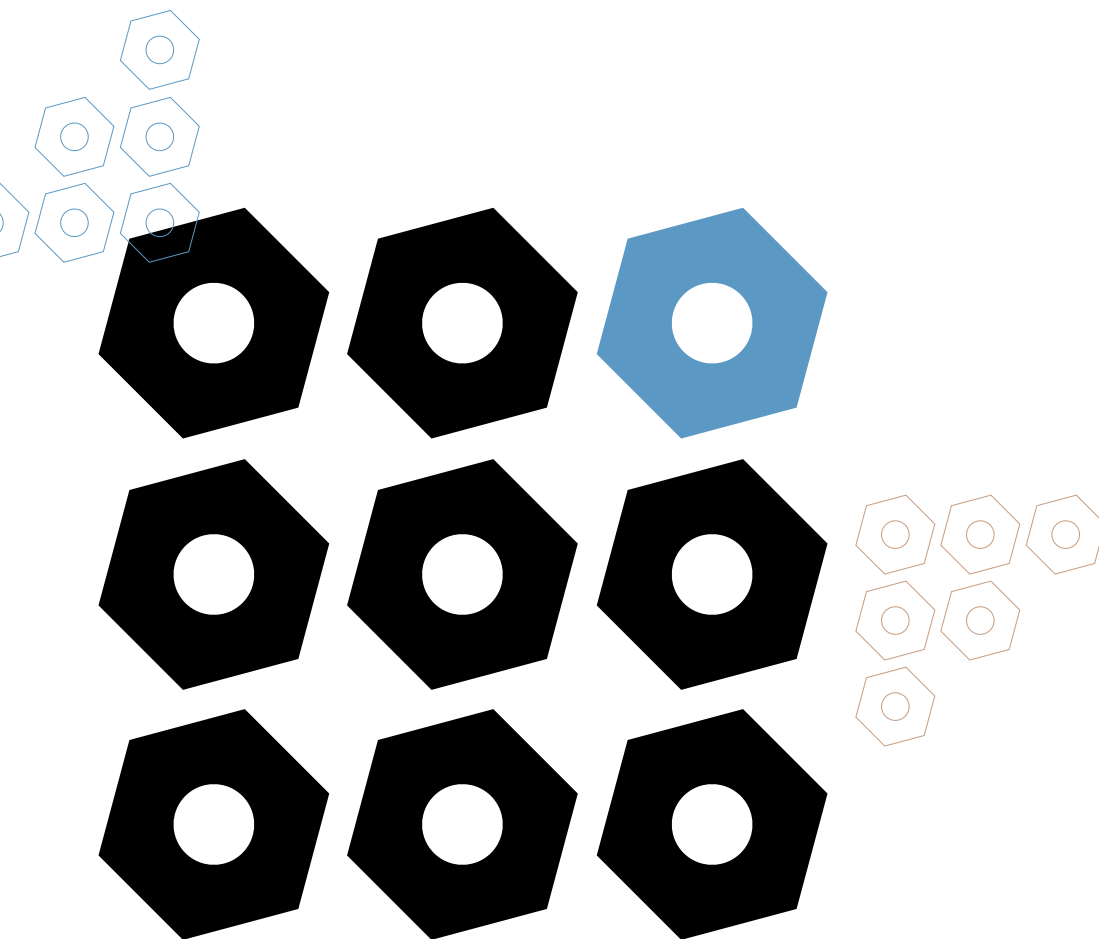
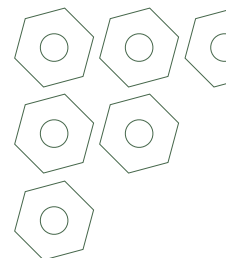


YOUR MOBILE PHONE'S A GOLD MINE!

TARGET AUDIENCE 10 to 12 years



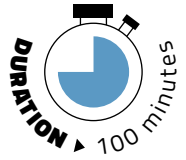
SHORT SUMMARY In this module, pupils discover that mobile phones contain valuable raw materials, and that these are lost in the stream of e-waste that is increasing significantly every year. They learn that repair is an option to avoid and/or reduce this waste stream.

REQUIRED PRIOR KNOWLEDGE Pupils know what raw materials are and are able to give a few examples.

MAKE IT WORK! LESSON 1



YOUR MOBILE PHONE'S A GOLD MINE!



