EASY | 6-12 | 30 MINS *followed by 24 hours to observe*

1. Discover the work of Edwin Chandross
2. Investigate the effect of temperature on glowstick brightness
3. Learn about chemiluminescence and bioluminescence

STORIES IN CHEMISTRY

THE GREAT GLOWSTICK CHALLENGE

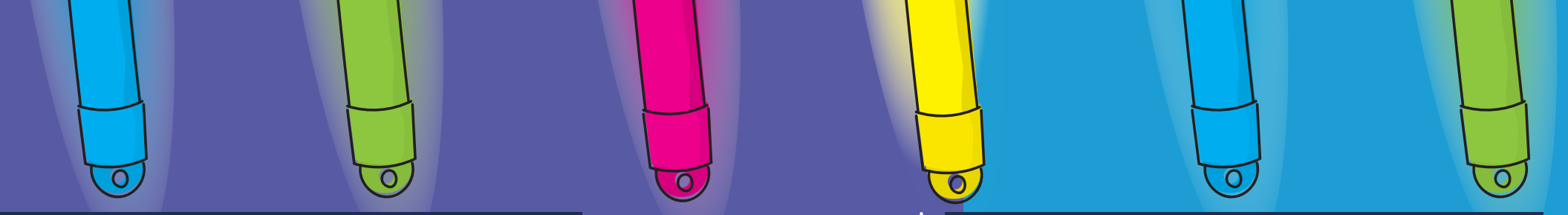
Illustration: Edwin Chandross

Salters' Institute

ENCOURAGING TOMORROW'S **CHEMISTS TODAY**

DISCOVER MORE ACTIVITIES AT **SALTERSINSTITUTE.ORG/RESOURCES**

IN PARTNERSHIP WITH SALTERS' PUBLIC PROGRAMMES INSPIRING LEARNERS OF ALL AGES



INTRODUCTION

Edwin Chandross was an American chemist born in the 1930s, in Brooklyn, USA.

He was especially interested in chemical reactions that produced light. In 1962 he discovered the chemical mixture required to make glowsticks by accident when experimenting in the laboratory. He was investigating a chemical called luminol and accidentally discovered that adding another chemical caused it to glow brightly. His initial discovery only glowed faintly, at just 0.1% of the strength of today's glow sticks.

Modern glowsticks use the same basic chemical reaction as Edwin discovered and incorporate a range of different coloured dyes. Different chemical dyes can produce different colours of glowing light ranging from red, orange, yellow, green and blue to white.

Glowsticks are useful because they produce light without heat. They are portable, waterproof, and do not require electricity. They can be used during emergencies and power cuts, by the armed forces, by divers and miners, and also just for fun.

DID YOU KNOW?

Edwin Chandross did not initially think his discovery would be very useful. Yet, the global glowstick market is now estimated to be worth just under two hundred million US dollars per year.

SAFETY

- **Take care with glowsticks - never puncture or cut the plastic glowstick tube.**
- **Glowsticks contain strong chemicals (similar to bleach) and may stain fabrics or cause irritation to skin and eyes.**
- **This activity should be supervised at all times.**

ACTIVITY

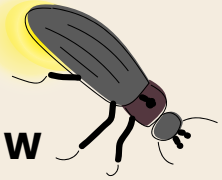
INVESTIGATE THE EFFECT OF TEMPERATURE ON GLOWSTICK BRIGHTNESS

To commemorate the work of Edwin Chandross, the experiment below will demonstrate the effect of temperature on the rate of a chemical reaction.

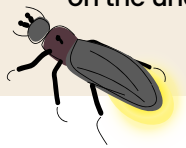
INSTRUCTIONS

1. Remove glowsticks from the packaging and bend entire length of glowstick. You may hear some snapping noises. Shake the glowsticks until they glow brightly.
2. In a darkened room, lay out the glowsticks on a table and take a photo.
3. Label each glowstick using the paper, pen and tape: 2 labelled 'hot', 2 labelled "room temperature", 2 labelled "fridge" and 2 labelled "freezer".
4. Ask an adult to fill a hot water bottle with hot (not boiling) water. Place the 2 glowsticks labelled "hot" under the hot water bottle cover to keep them warm.
5. Place the 2 glowsticks labelled "freezer" in a freezer. Place the 2 glowsticks labelled "fridge" in a fridge. Leave the 2 glowsticks labelled "room temperature" at room temperature.
6. After about 8 hours, collect the glowsticks and take them to a darkened room and observe what happened. Then return to the correct places according to their labels. After 24 hours, observe them again in a darkened room. Compare your observations. Why do you think this has happened?

DID YOU KNOW



Many animals, bacteria and fungi can produce light – such as fireflies, glow-worms, squid and some deep-sea fish. Light produced by chemicals within the bodies of animals and plants is called bioluminescence. Bioluminescence is used for a variety of functions – such as to attract mates, to confuse or distract predators, to lure prey and as camouflage on the underside of marine species.



YOU WILL NEED

- 8 glowsticks (any colours)
- Paper, pen and tape to label glowsticks
- Hot water bottle
- Access to a fridge
- Access to a freezer
- Access to a kettle
- Access to a darkened room
- Camera

WHAT'S HAPPENING?

When two chemicals react to produce light, scientists call this chemiluminescence. Glowsticks contain two different chemicals (and a coloured dye) kept separate by a thin layer of glass. When the glowsticks are bent and the glass is broken, the two chemicals can mix. The two chemicals react together causing the dye particles to release energy as a burst of glowing light. As the chemicals react together, they are slowly used up and eventually the glowstick stops glowing.

Most chemical reactions happen slower at colder temperatures and faster at higher temperatures. The hot water bottle heats the chemicals so the reaction will glow brighter at first, but the chemicals are used up quickly. The glowsticks in the freezer will react slowly and they may appear dimmer although the reaction will last longer, sometimes for weeks.