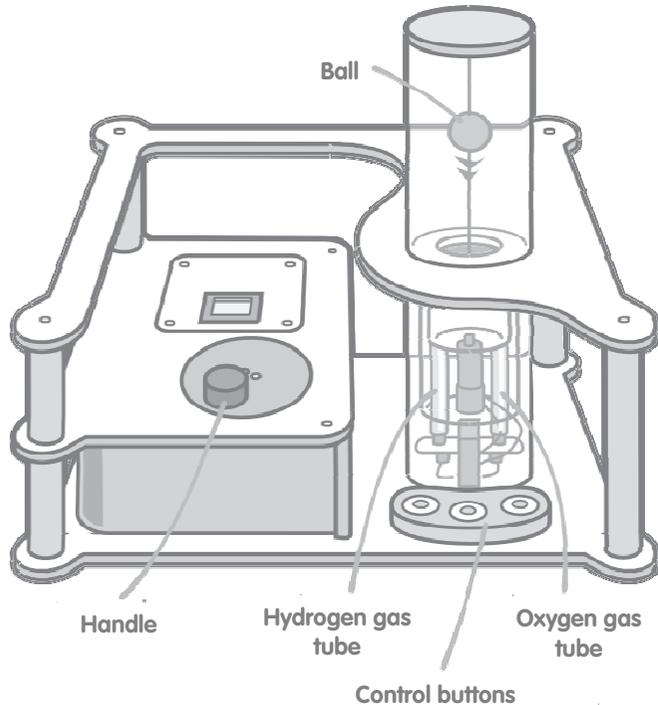


FUTURE FUEL

Challenge



Hydrogen could be the fuel of our future. It may even replace gas, oil and coal that are fast running out. Hydrogen is a clean fuel and is readily available.

What's happening?

In this exhibit, hydrogen gas is being made by **electrolysis**—a technique that uses an electric current to separate elements: In this case hydrogen and oxygen.

Before you start

Water is plentiful on Earth and a great source of hydrogen

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1. Water is a compound made up of two different atoms— **hydrogen** and **oxygen**.

Turn the handle to separate the water in the tubes. One fills with hydrogen and the other one fills with oxygen. Look at the two tubes to see them filling with the two different gases.

a) What do you observe about the volume of each gas that collects in each tube?

More hydrogen collecting than oxygen

b) Explain your answer

HINT: think about the chemical formula for water, H₂O

There are double the amount of hydrogen atoms than oxygen atoms in the water molecule.

Keep turning until the hydrogen tube is full of gas.

Press the hydrogen and oxygen buttons together to release the gases.

Then **immediately** press the 'heat' button.

Note: pressing the 'heat' button will heat this mixture of hydrogen and oxygen.

c) What happened?

There was an explosion and the ping pong ball was pushed up in the air

d) Can you explain why?

Hydrogen is a fuel and it combusted / burned in the oxygen. The explosive reaction exerted an upwards force on the ball.

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Burning hydrogen in oxygen is an **exothermic** reaction, meaning heat energy is released. This rapid release of heat energy causes the air around to expand very suddenly—producing the **explosion**.

2. Experiment

This time release **all** the hydrogen as before, but **different** amounts of oxygen. (you will need to watch carefully to estimate how much)

Record your observations in the table below:

Amount of hydrogen released	Amount of oxygen released	OBSERVATIONS Volume of explosion	OBSERVATIONS Height of ball
All	All		
All	Half	As the amount of oxygen is reduced, the volume of the explosion should	As the amount of oxygen is reduced, the height of the ball should
All	Quarter	Reduce (to zero)	reduce (to zero)
All	None		

Tip: If the ball chamber gets damp the 'heat' button may not work. Before each trial test the 'heat' button to check it glows. If it doesn't, wait a moment and try again.

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3. Conclusion

a) What effect did reducing the amount of oxygen have?

Reducing the amount of oxygen in the mixture reduced the height of the ball, and also the volume of the explosion.

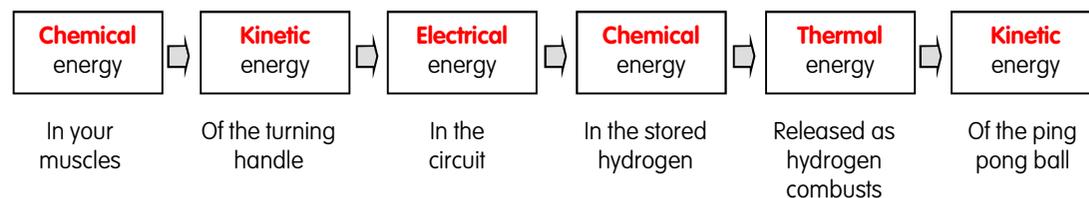
b) Explain your answer

The oxygen is needed to burn the hydrogen and releases energy. With less oxygen the hydrogen does not burn completely. Less energy is released and so the ball is not pushed as far into the air.

4. Energy transfer

Energy can be transferred between forms

Complete the energy transfers, selecting words from the box below. E



Eight forms of energy (you can use some more than once)

Electrical	Light	Sound	Gravitational potential
Kinetic	Thermal (heat)	Chemical	Elastic

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5. Chemical equations

Below are two word equations for the processes you have observed.

Add the correct labels

	Electrolysis or Combustion?	Exothermic or Endothermic?
water \longrightarrow hydrogen + oxygen	electrolysis	endothermic
hydrogen + oxygen \longrightarrow water	combustion	exothermic

Electrolysis is a technique that uses an electric current to separate elements—here, hydrogen and oxygen.

Endothermic is a reaction that takes in heat, which is the opposite to **exothermic** reactions.

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6. Balancing equations

Chemical equations are equal on both sides

Add the correct numbers to the boxes so that there are the same number of atoms on each side.

