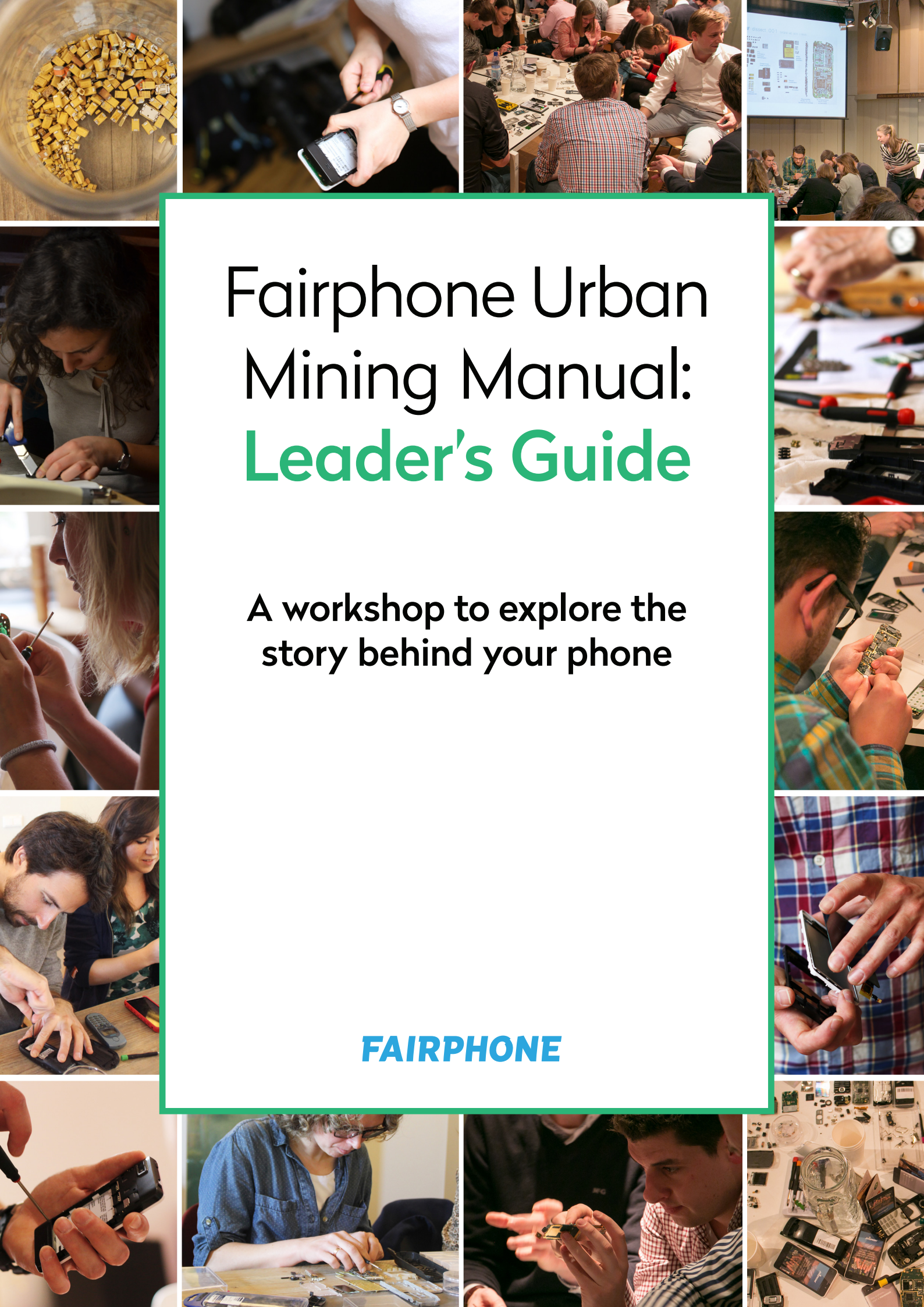


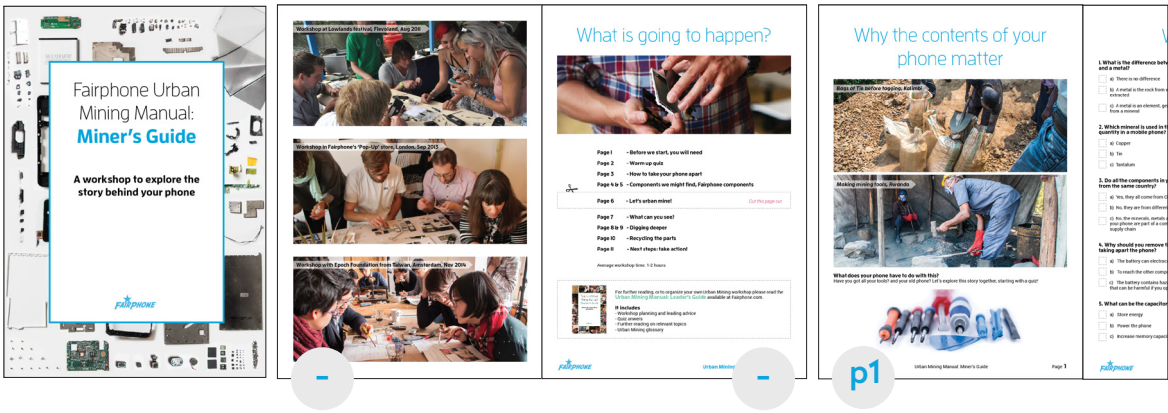
Fairphone Urban Mining Manual: Leader's Guide

A workshop to explore the story behind your phone

FAIRPHONE

What is going to happen?

These images represent the **Urban Mining Manual: Miner's Guide.** Each page of this Leader's Guide shows you the relevant page(s) in the Miner's Guide, which will be used by the workshop participants.



Average workshop time: 1-2 hours

1) Introducing the workshop and doing the warm up quiz (10-15 mins).
2) Taking phones apart and getting to know their components (25-40 mins).
3) Learning more about tin and tantalum in phones, discussing the issues around them (15-50 mins).
4) Concluding the workshop (10-15 mins).

The workshop is recommended for people aged 12+ because of skills you need to take the phones apart

Before we start

Miner's guide
Introducing the workshop objective and why the contents of your phone matter

Aim
Urban mining refers to the extraction of minerals from existing products. This leader's guide will take you through preparing a practical lesson on urban mining a mobile phone in a classroom or workshop.

Objective
The students or working group will take apart old (and no longer working) phones and explore the contents. A mobile phone contains over 30 different non-renewable minerals. However, in this lesson they will be digging for two minerals: tin and tantalum. This manual guides you to teach the students to identify and extract the components containing these two minerals. We encourage you to carry out further research on other minerals and materials which the students will come across in their mobile phones.

Use the information below to introduce the workshop to the participants. You can illustrate it by showing related photos from our Flickr album: Urban Mining

Why the contents of your phone matter
Some minerals contained in your phone, like tin and tantalum are mined in conditions that are harmful for both the environment and the people who mine them. Exploitation often occurs in conflict areas, where mines and mineworkers have been controlled by armed forces who use the high mineral revenues to finance their armies.

Once a mobile phone has reached its end-of-life, it often ends up being discarded as electronic waste. However, if handled and dismantled in the right way, many of the materials inside can be recycled and re-used, lowering the social and environmental footprint left behind by the phone.

Outcomes
- Students will have gained a more in depth knowledge on the role of various components within their phone.
- Students will have a greater understanding of where some minerals come from and issues in the mining industry. They will be able to relate this to the mobile phone supply chain.
- Students will better understand their role as a consumer.
- Students will have been exposed to the challenges faced when recycling electronic devices.

