrophilic**) and a water-hating side (**hydrophobic**). The water-loving side sticks to water molecules while the water-hating side sticks to the oil. When you shake it up, the water and oil become evenly dispersed by the presence of the soap. They do not separate as quickly as they would without the soap. The glow powder particles get caught up in the thick mixture. This type of mixture is called an **emulsion**.

Green Glow Powder



PART 2

FLUORESCENT GLOW STICKS

Neon glow from the spice drawer

You will need:

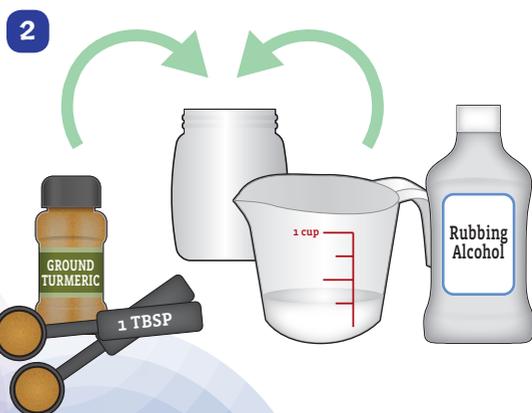
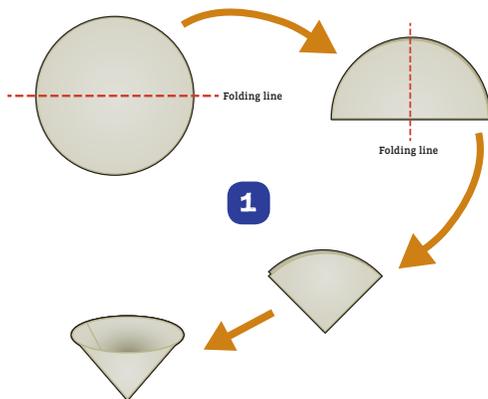
UV LED cap with hook, cap without led, hexagonal bottle, clear stopper, filter paper or coffee filter, turmeric powder, rubbing alcohol (denatured alcohol), tablespoon, measuring cup, jar, water, dark room

Here's how:

- 1 Make a cone out of filter paper (such as a coffee filter) as shown here.

- 2 Mix 2 tablespoons of turmeric powder and 1/4 cup of rubbing alcohol in a glass jar.

- 3 Pour the mixture through the filter into a clean hexagonal bottle.



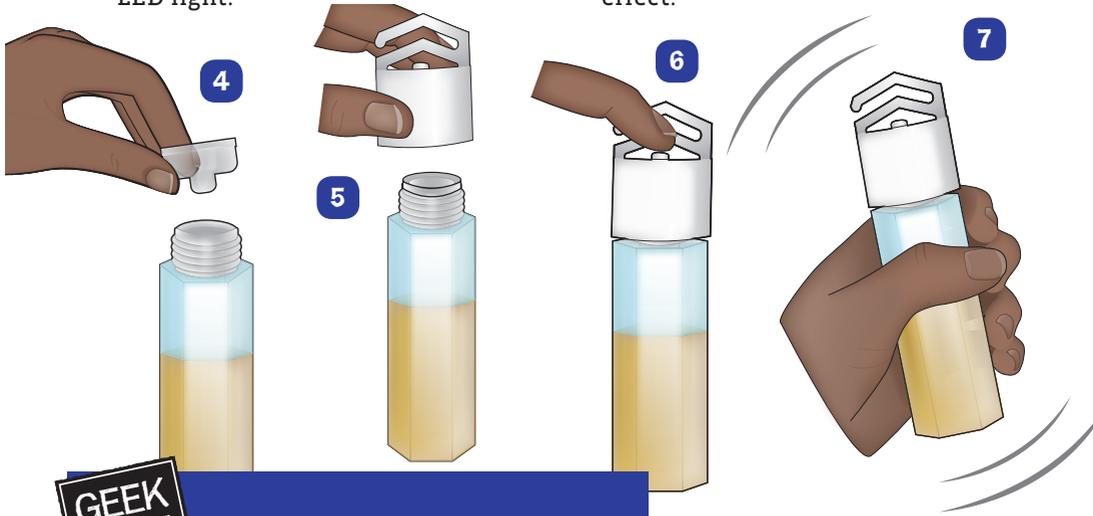
4 Insert the clear stopper and press it tightly into the bottle's opening. Make sure it's dry on the outside.

