

# MODULE: *Chemical Change*

## Episode 1: Chemistry Watch

### Activity Sheet 1.2: Energy – Exothermic and endothermic reactions

#### Part 1

Below is some information on exothermic and endothermic reactions. Read the information and discuss it with your partner.

#### Endothermic Reactions

These take in energy from the surroundings. The energy is normally transferred as heat, where the reaction mixture and its surroundings get colder. The decrease in temperature can be measured with a thermometer:

**REACTANTS + HEAT → PRODUCTS**

#### Examples

- the reaction between an acid and a base (e.g. ethanoic acid and sodium carbonate).
- the breakdown of a substance by an electric current (e.g. water), or by heat in a lime kiln at 825 °C (e.g. calcium carbonate):

calcium carbonate + **HEAT** → calcium oxide +  
carbon dioxide

(Limestone)

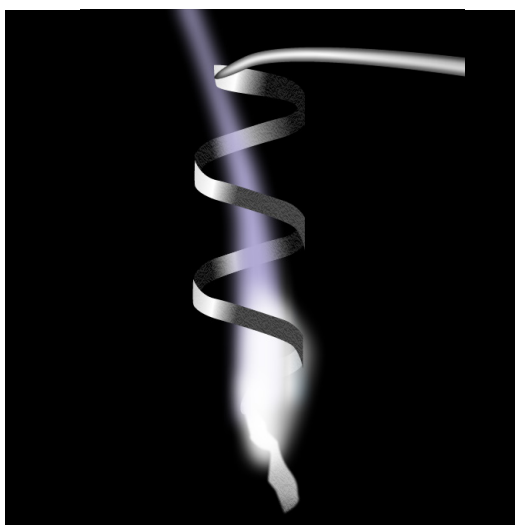
(quicklime)

- some others include: dissolving ammonium nitrate or ammonium chloride in water, or reacting barium hydroxide with ammonium nitrate.

## Exothermic Reactions

These are reactions that transfer energy to the surroundings. The energy is normally transferred as heat energy, so that the reaction mixture and its surroundings get hotter. The increase in temperature can be measured with a thermometer:

**REACTANTS** → **PRODUCTS** + **HEAT**



Magnesium burning in air in a Bunsen burner flame

## Examples

- Burning:

magnesium metal in oxygen → magnesium oxide + **HEAT**

- Neutralisation:

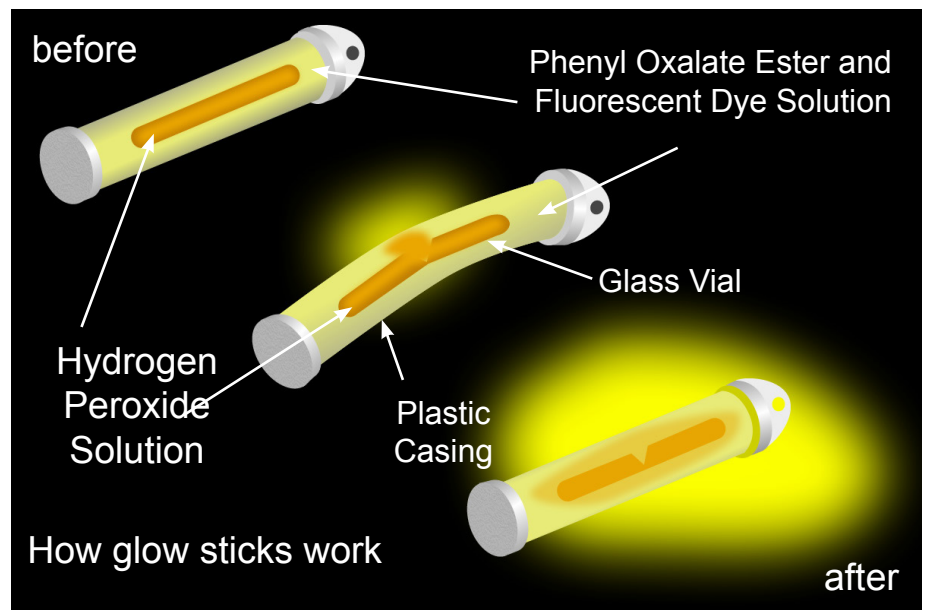
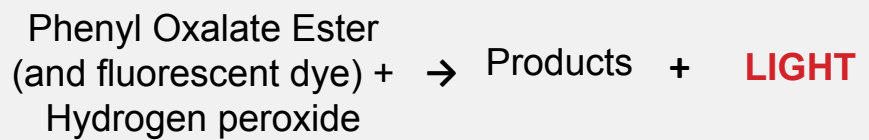
sodium hydroxide + hydrochloric acid → sodium chloride + water + **HEAT**

calcium oxide + water → calcium hydroxide + **HEAT**

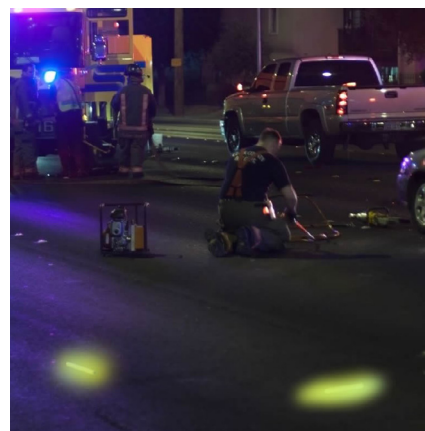
calcium chloride + water → calcium ions + chloride ions + **HEAT**

While exothermic reactions usually give out energy in the form of heat, some produce little or no heat and release their energy by the emission of light. These 'glowing' reactions are referred to as chemiluminescence.

Chemiluminescence is used in glowsticks.



## Part 2



### Investigation brief

You are part of a group of chemists working for the Government Defence Ministry. The Military have asked you to find out if 'glow sticks' would be effective light sources to use for night time manoeuvres. They want information about its usage in normal temperatures as well as in both hot (up to  $60\text{ }^{\circ}\text{C}$ ) and cold temperatures (around  $0\text{ }^{\circ}\text{C}$  or less) in underwater and melting ice conditions. They want to know what happens to the intensity or brightness of each glow stick and how long it takes for a change to occur at the different temperatures. You will need to plan, carry out and write a report of your investigation for the military.

1. Summarise the problem your group has been set.
2. Think about and write down your hypothesis.
3. Draw up an investigation plan to test your hypothesis. This should help you to:
  - Use the basic laboratory equipment and materials provided.
  - Observe and compare the intensity (amount) of glow coming from the glow sticks and the

time it takes for the reaction to occur (at room temperature).

- Collect the above data at the hot and cold temperature conditions stated in your brief.
  - Remember that you should try to conduct your investigations out of direct sunlight. You should discuss ideas in your group for doing this in the classroom or laboratory.
  - Estimate the time it will take to set up and collect your results in order to finish in good time.
  - Draw up a short list of the safety precautions you should take and check with your teacher before you start.
4. In your group, summarise the key findings of your investigation. You will use these in a report.

**Finding 1:**

**Finding 2:**

**Part 3** Here are some further questions to think about. Give reasons and justification for your answers:

1. What do you think you would see if you had one glow stick in a cold environment and another in a hot environment and you swapped them around?
2. Would it be a good idea to store glow sticks in a fridge before using them and would they give off a glow for longer?
3. Would the brightness of glow be more or less?
4. How does increasing the temperature affect the speed at which the chemical reaction occurs?

**Part 4 Evaluation**

1. How well do you feel your team carried out the investigation?
2. How well did you work in your team?