Recommendations
- Do this activity yourself before leading the workshop.
- Familiarize yourself with this guide and conduct any further necessary research to ensure you feel fully equipped to take the workshop.
- Find out where your nearest recycling point is so the students can safely recycle the metals and minerals.
- Tailor the workshop to fit the level of your students or working group.

Cautions
- **Remove the battery safely in one piece and recycle it after doing the workshop. Do not open or puncture the battery! It contains hazardous materials that can severely damage your health.**
- Be aware that this activity involves sharp tools and objects.
- Take care as the components within the phone are small and can be easily lost. Ensure the workspace is fully prepared with trays and cups to store the pieces.

The information in this guide is meant to supplement the workshop. The activities in the workshop may pose some risk and therefore, Fairphone advise you to take full responsibility for your own safety. Especially when taking out phone components, be sure that your equipment is complete and do not take risks beyond

You will need

Essentials

The Urban Mining Manual: Miner's Guide

A working surface
Somewhere clean and clear.

An old, non-functioning mobile phone
It is preferable that you don't use smartphones since they can possibly be refurbished and sold in a second-hand market, i.e. through the Fairphone Recycling Program.

Varying sized screwdrivers
Old phones aren't designed to be opened. So prepare yourself with big and small screwdrivers.

Metal spudgers
You'll need something strong and flat for leverage.

Tweezers
To pick those tiny components off the circuit board.

Extras

Containers
So that you don't lose the pieces.

Magnifying glass
To see the components in real detail.

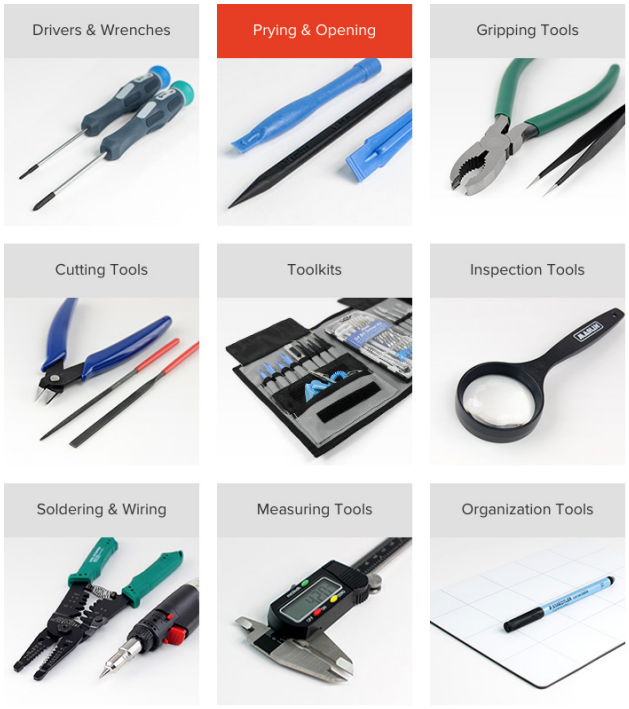
A camera
You will want to photograph this!

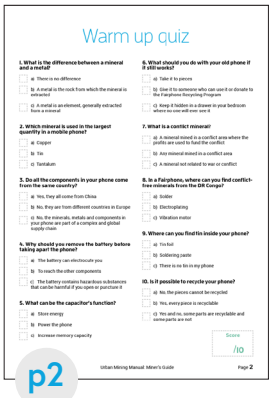
Plasters
With lots of small sharp pieces you might need some.

IFIXIT

You can buy tools for taking a phone apart from iFixit as well as use their free repair manuals to see how to take your phone apart.

https://www.ifixit.com/





Warm up quiz

Miner's guide

Hold this warm up quiz with the participants and check the answers together (we've highlighted correct answers in **green** here).

