



Science of Materials Computers and Mobile Phones

Computers and Mobile Phones: Taking apart your phone (and mending it!)

Lesson Objective:

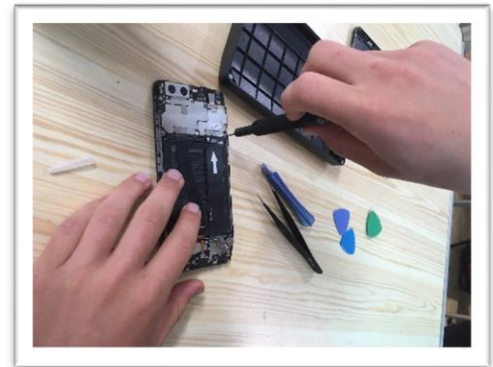
To learn what's inside computers and mobile phones, and to learn that repair and reuse is better than throwing old items away.

Science National Curriculum links:

Y4 Science: Electricity - Identify common appliances that run on electricity.

Resources:

- old computer parts like keyboards and mice (not screens)
- laptop, tablet or mobile phones – old and unused ones that have not been charged for at least a month
- set of small screwdrivers
- magnifying glass
- tray
- plastic tubs to hold small screws



Time required: 1 hour

Phone repair at a Repair Café. Photo credit to Lucy Mottram, Devon County Council.

Introduction to Activity:

All of us probably have a non-functioning laptop or mobile phone somewhere in our homes. This activity helps children to see that these can be taken apart and mended, and what is inside them

Main Activity:

The aim of the main activity is for children to have an opportunity to look inside mobile phones and laptop computers. This helps with understanding about how different materials are used and the variety of components inside a complex digital item, plus will help children understand that even these complex items can be taken apart and mended. Many of our greatest engineers learnt their trade by disassembling machines and learning how to put them together.

NOTE: There is lots of advice about household items that should not be taken apart. These include microwaves, cathode ray tube (CRT) televisions (or old CRT computer screens) and anything containing old capacitors. Modern equipment with lithium batteries should not be tampered with if the lithium battery is hot or damaged as they can be dangerous.

DID YOU KNOW?

An estimated **5 billion phones** are thrown away every year across the world. **Less than 20% of electrical equipment (e-waste) is recycled**, and even less is repaired and reused. Britain is rapidly becoming the worst country in the world for e-waste, with **103,000 tonnes** of electricals (including phones and computers) discarded every year. The average home has 30 unwanted electricals hiding in cupboards, drawers and attics.

[Recycle mobile phones - What you can do with old phones](#)

Results:

Children should learn that mobile phones, tablets and laptops are difficult to get into, often with tiny screws and covers that are glued in place. Many are not designed to be mended, meaning they are thrown away when they get old and break.

Items like computer mice and keyboards are easier to take apart. Can they work out how they work?

Discussion:

Can students think of reasons why throwing away mobile phones, computers and laptops is bad for the environment and for human health. It might help to break impacts of e-waste into 4 categories:

1. Resources
2. Economy
3. Financial value
4. Climate change

Discuss how many chemical elements there are inside a mobile phone. See the poster attached below.

Discuss why repair is important and discuss how it fits into a Circular Economy. (See [All about the circular economy - National Geographic Kids](#) for a useful guide for children). Should manufacturers be building more repairable mobiles and laptops?

Extension Activity:

Visit a local repair café (there are nearly 40 across Devon) or ask them to come into school and demonstrate what they do.

There's a Repair Club and educational resources around repair for 10-14 year olds here: [Team Repair](#). Ideal for a school STEM club.

Extra Resources:

For further information about Repair Cafes in your area check out the Recycle Devon pages: [Repair Cafe - Recycle Devon](#).

Share your pictures with us on Facebook, Twitter or Instagram by tagging @RecycleDevon #recycledevon

Make sure you have permission to share any photos first.

The chemical elements of a smartphone



Elements colour key:

Alkali metal

Alkaline earth metal

Transition metal

Group 13

Group 14

Group 15

Group 16

Halogen

Lanthanide

SCREEN



Touch: Indium tin oxide
Used in a transparent film over the phone's screen that conducts electricity. This allows the screen to function as a touch screen. This is the major use of indium.



Glass: Alumina and silica
On most phones the glass is aluminosilicate glass, a mix of aluminium oxide and silicon dioxide. It also contains potassium ions which help strengthen it.



Colours: Rare earth metals
A variety of rare earth metal-containing compounds are used to help to produce the colours in a smartphone's screen. Some of these compounds are also used to help reduce light penetration into the phone. Many of the rare earths occur commonly in the Earth's crust, but often at levels too low to be economically extracted.



Most phones use lithium-ion batteries, which are composed of lithium cobalt oxide as a positive electrode and graphite (carbon) as the negative electrode. Sometimes other metals, such as manganese, are used in place of cobalt. The battery casing is often made of aluminium.

BATTERY

ELECTRONICS



Wiring and microelectronics
Copper is used for wiring, and for micro-electrical components along with gold and silver. Tantalum is the major component in micro-capacitors.



Microphones and vibrations
Nickel is used in the microphone and for electrical connections. Rare earth element alloys are used in magnets in the speaker and microphone, and the vibration unit.



The silicon chip
Pure silicon is used to manufacture the chip, which is then oxidised to produce non-conducting regions. Other elements are added to allow the chip to conduct electricity.



Connecting electronics
Tin and lead were used in older solders; newer, lead-free solders use a mix of tin, copper and silver.

CASING



Magnesium alloy is used to make some phone cases. Many others are made of plastics, which are carbon-based. Plastics will also include flame-retardant compounds, some of which contain bromine, whilst nickel can be included to reduce electromagnetic interference.