MATERIALS REQUIRED

- › Bring a few broken or malfunctioning electrical and electronic devices, for example a broken bicycle light, a faulty hairdryer, a smartphone with a broken screen, a jammed toaster or printer, etc.
- › A disassembled old mobile phone or smartphone
- › Cards with texts 'From raw material to mobile phone' (appendix 1)
- › Cards with titles 'From raw material to mobile phone' (appendix 2)
- › Raw materials word cards (appendix 3)
- › Photo of a smartphone (broken or working) and e-waste mountain (appendices 4a, 4b, 4c)
- › Blank cards with a question mark (one for each student pair)
- › Optional: a few bits of string
- › A big flip chart
- › Red and green markers

PREPARATION

- › Read the background information attentively. This text gives you the what, why and how of the subject and the didactic knowledge and insights you need to work with this module.
- › Ask pupils in advance to bring a number of broken or faulty devices with them to class (see under Materials required). If you do this, give them a note to bring home for their parents to consent to the possible disassembling of the appliance during class, warning them that the devices may be returned in worse state. Also ask them to describe what is wrong with the device.
- › Consider bringing an old mobile phone yourself to disassemble. YouTube has several tutorials on this, both for older models and for smartphones. Use the search terms 'teardown + brand and model'.
- › Optional: place the bits of string beside the mobile phone.
- › Print the word cards (appendix) and cut them out.

BRIEF LESSON PLAN

1. Stimulus

Pupils observe and explore devices on a theme table.



2. Core

2.1 From raw material to mobile phone

- › Pupils watch a video on the raw materials in mobile phones.
- › Pupils name valuable raw materials in mobile phones.
- › Pupils explore the production chain of mobile phones.



2.2 The consequences of e-waste

- › Pupils watch a video on e-waste in Ghana.
- › Pupils summarize the content on the basis of question words.
- › Pupils explore the consequences of e-waste using the Siamese caterpillar.



2.3 The importance of repair

- › Pupils use a whiteboard diagram to explore how repair avoids or reduces the growth of e-waste.

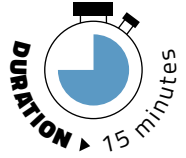


3. Conclusion

Pupils recap the lesson and write down on a post-it why repair is sensible.



LESSON PLAN



1 – STIMULUS

Place the old, malfunctioning or discarded electrical and electronic appliances – but not the disassembled smartphone – on a table. Ask the pupils to join you around the table.

What is the general word for these items?

- > Electrical and electronic devices

Ask the pupils to observe and/or pick up the devices and identify the problem (to the extent that this is visible) and/or show it to the group.

What electrical and electronic devices are there on the table?

Why aren't they in use anymore?

- > The battery of device X goes flat very fast.
- > The latest software doesn't run on the laptop.
- > The toaster doesn't get hot anymore.
- > There is a burning smell if you switch on the hairdryer.
- > etc.

Write down the problem on a post-it and stick this on the device.

What do you do with a broken device?

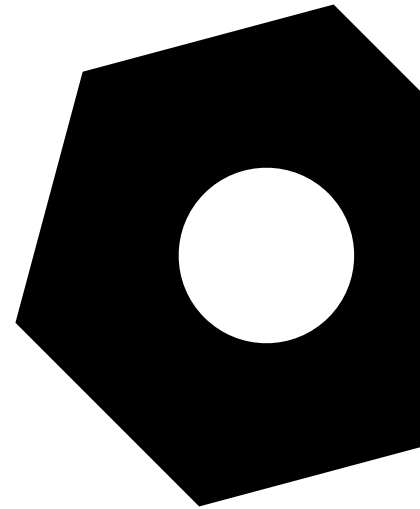
- > Bring it to the recycling centre
- > Bring it to a charity shop
- > Throw it away
- > Repair it
- > Keep it somewhere at home
- > etc.

What type of electronic device do people buy/replace very often?

- > Smartphones

Show the class a broken or used smartphone and the disassembled version. Ask the pupils to take a brief look at the loose parts. Explain to them that they will be learning about the materials and the production of the parts.

Ask the pupils to return to their seats.



2.1 – From raw material to mobile phone

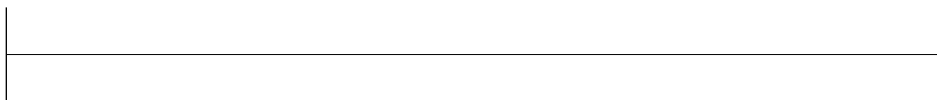
Tell the pupils that they will discover during this lesson that a huge number of electrical and electronic devices are turned into waste, and what this means for people and the environment. Explain that you could examine many types of devices, but that they will be focusing on one of the most-used and most-discarded electronic devices: smartphones.