1. What is the difference between a mineral and a metal?

- [ ] a) There is no difference
- [ ] b) A metal is the rock from which the mineral is extracted
- [x] c) A metal is an element, generally extracted from a mineral

2. Which metal is used in the largest quantity in a mobile phone?

- [x] a) Copper
- [ ] b) Tin
- [ ] c) Tantalum

3. Do all the components in your phone come from the same country?

- [ ] a) Yes, they all come from China
- [ ] b) No, they are from different countries in Europe
- [x] c) No, the minerals, metals and components in your phone are part of a complex and global supply chain

4. Why should you remove the battery before taking apart the phone?

- [ ] a) The battery can electrocute you
- [ ] b) To reach the other components
- [x] c) The battery contains hazardous substances that can be harmful if you open or puncture it

5. What can be the capacitor's function?

- [x] a) Store energy
- [ ] b) Power the phone
- [ ] c) Increase memory capacity

6. What should you do with your old phone if it still works?

- [ ] a) Take it to pieces
- [x] b) Give it to someone who can use it or donate it to the Fairphone Recycling Program
- [ ] c) Keep it hidden in a drawer in your bedroom where no one will ever see it

7. What is a conflict mineral?

- [x] a) A mineral mined in a conflict area where the profits are used to fund the conflict
- [ ] b) Any mineral mined in a conflict area
- [ ] c) A mineral not related to war or conflict

8. In a Fairphone, where can you find conflict-free minerals from the DR Congo?

- [x] a) Solder
- [ ] b) Electroplating
- [ ] c) Vibration motor

9. Where can you find tin inside your phone?

- [ ] a) Tin foil
- [x] b) Soldering paste
- [ ] c) There is no tin in my phone

10. Is it possible to recycle your phone?

- [ ] a) No, the pieces cannot be recycled
- [ ] b) Yes, every piece is recyclable
- [x] c) Yes and no, some parts are recyclable and some parts are not

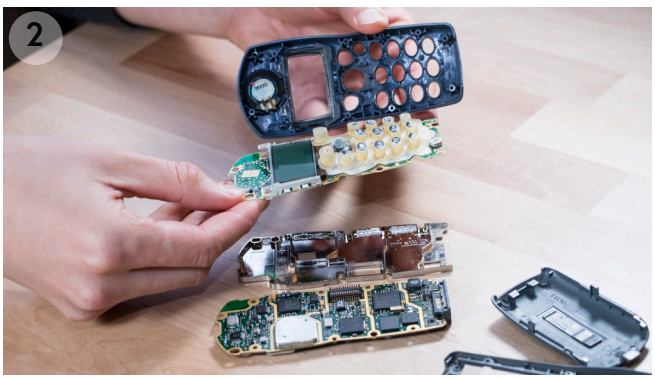
How to take your phone apart

p3

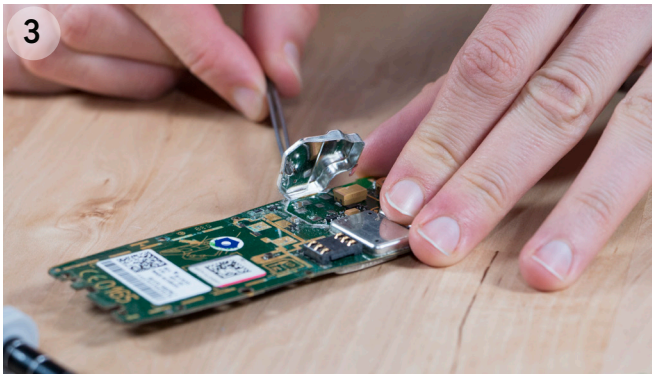
Miner's guide
Let the miners urban mine!

Once the participants have removed the batteries they are ready to start exploring the rest of it! This process can be frustrating without the right tools, so look back to check whether you have everything. Remember that these phones are old and no longer work so the students can be forceful, but they must be careful not to hurt themselves or those around them.