5 Screw on the LED cap tightly and your glow stick is ready!

6 Press the button to turn on the LED light.

7 Shake up the glow stick when the powder starts to settle.

8 Take the glow stick into a dark room and you will see the turmeric powder glow as long as the LED is shining on it! The darker the room, the better you will be able to see the glowing effect.



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WHAT'S HAPPENING?

Turmeric is a spice that comes from the root of a plant in the ginger family. It is used a lot in Indian cuisine. Turmeric contains a UV-fluorescent substance called **curcumin** that glows a bright chartreuse color in ultraviolet light, or UV for short. The LED in your glow stick emits UV light, which has a shorter wavelength and higher energy than visible light. Materials that are **fluorescent** under UV light absorb the light and then immediately re-emit light. Usually the emitted light has a lower energy and a longer wavelength and is therefore visible. As long as the UV light shines, the curcumin fluoresces.



Neon glow from the laundry room

You will need:

UV LED cap with hook, cap without led, hexagonal bottle, clear stopper, liquid laundry detergent (e.g., Tide®, Gain®, or All®), water, dark room

Here's how:

- 1 Pour liquid laundry detergent (one with optical brighteners, such as Tide®, Gain®, or All®) into a clean hexagonal bottle, up to a height of 1 inch in the bottle.
- 2 Fill the bottle up to the bottom of the threaded neck with water.



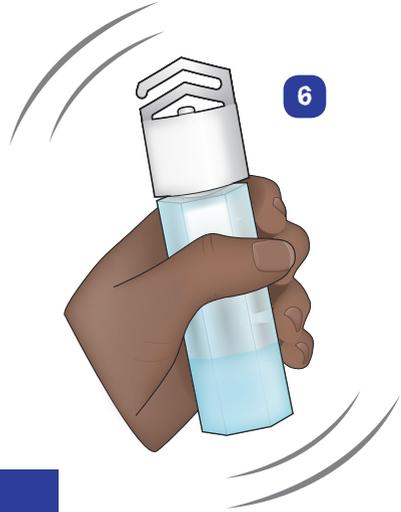
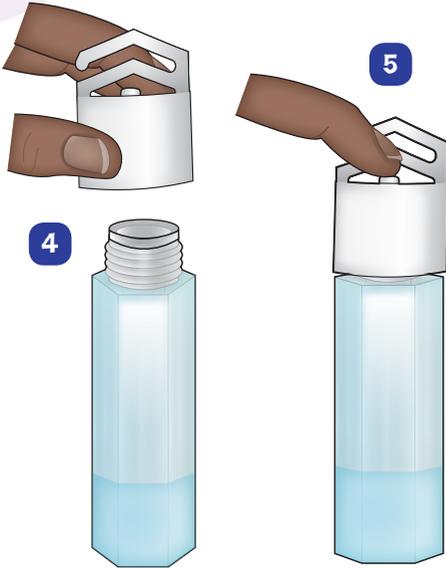
- 3 Insert the clear stopper and press it tightly into the bottle's opening. Make sure the top of the stopper and outer bottle threads are dry.

4 Screw on the LED cap tightly and your glow stick is ready!

5 Press the button to turn on the LED light.

6 Shake the glow stick to mix the detergent and water.

7 Take the glow stick into a dark room and you will see the solution glow as long as the LED is shining on it! The darker the room, the better you will be able to see the glowing effect.



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WHAT'S HAPPENING?

The detergent solution glows with a mysterious light blue light. There are chemical substances in the detergent that absorb the UV light and convert it into visible light. This phenomenon is known as fluorescence. Detergent manufacturers add fluorescent substances (known as **optical brighteners**) to their products to make your washed laundry whites look more dazzling. Paper manufacturers use the same method to make their white paper look brighter. Some dance clubs and amusement parks use UV light (also known as black light) to create special lighting effects for their customers to enjoy.