Ask pupils if they know what materials mobile phones are made of. Consider writing down a few raw materials on the whiteboard.

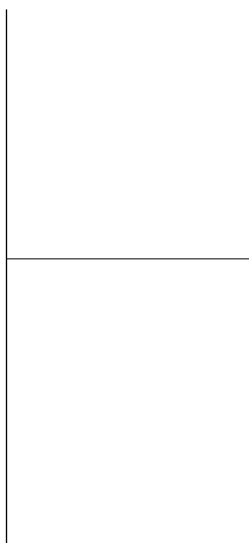
Then show them a clip from a video that explains what valuable and rare raw materials smartphones contain.

Ask the pupils to watch and listen carefully. Then divide them into pairs, give each pair the question they are to keep in mind while watching the video, and an empty sheet with a question mark for them to write their answer(s) on.

What raw materials do mobile phones contain?



Summarize the video in class and write down the different parts of a mobile phone on the whiteboard. Hang the word cards with the raw materials beside this on the whiteboard.



VIDEO

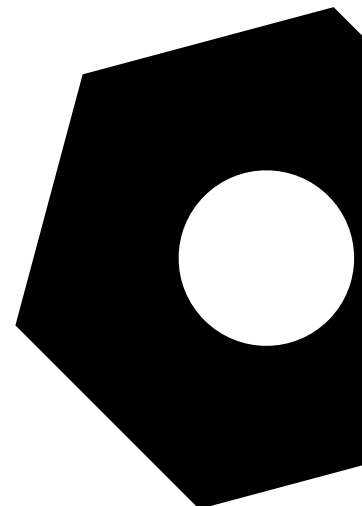
Show the class part of the video 'What's a smartphone made of?' (TED-Ed from 0 to 0m 42s, including a transcription) or What is a Smartphone made of? (Mining2Me from 0 to 0m 27s)

The TED-Ed video shifts focus after this to the ecological and social impact of the production and disposal of smartphones. This information is not necessary at this stage of the lesson, but you could consider showing it at a later point or after the second lesson of this pack.



TIP

Alternatively, visually link raw materials to the corresponding parts of a mobile phone on the table by arranging a piece of string from the old, broken or disassembled mobile phone to the word card with the raw material in question.

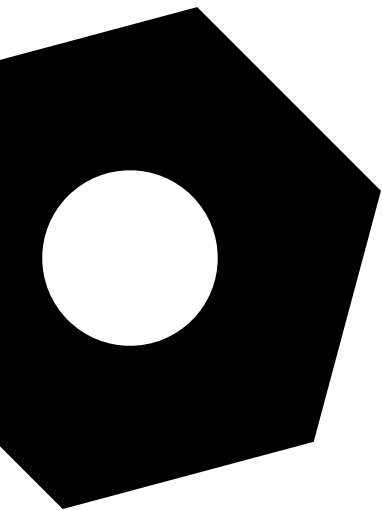


What raw materials are the parts of a mobile phone made of?

> Gold, silver, tin, copper, etc.

What valuable raw materials have you heard of before?

Gold, tin, silver, etc.



Where do these raw materials come from?

These raw materials come from various types of mines across the world.

Explain that you are now going to explore together how smartphones are made.

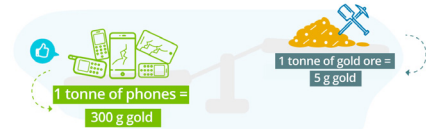
Divide the pupils into groups of six. Give each group six cards with information about the production chain, from raw material to mobile phone (appendix 1). Ask every pupil to read their card silently, and then place the cards in the right order, matching the titles (appendix 2).

Write down the titles of the chain on the whiteboard. Complete the chain in class by writing several key terms under or near the titles.

TIP

Include information about the cost of gold and the number of grams of gold per mobile phone in your mathematics lesson.

How many phones would you need to make up a kilo of gold? How many loaves of bread, trousers, etc. would you be able to buy with a kilo of gold?



© Recupel

Read more on this topic in '[Your old phone is full of untapped precious metals](#)'.

TIP

Find the various stages and corresponding images to show in class on [The Restart Project](#) website.

What information belongs to stage ...? What is this about?
 Discuss briefly in your own words.