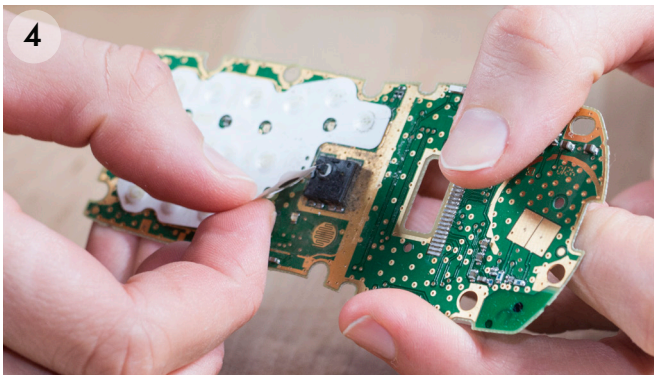
"Lefty loosey, righty tighty!" Use a small screwdriver to remove those tiny screws on the outside. Keep the loose screws in a container so they don't get lost.



The phone will split into different layers, sometimes these are held firmly together and will require some strength to separate.



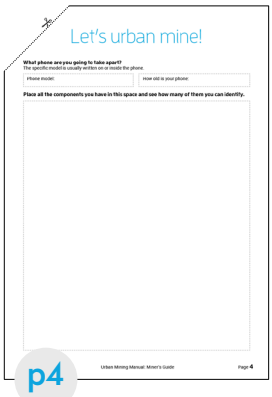
Protective covers sit on the Printed Circuit Board. Use tweezers to try and peel these off to find the components underneath.



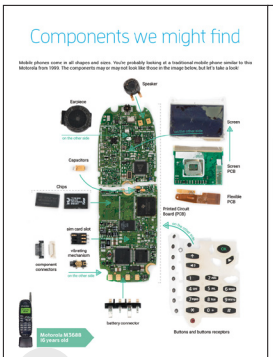
Enjoy exploring the rest of your phone, some parts don't even require tools. Pull out the buttons and peel back the button receptors with your fingers.

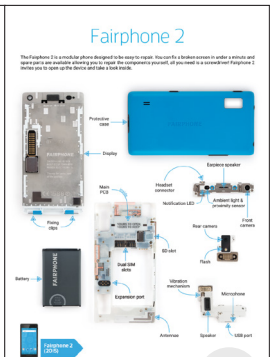
Although many components are attached to the PCB, don't forget to look inside the outer casing. You may find the speaker, SIM holder, antenna etc...

Let's urban mine

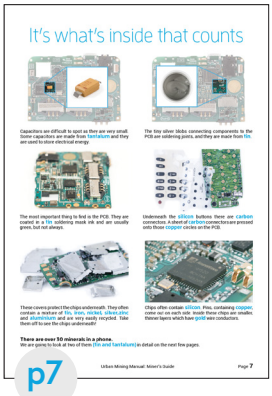


Miner's guide
Participants should cut out this page and put all the components on it. How many can they name?





Miner's guide
Look through these pages with the participants and see if they can identify even more components of their dismantled phones now. Do they have ideas about what these components are made of? The next page provides answers to this question so you might want to give this part to the miners only after this discussion.



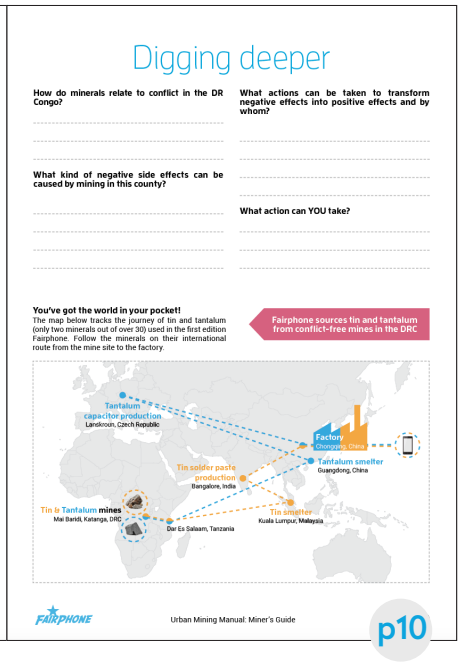
Miner's guide
This page provides information about the minerals contained in some of the components. Let the miners explore!

