NO PREP

The Chemistry of Glow Sticks

Includes: Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

The Chemistry of Glow Sticks

Light Without Heat

On Halloween night, glow sticks light up costumes, trick-or-treat bags, and haunted houses. These colorful tubes work through a process called chemiluminescence, which is the production of light from a chemical reaction without heat. Unlike fire or electricity, which give off both light and heat, glow sticks release energy only as light. This makes them safe for children to carry and perfect for creating eerie effects in the dark. Inside every glow stick are two compartments: one filled with a liquid containing hydrogen peroxide, and another sealed glass vial containing a different liquid made of phenyl oxalate ester and a fluorescent dye. When the stick is bent, the glass vial breaks, allowing the liquids to mix. The chemical

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The Science Behind the Glow

The reaction in glow sticks involves several steps. First, hydrogen peroxide oxidizes the phenyl oxalate ester. This creates an unstable compound that quickly breaks down into carbon dioxide and energy. The energy excites the dye molecules, pushing their electrons into a higher energy state. As the electrons return to normal, they release light. Temperature plays an important role. In warmer conditions, the reaction happens faster, making the glow brighter but shorter-lasting. In colder conditions, the reaction slows down, producing dimmer light that lasts longer. This is why people sometimes put glow sticks in the freezer to extend their glow time.

Halloween and Everyday Science

Glow sticks are more than just toys; they are examples of chemistry in action. They show how chemical reactions can create light safely and efficiently, while also adding to holiday fun. By understanding the science behind them, students can see how

everyday objects connect to the principles of chemistry and how innovation makes celebrations safer.

Key Information: Table: Glow Stick Chemistry at a Glance

Component	Role
Hydrogen peroxide	Oxidizes other chemicals to release energy
Phenyl oxalate ester	Reacts to form unstable compounds
Fluorescent dye	Emits visible light in different colors
Glass vial	Keeps chemicals separate until activated
Temperature	Controls brightness and duration of glow

Case Study: Safe Chemical Reactions for Halloween Fun

Glow sticks became popular in the 1970s, originally developed for military use as emergency lights. Their safety and portability quickly made them popular for recreational use, especially at concerts and holiday celebrations like Halloween. Unlike candles or sparklers, glow sticks do not produce flames or heat, making them safe for children. They also do not require batteries or electricity, which makes them reliable in emergencies. However, while glow sticks are safe when used properly, they should not be cut open or ingested. The chemicals inside can cause skin irritation or other health problems. Public health campaigns often remind parents to supervise children and dispose of used glow sticks properly. This case demonstrates how chemistry can create both fun and safe alternatives to traditional light sources, balancing enjoyment with safety.

1. Why were glow sticks originally developed, and how did their use expand?

2. Why should glow sticks never be cut open or ingested?

_____

_____

Multiple Choice

1. What type of process makes glow sticks light up?
    a) Chemiluminescence
    b) Combustion
    c) Fluorescence only
    d) Photosynthesis

2. What is the role of fluorescent dye in a glow stick?
    a) To keep the reaction cold
    b) To absorb excess heat and prevent damage
    c) To mix chemicals safely
    d) To emit visible light in different colors

3. How does cold temperature affect a glow stick?
    a) The glow is dimmer but lasts longer
    b) The glow is unaffected
    c) The glow is brighter but shorter
    d) The glow stick stops glowing immediately

Matching

Write the letter of the correct definition on the line next to each term.

Term	Definition
1. ___ Hydrogen peroxide	A) Reacts to form unstable compounds
2. ___ Phenyl oxalate ester	B) Keeps chemicals separate until activated
3. ___ Fluorescent dye	C) Oxidizes chemicals to release energy
4. ___ Glass vial	D) Controls brightness and duration of glow
5. ___ Temperature	E) Emits visible light of different colors

Fill-in-the-Blank

1. The process of producing light without heat in glow sticks is called _____.

2. Glow sticks were first developed for the _____ to use as emergency lights.

3. Warmer temperatures make glow sticks brighter but _____-lasting.

Short Answer

Answer each question in 2-4 complete sentences.

1. Why are glow sticks considered safer than candles or sparklers during Halloween?

_____

_____

_____

2. How does the chemical reaction in glow sticks demonstrate the transfer of energy?

3. What does the popularity of glow sticks reveal about the relationship between science and culture?