

# Fruity Batteries



## Topic

Chemical reactions

## Introduction

We can use the energy from chemical reactions to provide electrical energy. The devices that enable us to do this are called batteries, and they are used to power hundreds of devices, from flashlights and portable music systems to railcars and automobiles. A battery is made up of chemical cells. In this experiment you will be comparing the strength of some simple chemical cells. When a metal is placed in an electrolyte (a solution that conducts electricity) it acquires an electrical charge. A second metal dipped in the same electrolyte acquires a different electrical charge. There is a potential difference between the two metals, and if we connect them together we can measure the voltage generated using a voltmeter. This arrangement is called a chemical cell. The greater the potential difference between the two metals, the greater the voltage generated – and the more powerful the cell.

## Time required

45 minutes

## Materials

0–1V voltmeter (preferably digital)  
bell wire for connecting leads  
crocodile clips  
a variety of soft fruits, such as oranges, lemons, kiwi fruit, grapefruit  
sharp knife  
clean strips of copper, aluminum, zinc, iron, magnesium (all approximately the same size)

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## Safety note



Take care when cutting up the fruit. Hold the fruit firmly and cut only on a proper cutting board.

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## Procedure

### *Part A*



1. Take one fruit and carefully cut it in half. Use the top line of data table A (on the next page) to record which fruit you have chosen to test.



**Part B**

1. Take two different metals and set up the circuit as in Part A. Record which two metals you have chosen and the voltage reading in data table B.

DATA TABLE B	
Metals tested: ..... and .....	
Fruit	Voltage (volts)



2. Repeat stage 1 using the same two metals but a different fruit.
3. Record the name of the new fruit and the new voltage reading in the data table.
4. Repeat the process until you have tested each fruit.

### Analysis

**Part A**

1. Which combination of metals gave the highest reading on the voltmeter?
2. What do you think would have happened if you had tested two strips of the same metal?

**Part B**

1. Which fruit gave the highest reading on the voltmeter?
2. Using your answers to the questions above, see if you can predict which combination of metals and fruit would give the highest reading on the voltmeter – in other words, would make the most powerful battery.

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### *Part A*

1. The metals giving the highest voltage reading are magnesium and copper. This is predicted from the electrochemical series. The electrochemical series lists the metals in order of reactivity. For the metals used the order is:

magnesium  
aluminum  
zinc  
iron  
copper

where magnesium is the most reactive and copper the least reactive. The greatest difference in reactivity is between magnesium and copper, so the potential difference (voltage) generated will be the greatest when these two metals are used.

2. Using two strips of the same metal will not produce a voltage, since there is no difference in reactivity and therefore no potential difference.

### *Part B*

1. Different fruits have different internal resistances and so give different voltages. The results you obtain will also depend on the freshness of the fruit!
2. You should find that the most powerful battery will be one made using copper and magnesium strips embedded in the most powerful fruit you tested.