Your notes

Digging deeper

Now the phones have been opened, it's time to unravel some of their hidden stories.
Over 30 minerals are found in a phone.[1] They are mined all over the world, so how do they end up in our phone? Many steps take place between the mine site and the final product. So let's begin to uncover the supply chain by discovering more about how a phone is made, revealing some of the social and environmental issues. We're going to focus on tin and tantalum. We've chosen these minerals as Fairphone sources conflict-free tin and tantalum that can be traced to its original mine, showing it's possible to source conflict-free minerals.

In this part of the Leader's Guide we supply you with background information to equip you to lead the discussion. It's up to you to decide how to share this information with your students. The Miner's Guide is more image based and includes a few fun facts. You may choose to make copies of the leader's section on minerals to share among the students. Be sure to also check the Glossary section to understand the different concepts around mining.



Miner's guide
Student's should now progress from learning about their phone's components to where these components come from. Use this page to introduce this part of the workshop.

Miner's guide
Overview of how tin and tantalum become phone components, where in the world they are produced and where you can find them besides electronics.

Miner's guide
Recommended discussion points about mining practices, problems and solutions and the journey of tin and tantalum in the Fairphone

Digging deeper

See the recommended discussion points in the Miner's Guide. These are aimed at opening up a dialogue about the complexity of the supply chain and our role as consumers. You may consider simplifying them depending on the level of your group. The information provided on the next few pages will help you to guide this discussion.

If you have time, we suggest you watch Fairphone's short film Visiting Tin, Tantalum and Tungsten Mines in the DRC and Rwanda on Vimeo or Youtube with the students.
Time: 05:16

Minerals and artisanal mining

A mobile phone contains dozens of different minerals like gold, copper, cobalt, tin, tungsten and tantalum. Mineral extraction occurs worldwide using a variety of methods. These methods can be divided into the categories of **artisanal mining** (labor intensive mining using few basic tools), **semi-industrial mining** (predominantly manual labor, employing limited advanced machinery) or **industrial mining** (mining relying on heavy machinery and technology with hardly any manual labor).

In developing countries, artisanal mining is the dominant form of mining. Tunnels are not built securely and they're prone to collapse. Mineworkers often lack protective gear like helmets, gloves and boots. Underground hard rock mining can push workers to dig steep tunnels, sometimes reaching 150 meters below ground. Deep tunnels often mean mineworkers stay underground for several days, while only making 1-3 USD per day.[2] Mining can cause massive environmental degradation, while at the same time local communities are heavily dependent on the use of land, i.e. to grow food or fetch water.

Conflict minerals

In conflict areas or areas at risk of conflict, the high revenues of mining can prolong fighting by providing the financial means for purchasing weapons and other army supplies. The term '**conflict minerals**' is used if the *"control, exploitation, trade, taxation or protection contributes to, or benefits from the context of, armed conflict"*.[3] The most infamous example is the Democratic Republic of Congo (DRC) where the extraction and trade of minerals has been heavily controlled by armed groups, resulting in severe human rights violations, including forced and child labor.

Ways forward

The United States passed the **Dodd-Frank Act** in 2010, which requires companies to report on the use and origin of four specified minerals; tin, tantalum, tungsten and gold (3T's and G). The European Union as well as the OECD and other organizations are working on similar legislation and tools to help companies address conflict minerals and incorporate traceability (tracking the route of a mineral to a product) and transparency (publicly disclosing these routes) in their supply chains.