Land and people	Mining	Making parts	Production	Waste	Recycling
<ul style="list-style-type: none"> > Cobalt > Mines > Unsafe > Low wages > Residents removed 	<ul style="list-style-type: none"> > Mining > Harmful > People and animals > Shortage of drinking water 	<ul style="list-style-type: none"> > Processing > Health hazard > Graphite in China 	<ul style="list-style-type: none"> > More than 2 billion/year > China and Vietnam > Dangerous work > Fairphone 	<ul style="list-style-type: none"> > 318 stadiums > 16 kg pp > Design > Waste mountain 	<ul style="list-style-type: none"> > Battery > Complex > A lot of energy > Improved techniques

What stage or information surprised you? Why?

Then explain briefly that you have been talking about mobile phones, but that the same applies to other electrical and electronic devices.

Can you think of examples of any other devices?

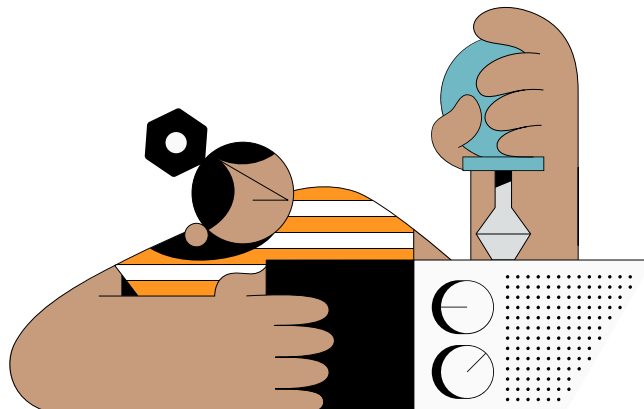
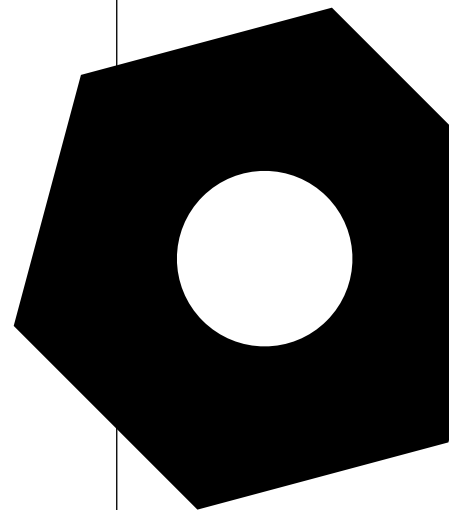
These devices contain other, but equally valuable and rare materials that are extracted from mines across the world. The demand for these raw materials continues to grow, for instance for lithium, which is used in the batteries of electric vehicles.

Are all broken or unused mobile phones thrown away? Explain.
 Not all, but still too many electrical and electronic devices are thrown away.

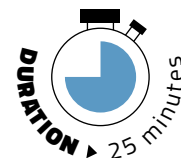
Where do they go when they are thrown away? What happens when people across the world throw away many old, unused or broken mobile phones?

- > In the recycling centre, in the rubbish bin, kept at home, dump sites (fly tipping), incinerator, etc. The volume of waste grows and a waste mountain is created.
- > New raw materials have to be mined.

What do you call waste that is made up of electrical devices?
 E-waste



2.2 – The consequences of e-waste



2.2.1 – E-waste in Africa

Explain that you are going to watch a video on e-waste together. Write the question words 'what', 'where', 'how', 'who', 'when' on the whiteboard and assign them to a number of pupils. Make sure that no two neighbours have the same question word.

Then watch a clip from the video on dumping e-waste in Africa. Ask every pupil to come up with a question about the video and write it down. The question must be related to the problem of electronic or electrical waste.

