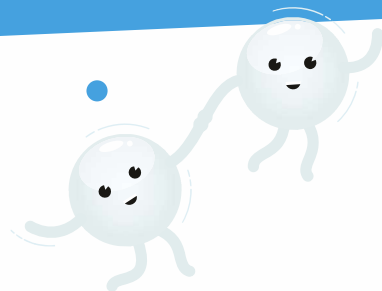


## 16. Hydrogen bus

A remote-control bus,  
powered by hydrogen gas



### Overview

The hydrogen-powered bus is a remote-controlled model, which links to real-life examples of hydrogen-powered bus fleets across the UK.

### What's happening?

The hydrogen-powered bus is a remote-control bus, converted to be powered by two hydrogen fuel cells attached to the top of the bus. Instead of the battery pack that originally provided the power, the flow of electrons (electricity) is provided straight from the output of these fuel cells, into the electrical motor of the bus.

The hydrogen the bus runs on can come from either a prepared balloon of hydrogen (see activity 13) or from the Hydrostik (Activity 14). Kit is supplied to connect either of these sources of hydrogen to the hydrogen fuel cells in the bus. The bus should run for at least five minutes from a balloon containing 2 litres of hydrogen gas.

### Why is this important?

Hydrogen powered buses already exist around the UK. The largest fleet of buses in Europe is in Aberdeen, with the current fleet of ten buses set to double after an announcement by the Scottish Government earlier this year. Using hydrogen to power mass transportation vehicles is where many people see the immediate future of hydrogen fuel cell vehicles. Fuel cell cars such as the Toyota Mirai are currently commercially available, but the hydrogen refuelling infrastructure systems currently available favour centralised transport systems such as buses running from a single depot. Showing audiences that even a remote-controlled bus can be powered by a balloon filled with hydrogen gas should be a powerful demonstration of the energy carrying capacity of hydrogen gas.



## The Activity

This is an interactive piece of kit that can be driven around the stage or performance area. You can get audience members to come up and have a shot of controlling it if you are confident it can be maneuvered safely. If using the balloon on top, the gas from the balloon feeds into the fuel cells to provide the electrical current, but the balloon won't go down in size that much as the fuel cell needs so little hydrogen to run.

## More stories to tell

### How do the fuel cells produce electricity?

The fuel cells used in this activity are the same as the demonstration fuel cells provided in the kit. These cells take the hydrogen that is supplied and split it into protons and electrons. Hydrogen atoms that have lost an electron only have protons left, which are conducted through the semipermeable Proton Exchange Membrane (PEM). The electrons are forced to travel round the membrane to reach the anode that they are attracted to. An electrical device that draws a current is placed within this circuitous route, and the flow of electrons provides electricity.

### How is the fuel cell controlled?

Connected to the fuel cell on the bus there is an Arduino controller and fuel cell controller shield which regulate the fuel cell output and manage the purging and pulsing of the fuel cell. These control strategies help to ensure the 'health' of the fuel cell over time.

## Troubleshooting

When the hydrogen gas is connected, the fuel cells will need to 'charge up' for around one minute, after which enough hydrogen will have been used by the cells to create an electrical flow to start the bus, and begin driving it around. If the motor cuts out, this is generally because the pressure of the hydrogen gas going into the fuel cells has dropped. Giving the balloon a little squeeze, and restarting the bus (by pressing the start button on the controller) should get it going again.

## Health and Safety



The bus uses hydrogen, which is a flammable gas, and therefore needs to be kept away from naked flames and sources of ignition.

