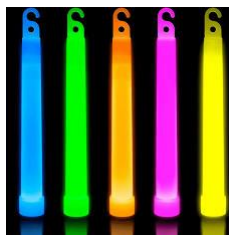


Let It Glow

Plastic tubes filled with chemicals are sure to get a reaction!



Students love anything that glows! This activity uses glowsticks to illustrate how chemical reactions can produce light and how temperature can affect reactions.

Activity Challenge

Investigate the effect of temperature on the relative brightness of glowsticks placed in different water baths.

Preparation

1. Review the Materials Needed list, gather required items, and put them in a work area that can be darkened.
2. Prepare 4 separate water baths by filling large cups with the following:
 - a. Room temperature water (68°-72° F). Water feels neither hot nor cold.
 - b. Warm tap water (90°-110° F). Water feels hot, but not painful.
 - c. Cold water + ice (¼ cup). Stir to mix.
 - d. Cold water + salt (2 teaspoons). Stir to dissolve, then stir in ¼ cup ice.
3. Optional: measure exact temperatures with a thermometer in each water bath.

To Do

Warning: Glowstick chemicals can cause discomfort to bare skin. If a glowstick begins to leak, dispose of it and wash exposed skin with soap and water.

1. In a darkened area, activate 4 glowsticks (preferably the same color) by bending them until an audible cracking noise is heard.
2. If using a glow bracelet or necklace, crack along the entire length of the glowstick. Shake the glowsticks to mix the chemicals inside.
3. Insert an activated glowstick into each water bath. Leave the glowsticks in each cup for about 3 to 5 minutes.

Observations

- After 3 to 5 minutes, observe the relative brightness of each glowstick.
- Which glowstick was the brightest? Which was the least bright?
- What conclusions can be drawn from this investigation about the effects of temperature on glowstick brightness?

Material Needed

- Glowsticks, glow bracelets or glow necklaces (attainable at party stores)
- Large clear cups
- Cold and warm water
- Ice
- Salt
- Measuring spoons/cups
- Dark work area
- Optional: Thermometers (submersible)

Grade Range

3-5
6-8

Topics/Skills

Structure and Properties of Matter
Mixtures
Chemical Reactions

Learning Standards

NGSS: [Structure and Properties of matter](#); [Chemical Reactions](#)

Duration

15-30 minutes

Prep Time

5-10 minutes

Extensions

- Leave the glowsticks in each of the water baths. Note what happens to their brightness over time. What is the relationship between glow time and temperature?
- Activate a glow stick, then place in freezer. Does it glow when frozen? Defrost the next day. Does it start to glow again when it thaws?
- Repeat the investigation with different colors/types/sizes of glowsticks.
- Download a light meter app onto a smartphone or tablet and measure the glowstick brightness for each temperature water bath.

The Science behind the Activity

Glowsticks contain 2 liquid chemical solutions. One of the chemical solutions is placed in a sealed vial to keep the 2 solutions separate. To generate light the glowstick needs to be bent until the inner vial breaks, allowing the 2 solutions to mix and react. The reaction releases energy that results in colored light being given off by the fluorescent dye in the glowstick solution, a process called **chemiluminescence**. These chemicals, usually hydrogen peroxide and a solution of a phenyl oxalate ester and a colored fluorescent dye, mix and release energy as the chemical reaction is taking place. The energy produced by the reaction causes electrons in the fluorescent dye to jump to higher energy levels. As electrons in the fluorescent dye fall back to lower energy levels, the released energy is emitted in the form of photons of light. The color of the light is determined by the color of the fluorescent dye.

Changes in temperature can greatly affect the rate of a chemical reaction, such as the chemical reactions within a glowstick. When the mixed chemicals in a glowstick are cooled they have less kinetic (motion) energy. The molecules are moving more slowly, reactions are slowed, and less light is produced. When a glowstick is heated the molecules have more kinetic energy, collide more frequently with more energy, causing the reaction rate to increase which causes the glowstick to emit a brighter light for a shorter time period.