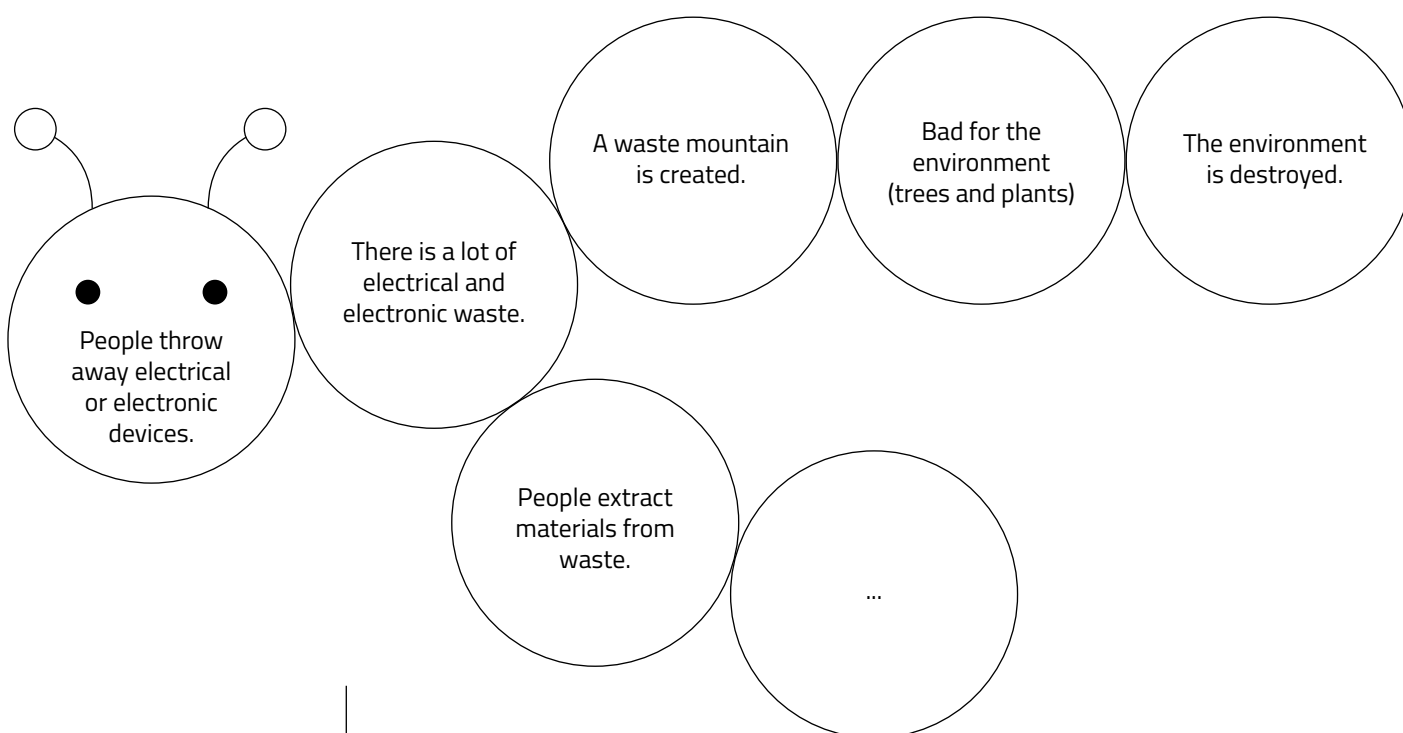
 VIDEO

Video on e-waste in Africa
(Making a living from toxic electronic waste in Ghana - BBC).
Select a few clips from this video to watch together.

After watching one or more clips, every pupil writes down a question individually. Then the pupils pair up and exchange their questions with their partner: one pupil asks the question, the other responds. Afterwards, they choose a third question word together and think of a new question.

Go over the question words. Invite one or more pupils to ask a corresponding question and another pupil to respond. Ask a number of pupils to summarize the video on the basis of questions and answers.

Then examine the consequences of the growing e-waste mountain together, using the 'Siamese caterpillar'.



2.2.2 – Examining the consequences using the Siamese caterpillar¹ (© Djapo)

Write the initial situation on the left of a flip chart. Draw the head of a caterpillar around it.

The initial situation is: 'People throw away electrical and electronic devices.' Then ask: 'What happens when people throw away electrical and electronic devices?' Write the consequence to the right of the caterpillar's head and draw a circle around it.

Repeat this step a few times: think of a consequence of the previous consequence. Thinking of consequences amounts to examining the chain reaction that the situation has (or may) set in motion.

Go over the chain of consequences in the caterpillar together. Check whether there are any second or other consequences that you can think of for any circle. Write down the second consequence above or below the circle and draw another circle around it. Reflect on the consequence in the new circle and create a second branch, turning the caterpillar into a 'Siamese caterpillar'. Carry out the same procedure for one or more other consequences elsewhere in the caterpillar.

Colour or mark the positive consequences in green, and the negative consequences in red.

Which consequences are negative and which are positive? Explain. Which consequences are more frequent: the negative or the positive?

Reflect

- > Which consequences had you expected? Which had you not expected? Which consequences affect you? Why?
- > What broken electrical or electronic device have you, or someone else in your family, ever thrown away? What would you like to happen to this device?

Explain that there are several ways of reducing or avoiding electrical and electronic waste.