Neon glow from the soda bottle

You will need:

UV LED cap with hook, cap without led, hexagonal bottle, clear stopper, tonic water (or bitter lemon drink), dark room

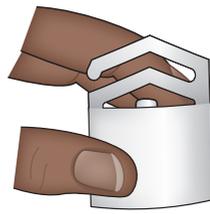
Here's how:

- 1 Fill the hexagonal bottle up to just beneath the threaded neck with tonic water.

- 2 Insert the clear stopper and press it tightly into the bottle's opening. Make sure the top of the stopper and outer bottle threads are dry.
- 3 Screw on the LED cap tightly and your glow stick is ready!



- 4 Press the button to turn on the LED light.
- 5 Take the glow stick into a dark room and you will see the solution glow as long as the LED is shining on it! The darker the room, the better you will be able to see the glowing effect.
- 6 Never drink or eat foodstuffs that you experiment with. Pour the tonic water down the drain when you are done.



3



4



Hey, how's it glowing?



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WHAT'S HAPPENING?

The effervescent beverages tonic water and bitter lemon are fluorescent under UV light. They contain very small quantities of **quinine**, a bitter substance obtained from the bark of the cinchona tree. Quinine consistently absorbs light in the UV spectrum and emits light in the cyan blue (light blue) range. Quinine was formerly used as a medicine for malaria.

You can also create a really cool light effect with quinine by making a tonic water ice cube in the freezer: Fill one ice cube tray compartment with tonic water and stir until all the air bubbles have disappeared. Place it in the freezer until the tonic water is frozen solid. Place the ice cube in a glass of water and shine the UV light on it as it melts! After the experiment, pour the liquid down the drain.

5

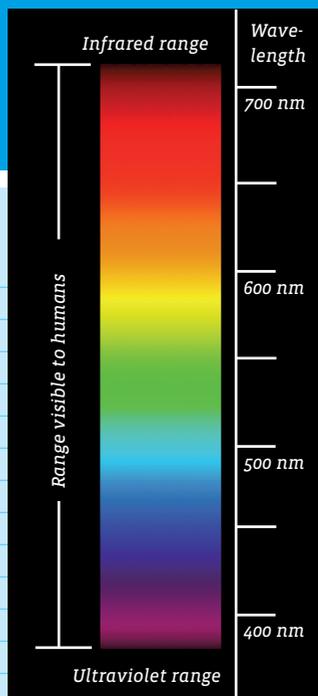


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THE LIGHT SPECTRUM

The sun emits invisible light in addition to visible light. In a rainbow, you see the colors that are visible to the naked eye. Each end of the rainbow is bordered by light that our eyes cannot see! There is an infrared range that borders red light as well as an ultraviolet range that borders violet light.

Ultraviolet light (or UV light for short) displays some astonishing properties. It has a higher energy and a shorter wavelength than visible light, which means it behaves differently than visible light in many ways. For example, it has a much stronger effect on photographic film (which is how it was discovered in the first place), it tans the skin, and it produces fluorescence, as you saw with the laundry detergent and tonic water. Strong ultraviolet light from the sun is very useful in nature. Unlike humans, many bird species, honeybees, and bumblebees can see UV light. That is why a lot of flowers (such as dandelions and orchids) have patterns that are only visible to humans under UV light, and that are invisible to the human eye normally.



Luminescent light is emitted without heat, and is also known as **cold light**. There are many types of luminescence. **Chemiluminescence** is light emitted by a chemical reaction, like glow sticks and glowing diatoms in the ocean.

A solid substance that lights up when exposed to energy, like light or electricity, is called a **phosphor**. A phosphor can be **phosphorescent**, which stays glowing after the energy source is removed, or **fluorescent**, which only glows while the energy is present and for a brief moment after. Conventional glow sticks and glow-in-the-dark stars are made of phosphor. In this kit, the strontium aluminate mixtures are phosphorescent and the other solutions are fluorescent.

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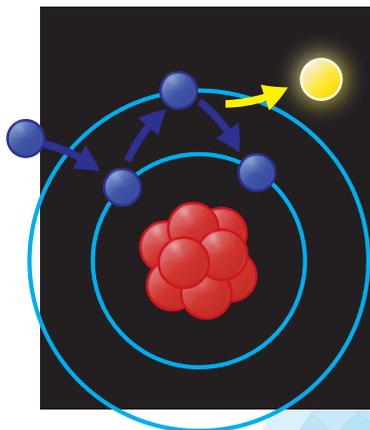
GLOW STICKS

You have probably seen conventional **glow sticks** during Halloween time or at nighttime parties. They are also used during emergencies and rescue operations.

