# Change is Bright with Light Sticks

At-Home

The glow of a chemical light stick (also called a glow stick) comes from a chemical reaction. There are a couple of different chemical compounds in the stick. One is kept inside of a glass tube, while others are outside of it. All of this is sealed inside of a plastic tube that is safe to hold. When you break the glass tube inside by bending the stick, the chemicals mix, react, and glow! Explore the chemistry of glow sticks in this activity.

## Question to investigate

**How can you slow the glow of a light stick so that the light lasts longer?**

## Chemistry concepts

- The light given off when solutions inside a glowstick mix is a clue that a chemical reaction is taking place.
- The intensity of the light provides a clue about the rate of the chemical reaction.
- Temperature can affect the rate of a chemical reaction.
- When a glowstick no longer releases light, the chemical reaction is over.

## Activity logistics

- **Ages**: As written, this activity is suited for ages 5-12.
- **Time**: 20-30 minutes

## Be Safe

- Safety glasses suggested.
- Caution: hot liquids!
- Use an insulated oven mitt or potholder to hold container of hot water.
- Be careful when removing the light stick from hot water.
- To avoid contact with the chemicals, do not cut open the light sticks.

**Disposal:** At the conclusion of all observations, the light sticks can be disposed of in the regular household trash. Pour excess water down the drain.

## General Safety Guidelines

- Ask an adult for permission to do the activity and for help when necessary.
- Read all directions and safety recommendations before starting the activity.
- Wear appropriate personal protective equipment (safety glasses, at a minimum), including during preparation and clean up.
- Tie back long hair and secure loose clothing, such as long sleeves and drawstrings.

- Do not eat or drink food when conducting this activity.
- Clean up and dispose of materials properly when you are finished with the activity.
- Thoroughly wash hands after conducting the activity.

## What you'll need

- 3 light sticks (Cyalume or generic glow sticks)
- 3 tall clear plastic or glass cups that are taller than the light sticks
- Oven mitt or potholder
- Kitchen tongs
- Cold water made by placing several ice cubes in water
- Hot tap water (do not use water that is hotter than 120°F, or about 50°C)

## Procedure

1. Fill one clear cup with ice water and another with hot water. Fill each to a level that will mostly cover the light stick. Be sure to use an oven mitt or potholder to handle the cup of hot water.
2. Bend three light sticks. Listen closely! You might be able to hear the glass tube inside of the light stick breaking. Shake each light stick to help the chemicals mix.
3. At the same time, place one light stick in the cold water, and another one in the hot water. Place the final one in the empty cup as a control.
4. Wait several minutes. If necessary, wipe the outside of each cup with a towel so you can clearly see the light sticks. Compare the brightness of the light sticks in cold water and hot water to the control light stick at room temperature. Add ice cubes to the cold water as needed.
5. Use kitchen tongs to switch the light sticks in the cold and hot water.

## What did you observe?

How does the intensity of the light in the light sticks change after several minutes in the hot and cold water?

What happens to the intensity of the light in the light sticks after you switched them from cold to hot water and from hot to cold water?

How can you slow the chemical reaction in the light stick down so that your glow stick lasts longer?

## How does it work?

A light stick contains more than one chemical. One solution is inside the glass tube and another is outside the tube, but inside of the plastic glow stick. One solution is a phenyl oxalate ester mixed with a fluorescent dye and the other solution is hydrogen peroxide. When you bend the light stick, the glass tube breaks, which causes the solutions to mix and chemically react. The energy of the reaction is transferred to the dye, which produces the light. The intensity of the light is related to the reaction rate.

By changing the temperature, you can slow down or speed up the reaction. Did you notice that the glow is dimmer from the light stick in the cold water than in the hot water? The reaction in the light stick in the cold water is happening more slowly because the cold temperature slows down the molecules of the chemicals inside the light stick. That causes them to collide less, and react more slowly.

Light sticks will continue to glow as long as the chemical reaction is happening. Eventually all light sticks get to a point when they no longer produce light. This is because the chemicals were used up in the chemical reaction. When the chemical reaction inside a light stick ends, it stops glowing. If you observed the light sticks over a few hours, after a while the light stick in the hot water becomes dimmer than the light stick in the cold water. This is because all of the chemicals have been used up in the faster reaction of the light stick in the hot water.

Now your challenge is to see if you can apply what you've learned to make your light sticks last as long as they can! (Hint: think of a cold place you have in your home!)

*This activity is adapted from an activity that originally appeared in the* Celebrating Chemistry *issue for National Chemistry Week 2021, written by David A. Katz.*