TIP

- > Keep this flip chart so that the pupils can review it at the end of the lesson. This flip chart also contains subject matter for the second lesson of this pack, or can be a stimulus for further inquiry. You could make a new caterpillar after the second lesson, for example, and examine the consequences of the situation 'Electrical and electronic devices are normally repaired'.
- > If there are too many branches, consider drawing a new caterpillar starting with a branch of the first caterpillar. Or ask the pupils to make a caterpillar of consequences themselves in pairs or groups.
- > You are practising 'examining consequences'. Regularly repeat the term 'consequence' and the accompanying question 'What if ... ?' Explicitly mention the steps that must be taken between two circles, by saying 'If ... then ...', or ask the pupils to repeat this sentence. You could also consider approaching the issue from the other end once or twice, by asking 'Why is this?' and identifying the response as a cause. This helps the pupils to reflect explicitly on their thinking process.

¹ - The Siamese caterpillar formula is part of Djapo's Systems Thinking method. Systems thinking helps students to explore our complex world by consciously looking for connections. It helps them develop a nuanced perspective on the world, and to remain alert to the various points of view in any story. This helps them to defer judgement before adopting an opinion, and to gain greater insight into complex themes. For more information about systems thinking, visit www.djapo.be

2.3 – The importance of repair

Show the devices to the pupils again.

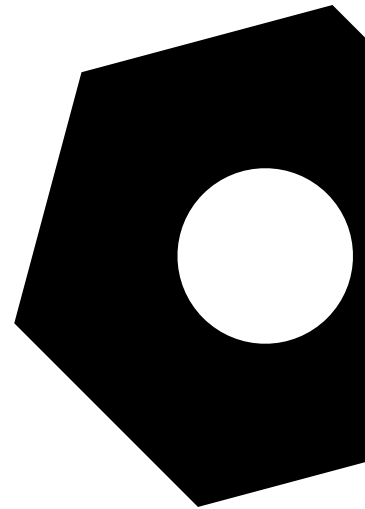
Place the disassembled mobile phone, an old, unused mobile phone and another broken electronic device in the centre. Move the other broken devices to one side of the table.

What happens often to old mobile phones and other devices that aren't used anymore or that are broken?

They are thrown away. Worldwide, millions of mobile phones and smartphones are thrown away every year without being recycled.

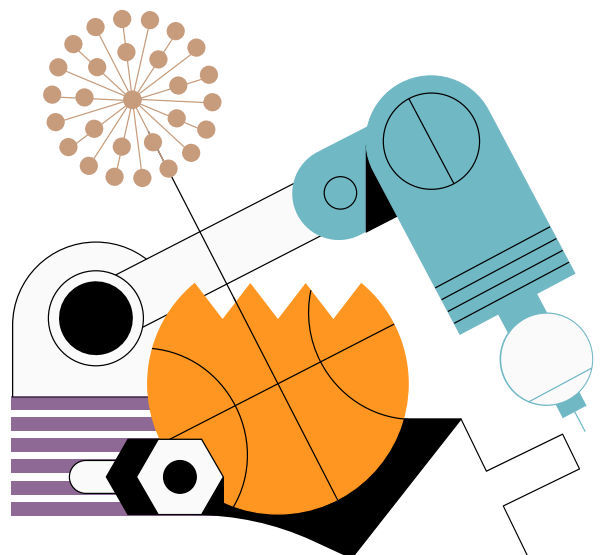
- > What do you think of the huge e-waste mountain that is created every year and that keeps growing?
- > Why are mobile phones so valuable?

Point at the old mobile phone in the middle. You could consider adding the raw materials word cards.



Take the printed photos (appendices 4a, 4b, 4c) of the smartphone, broken smartphone and the waste mountain or prepare them for display on screen. Hang or display a photo of a broken smartphone in the middle of the whiteboard. Hang the word cards with the raw materials underneath, and a photo of a waste mountain to the left. Write 'e-waste' above it. Hang or display a photo of a smartphone to the right of this.

Study the diagram together with the pupils to explore why repair is an important option.



1 – Why is there a waste mountain?

There is a waste mountain because so many old or broken electrical and electronic appliances are thrown out.

Draw a red arrow to the left, from the broken mobile phone to the mountain.

How can we ensure that old, broken mobile phones, etc., don't end up on this waste mountain?

2 – One option is to take the raw materials out of the mobile phones and recycle them.

Draw a green arrow to the right, from the broken mobile phone to the working mobile phone.