Glow sticks contain chemicals that produce light when they mix together. The chemicals mix when the flexible plastic outer tube holding one chemical is bent enough to break a smaller glass tube inside of it, which holds a different chemical.

The chemicals in the outer tube are diphenyl oxalate and a dye, while the inner tube contains hydrogen peroxide. When the chemicals mix, energy is released, which excites the dye to a higher energy state. When the dye returns back to its normal energy state, it releases photons of light. Depending on the specific dye used, the light will be red, blue, green, pink, or yellow in color. The dyes are called fluorophores.

This reaction produces a dangerous byproduct called phenol which is corrosive and toxic. This is why they are completely sealed inside thick plastic. Once the reaction is complete, the glow stick cannot be reused. Obviously, the glow sticks in this kit work in a very different way.



WHY DO FLUOROPHORES LIGHT UP?

Energy from the reaction excites **electrons** in the atoms in the fluorophores causing them to jump up to another energy level. When they fall back down, they release light energy, or **photons**. The chemical reaction provides a continuous cycle of energy to excite the electrons and make the fluorophores glow steadily. When the reaction stops, the fluorophores stop glowing. However, they may still glow under a UV light, which also provides the energy they need to glow.

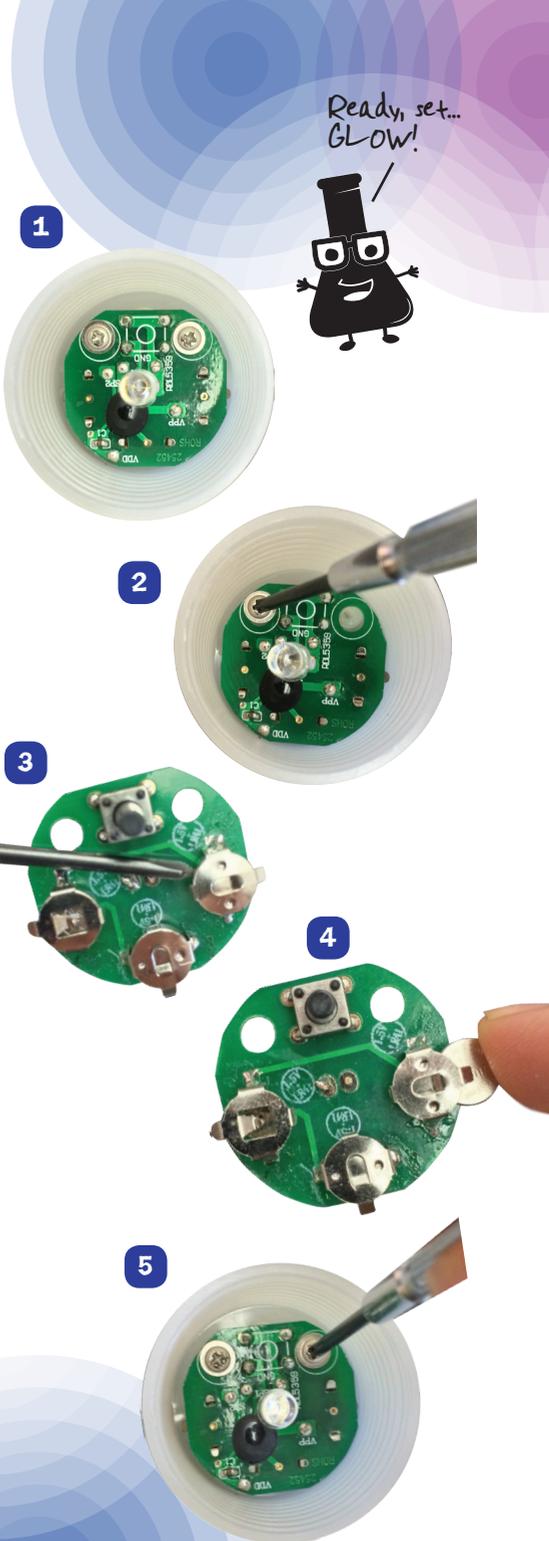
How to replace the batteries

You will need:

UV LED cap with exhausted batteries, small Phillips head (cross-head) screwdriver, 3 button cell batteries (1.5 volt, 7.9 mm wide by 3.6 mm high; common names: LR41, SR41, 192, 384, 392, AG3, SG3, G3-A)

Here's how:

- 1 Unscrew the LED cap from the bottle and turn it over.
- 2 With a small Phillips head screwdriver, unscrew the two screws holding the circuit board in place. Set the screws aside in a safe place.
- 3 Remove the circuit board from the cap and turn it over. With the screw-driver, gently press the three exhausted batteries out of the battery holders.
- 4 Gently press the three new batteries into the battery holders. Make sure you insert them in the same orientation as the batteries you removed.
- 5 Place the circuit board back inside the cap, aligning the screw holes with the screw pegs and making sure the push button slides into its hole. Fix the circuit board in place by screwing the screws back into the cap.





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 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.

Notes on experimenting with batteries



Warning. Only suitable for children over 8 years. Instructions for parents or other supervising adults are included and must be followed. Save the packaging and instructions. They contain important information. The wires are not to be inserted into socket-outlets. Never perform experiments using household current! The high voltage can be extremely dangerous or fatal!

Three button cell batteries (1.5 volt, 7.9 mm wide by 3.6 mm high; common names: LR41, SR41, 192, 384, 392, AG3, SG3, G3-A) are included. Refer to the manual for battery replacement instructions.

Different types of batteries or new and used batteries are not to be mixed.

Do not mix old and new batteries. Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.

Always insert batteries in the right

polarity orientation, pressing them gently into the battery compartment. 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 supply terminals are not to be short-circuited. A short circuit can cause the wires to overheat and the batteries to explode.

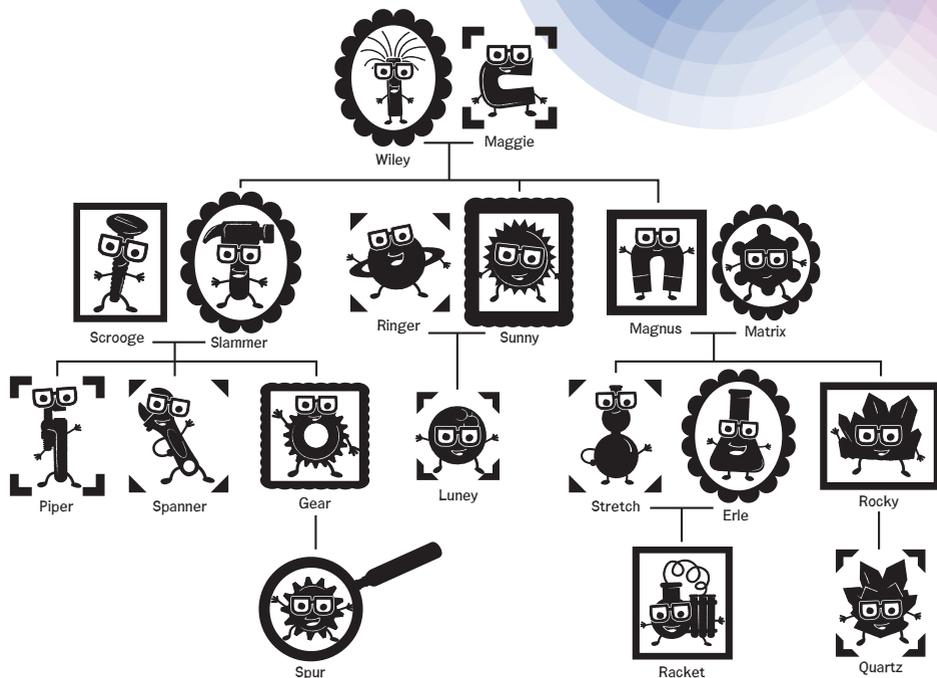
Dispose of used batteries in accordance with environmental provisions.

Be sure not to bring batteries into contact with coins, keys, or other metal objects.

Avoid deforming the batteries.

Have an adult check the toy before you use it so you can be sure it was assembled properly!

MEET THE GEEKERS!



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