

2b. SUSTAINABLE FUEL: ELECTRICITY TO GAS

30 MINS

Children observe what happens when an electric current is passed through water, seeing how the combined hydrogen and oxygen in liquid water are released as gases. Seeing this process and understanding that it is reversible is central to children learning about the work of scientists in making hydrogen fuel cells for electric vehicles.

TYPE OF ENQUIRY

Observing changes over time

OBJECTIVES

Demonstrate that changes of state are reversible changes. (Y5 materials)

Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible. (Y5 materials)

Make systematic and careful observations (non-statutory)

SCIENCE VOCABULARY

change of state, liquid, gas

RESOURCES

For adult demonstration only

- **Activity Sheet 4**
- **PowerPoint presentation:** Electricity to gas
- 1ltr transparent jug or beaker
- 15 cm x 15cm card (enough to cover the top of measuring jug)
- 2 carbon rods² (fixed to card - see diagram in activity notes)
- 2 crocodile clip wires
- Sticky tape (to secure wires and card)
- 9v zinc chloride PP3 battery³

SAFETY GUIDANCE

To avoid short circuiting the battery, ensure the carbon electrodes do not touch each other, and that the wires are connected to electrodes before connecting to the battery. Do not leave the cell running for extended lengths of time. Once the children have clearly seen the bubbles, disconnect the wires from the battery before the electrode at the end of the demonstration.

²Ensure these are purchased from a reputable science education supplier, such as Philip Harris. At the time of publication, a pack of 10 costs £11.15 +VAT and P&P. Alternatively, borrow the equipment from a local secondary school.

³9v PP3 batteries must be used, and purchased from a reputable education supplier, such as Philip Harris. Typical price at the time of publication is 65p - £1.00 from a wide range of suppliers.

For comprehensive safety guidance regarding use of batteries in the classroom, the CLEAPSS guidance document Batteries for practical circuit work has up to date advice⁴

PRIOR KNOWLEDGE/EXPERIENCE

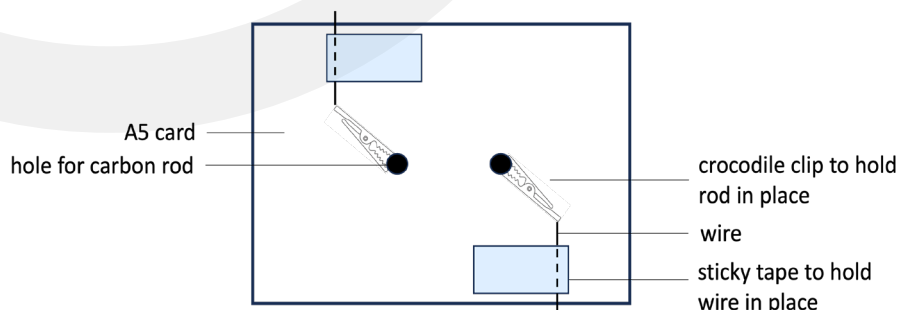
Children should have observed changes in state of water from liquid to gas and been introduced to the idea that this process is reversible (evaporation and condensation). They should also have been introduced to the idea that some changes result in the formation on new materials.

ACTIVITY NOTES

Start by reading the letter from Emily Nesling, scientist at Johnson Matthey (**Activity Sheet 4**) to the class to introduce the Sustainable Fuel challenges.

Carry out the Electricity to gas demonstration. You can construct the equipment before the lesson or with the class watching, as it is quick to assemble.

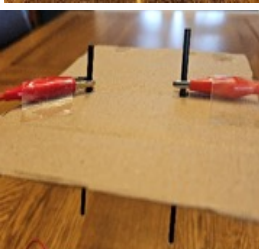
Making your carbon rod holding device:



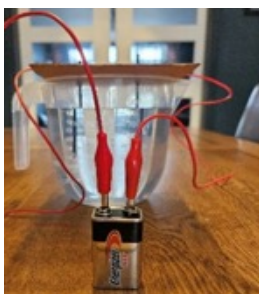
The demonstration:



1. Fill a transparent jug three-quarters full with water.



2. Add the carbon rods through the holes in the card, ensuring they do not touch.
3. Attach a crocodile clip to a carbon rod, securing it with sticky tape to the card.
4. Repeat for the second rod and wire.



5. Attach the crocodile clips at the other end of each wire one to the battery terminal.
6. Observe the rods in the water.

Note: You will need to wait 5-10 minutes to see small bubbles forming

⁴For comprehensive safety guidance regarding use of batteries in the classroom, the **CLEAPSS** guidance document **Batteries for practical circuit work** has up to date advice.

Children should see bubbles of gas gathering at each of the carbon rods. Oxygen gathers at one rod, and hydrogen gathers at the other.

Use the Electricity to gas presentation to explain to children how the demonstration relates to work scientists and engineers are doing to generate electricity from hydrogen.

Explain that fuel cells go through many stages of computer design and modelling before the final product is made. A prototype, or full-scale model, is made and tested to find out whether the modelled design works, then it is mass manufactured in a factory. Scientists and engineers make decisions together about how successfully tested prototypes will be manufactured on a large scale.

QUESTIONS FOR THINKING

- What do you see happening?
- What do you think the bubbles are?
- Why do you think that?
- Are the bubbles different at each rod?
- What states of matter can you see in this activity?
- Where is the electricity coming from?
- Where are the gas bubbles come from?
- Do you know any other changes of state which are reversible?
- Do you know any irreversible change of state where new materials are made?
- Do you know of any other renewable ways of getting electricity?

USING THE PRESENTATION SLIDES

Explain that fuel cells go through many stages of computer design and modelling before the final product is made. Scientists and engineers then make decisions about how they will be manufactured on a large scale. A prototype, or full-scale model, is made to check the design works, then the design is mass manufactured in a factory.

BACKGROUND INFORMATION

This information is for teacher use only. It is not intended to be used with children, as most of the science is beyond the Key Stage 2 curriculum.

Electricity can be used to get hydrogen and oxygen gases from water. This is a reversible process, and hydrogen fuel cells use hydrogen gas to generate electricity. This is a more sustainable process than burning fossil fuels such as natural gas, coal, and oil.

Scientists and engineers design, test and build fuel cells and their component parts, for use in electric vehicles. Electric vehicles which use electricity generated from sustainable sources, are much better for the environment than those which burn fossil fuels found in petrol and diesel.

The electricity generated from this type of fuel cell is clean which makes it better for our planet than using fossil fuels.

INDUSTRY LINKS AND AMBASSADORS

Ambassadors visiting the classroom could bring examples of the equipment used in the workplace to separate water into hydrogen and oxygen. This process is called 'electrolysis' but this language is not needed in the primary classroom, when more important primary science vocabulary is being introduced to children. Videos and images are an effective way to show items which are too big or unsafe to bring into the classroom.

Video conferencing could also be used so children get to see a scientist working in their lab and have their questions answered.

This electrolysis is safe to carry out in the primary classroom. Visiting lab-based scientists developing hydrogen fuel cell technology, or engineers working at a manufacturing plant would provide an opportunity to see the process of electrolysis in practice in a real-world context.

STEM CAREERS



Dan is a project manager at Johnson Matthey and is responsible for working out how fuel cells can be made in large quantities and whether they have the right machines and equipment.

You can learn more about Dan and STEM careers linked to sustainable fuel in **Activity 6**.