What can you do with a device that is broken, isn't working or working properly anymore? We want to prevent mobile phones ending up on a waste mountain.

Draw an X over the mountain of waste.

3 – You can repair a mobile phone or other device, or have it repaired.

So how can we reduce or avoid the waste mountain?

- > By recycling or repairing broken mobile phones and other electronic devices
- > By buying a second-hand mobile phone or by selling our own
- > By donating it to a charity shop or to a good cause (collection campaign)
- > By giving it to someone else in your family
- > Buying a refurbished mobile phone or tablet is another option.

Write these words below the mobile phone in the middle.

What does 'refurbished' mean?

Refurbished means that an older model of mobile phone has been checked and old parts have been replaced by new ones, such as the battery or the screen etc. The supplier of a refurbished mobile phone also gives a warranty.

What other things can you do to reduce the size of the waste mountain of mobile phones or electronic devices? The waste mountain is made up of a huge pile of mobile phones that used to work. Or of coffee machines or hairdryers etc. that used to work. How do you reduce the number of electrical or electronic devices?

- > By buying fewer or no devices or asking for fewer or none as presents: by refusing them.
- > By reusing them, for instance by buying them second-hand from someone. You could share a device by using a tablet or game console together with your brother or sister. You could also share a device you don't use very often with a neighbour, for example lawn mowers, raclette sets, etc.

Write the children's ideas to the left of the old mobile phone. Explain to them that if fewer devices (including mobile phones) have to be made, fewer will be thrown out. Tell them that dumping electrical or electronic waste is the last available option you have.



TIP

The children may mention arguments against, or thresholds for sharing or passing on mobile phones, etc., such as quality warranty, privacy. This could be the beginning of an interesting conversation: what is more important when you are buying a smartphone: the price, quality, sustainability, the status that a new model gives, privacy, etc.?

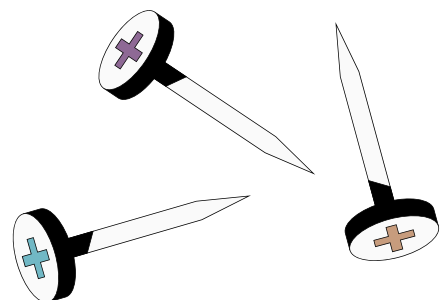
Additional information on removing personal data

If you are donating your old or broken mobile phone, laptop or other electronic device to a second-hand shop, you should wipe all personal data and/or restore the device to factory settings. Some second-hand shops and other organizations will use special programs to wipe all personal data themselves.

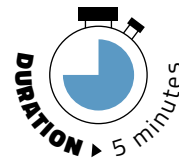
But recycling should always be a last resort because it is such an energy-intensive process and most of the materials (including most critical raw materials such as gallium, tantalum etc.) are not recovered.

Read more on:

- > [Recycle.more.co.uk](https://www.recycle.more.co.uk)
- > [Recycle your electricals](#)



3 – CONCLUSION

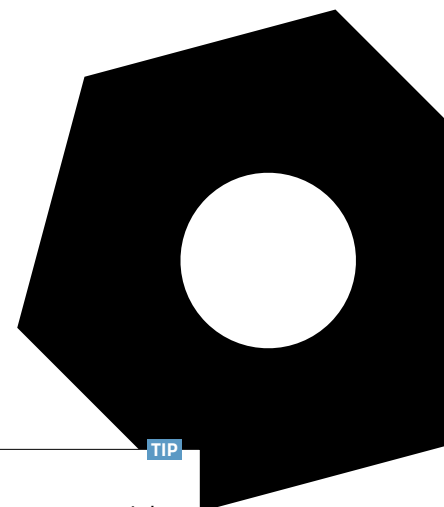


Give every pupil a post-it. Ask them to write their initials on it as well as an answer to the following question: *why is repairing mobile phones (and other electrical and electronic devices) important?*

Ask them to write legibly so that a fellow pupil can read their thoughts or opinion (see Stimulus in lesson 2). Ask them to briefly share their opinions on this.

What is your view on repairing mobile phones or other devices?

Collect the post-its and identify subsequently what insights the pupils are taking from the lesson. Keep the post-its to jog their memories of these insights again during the second lesson.



TIP

You could limit the raw materials word cards to gold, tin, cobalt and lithium, for example.

BACKGROUND INFORMATION

Electrical devices are simple devices that run on electricity and can often be **switched on** using a power switch, such as blenders, heaters or simple coffee machines. They usually have a **single function** that is operated exclusively by electrical components such as a power supply, a cable and a motor.

