

## Lithium-ion rechargeable batteries

### *Education in Chemistry*

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Lithium-ion batteries power much of our modern lives, from our mobile phones to our laptops. In this activity you will look at the chemistry of how they work. Then in the second part you will look at some problems caused by the manufacture and disposal of lithium-ion batteries.

### Chemistry of lithium-ion batteries

**01** A simple cell can be made by connecting two different metals in contact with an electrolyte. A scientist makes a simple cell by connecting an electrode made from copper to an electrode made from a different metal.

**Table 1** shows the voltage the different metals produced when combined with copper in a cell and the density of the metals.

Metal	Voltage produced by combining metal with copper in V	Density of metal in g/cm <sup>3</sup>
Iron	0.78	7.86
Lithium	3.37	0.53
Lead	0.47	11.34
Magnesium	2.71	1.74

**01.1** Suggest **two** reasons why lithium is used to make mobile phone batteries.

Use **Table 1**.

**01.2** Explain why non-rechargeable cells eventually stop working.

**01.3** Describe what happens to the reaction inside a rechargeable cell when it is recharged.

**01.4** Give **one** environmental advantage of a rechargeable cell compared with a non-rechargeable cell.

**01.5** Describe how a battery is made from cells.

**01.6** Early lithium-ion cells used lithium metal as the negative electrode. In the electrode reaction the lithium atoms lose an electron to become lithium ions.

Write a half equation to show how lithium atoms lose an electron to become lithium ions.

**01.7** Group 1 metals easily lose electrons when used as a negative electrode.

Explain whether lithium or sodium would lose electrons more easily.

**01.8** The electrolyte used in lithium ion cells does not contain water.

Suggest why it should not contain water.

### **Life-cycle assessment for lithium ion batteries**

**02** Much of the world's lithium is mined from salt flats in South American countries. The mines are often in areas where indigenous people live. A lot of water is needed to extract and process the lithium.

A company manufactures lithium batteries. They conduct a life-cycle assessment to assess the environmental impact of their product.

Suggest some issues the company should consider when extracting and processing the raw materials for their batteries.

**03** The company needs to consider the disposal of the battery at the end of its useful life.

Read the article [New power, old batteries](#).

**03.1** Explain the difference between reusing a battery and recycling a battery.

**03.2** Explain why it is has been difficult to recycle lithium batteries.

**03.3** Describe how legislation could be used to make batteries more recyclable.

**03.4** Explain why it is important that batteries should be recycled.