Electronic devices are **controllable** devices that often have **multiple functions**, for example smartphones or coffee machines with settings for one or more cups. They are operated (at least partially) by electronic components such as a **circuit board**, a diode and a capacitor.

ADDITIONAL ACTIVITY

If you want to delve more deeply into the impact on working or living conditions for the people who mine raw materials, or residents in the vicinity of mines, then visit the website of [ABC News](#). Read more information about child labour in the Democratic Republic of Congo [on the website of Unicef](#).

You could extend this lesson with one or more extra activities:

- › Activity 1 – A repair survey or campaign
- › Activity 2 – Having a repairer over/visiting a repairer
- › Activity 3 – Roll up your sleeves! Mini workshop: the flow of water in a coffee machine.

Ask the pupils to look up the countries or continents where mining takes place in an atlas.

FROM RAW MATERIAL TO MOBILE PHONE

TEXT SHEETS

Cut out the text sheets and give one to every pupil. Create groups of six pupils, ensuring that every pupil has a different sheet.

A smartphone or mobile phone contains various raw materials that come from mines under the ground. One of these materials is cobalt. Cobalt is used in batteries. Most of the cobalt used in batteries comes from Democratic Republic of Congo in Central Africa.

In some places, children are forced to work in mines. Sometimes, the owners of the mines remove the local residents from their land.

The mines create jobs for the population, but the work is not always safe and often poorly paid.

Extracting or mining raw materials can be harmful both to ground water and to the soil. Mining changes the environment in which people and animals live. Mining sometimes pollutes drinking water and crops.

Lithium is used in the batteries of mobile phones. It is mainly recovered from water under the salt flats in Argentina, Bolivia and Chile. The water is pumped into basins and left to evaporate in the sun. This makes it difficult for local residents and animals to find drinking water.

Raw materials are used to make parts for mobile phones, for example the screen, the battery or the casing.

To make these parts, the manufacturer must first clean the raw materials, heat them and then assemble them. Some of these materials are bad for people's health, and producing them can therefore be dirty and dangerous.

The batteries of mobile phones often contain the raw material graphite. Working with graphite is a dusty business. If the workers cannot dig safely for graphite, their work damages their health.

People near a graphite mine in North-East China discovered that they were falling ill more often and that the trees had stopped growing.

Smartphones that cannot be repaired will become electronic waste.

According to the UN, we discard 53 billion tonnes of electronic waste worldwide per year. That is enough to fill a big sports stadium 318 times over. Europeans throw out the most devices: 16 kilos per person per year.

We could prevent this waste by designing devices better. For instance, manufacturers could make them easy to take apart without breaking them.

If we make devices easy to repair, reuse or recycle them, they will end up less frequently on the waste mountain. Fairphone is one example of a phone that can be repaired easily.

Approximately 2 billion smartphones are made in factories every year: sixty per second. These phones are mainly made in China, but also in other countries such as Vietnam.

Mobile phone parts are usually assembled manually. In some factories, workers have to work in unsafe conditions and for longer periods than permitted by law.

Fairphone is a smartphone manufacturer that provides a safer, pleasant working environment and a fair wage.

Recycling raw materials from old or broken phones means that they can be used again. The good news is that we are increasingly able to recycle raw materials in batteries.

Recovering raw materials from electronic devices is complicated and costs a lot of energy. Companies worldwide are working on new and better technologies to recycle phones.

Source: <https://materialsmatter.eu/>
This website was created as part of the REFER project, with the support of the European Institute of Innovation and Technology, in a European partnership in which The Restart Project is a participant. <https://therestartproject.org/about/>

FROM RAW MATERIAL TO MOBILE PHONE

WORD CARDS

Land and people

Mining

Making parts

Production

Waste

Recycling

FROM RAW MATERIAL TO MOBILE PHONE

RAW MATERIALS WORD CARDS

Valuable and rare resources

Gold

Tin

Silver

Palladium

Lithium

Neodymium

Lead

Copper

THE IMPORTANCE OF REPAIR

IMAGE FOR WHITEBOARD DIAGRAM



THE IMPORTANCE OF REPAIR

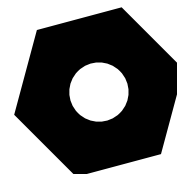
IMAGE FOR WHITEBOARD DIAGRAM



THE IMPORTANCE OF REPAIR

IMAGE FOR WHITEBOARD DIAGRAM





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elijn
Ostinghes-Loozele-le-Neuve