At the consumer end of the supply chain, urban mining and recycling are ways to reduce the pressure on mining by enabling the reuse of a mineral or metal. Currently, only an estimated 20% of both the tin and tantalum supply is recycled, as many products are not properly collected for recycling as well as recycling technologies are not yet optimized.[4]

Digging deeper: tin

Tin is a silvery, white metal, mainly extracted from an ore called cassiterite. It's mined by both large industrial operations as well as artisanal methods, using either underground hard rock, surface or alluvial mining. There are several steps between the mine site and the smelting company, such as transporters, traders, etc.[5] In countries with predominantly artisanal mining, these steps often go undocumented making it difficult to trace the tin back to the original mine site.

How much tin is produced? and where?

Miner's Guide page 8: Tin and tantalum production map

The electronics industry accounts for 36% of the world's tin consumption. In 2013, Europe imported 240 million mobile phones, which together contained 96,000 kgs of tin (it's estimated that 1% of a phone is made up of tin).[6]

As with all minerals, the world reserves and world production of tin is hard to determine. Political and economic bias can influence the numbers of mineral reserves, but figures also change over time due to mineral depletion. Statistics on world reserves should therefore always be understood as an estimate.

Inside our phones: Where is the metal and what's its function?

Tin has different uses in your phone. For example it's used in solder, which connects the tiny components of your phone to the printed circuit board (PCB). Once the solder paste applied to the PCB is heated, the solder becomes hard and turns into what we call a solder joint; both acting as an electrical connector as well as to keep all the small components in place on the PCB.

Theoretically, in a smartphone you need around one gram of solder paste. Solder paste contains 40–90% tin, meaning the solder in your phone contains approximately 0.4 – 0.9 grams of tin.

Beyond electronics - where else is tin used?

Miner's Guide page 8: Examples of tin in other products

Besides electronics, many chemical uses of tin exist, from dyes to glazes, to mirrors and coatings. A common use of tin is tinplating which is used in small quantities in food packaging and cans. It's also widely used in the automotive and aviation industry.

Answers to the quiz in the Miner's Guide highlighted in green

- ■ Dyes
- ☐ Tin foil
- ■ Mirrors
- ■ Cans
- ■ Vehicles
- ☐ Roofing in houses

Tin in the Fairphone

Miner's Guide page 9: You've got the world in your pocket!

The tin in the soldering paste of the first Fairphone comes from the DRC via the Conflict-Free Tin Initiative (CFTI). In this initiative, governments, NGO's and leading industry players, work together to create a traceable and transparent supply chain. This enables us to guarantee the minerals are extracted and traded without supporting armed groups, showing that it's possible to source conflict-free tin from the DRC.

On the Fairphone website, you can find even more information about Fairphone tin and tantalum.

Digging deeper: tantalum

Tantalum is a shiny, silvery metal. The rock, or ore, in the ground is called columbite-tantalite, or coltan. Columbite-tantalite is separated into columbium (also called niobium) and tantalite. From the mineral tantalite, you can extract the metal tantalum.

Tantalum can be extracted by multiple methods (artisanal, semi-industrial, and industrial), however, around half of the world's coltan production is estimated to come from artisanal and small-scale mines.[7] Some suggest that artisanal mining for tantalum extraction is preferred as the ore is generally not distributed evenly in the soil. Instead, it occurs in vein-like deposits stretching out across the earth's rock, meaning that it requires precision to locate and extract the coltan. Artisanal labor is more precise as you can choose which part of the rock to extract. Using industrial methods such as big machines or dynamite, you risk extracting huge quantities of rocks which do not contain significant quantities of the mineral.

How much tantalum is produced? and where?

Miner's Guide page 8: Tin and tantalum production map

The location of coltan's world reserves is not so clear cut. There exists contradictory research, with some stating that more than 60%[8] of the reserves are located in the DRC, while others cite a minor 10%.[9] However, there is a general consensus that a considerable amount is found in the DRC. Until 2008, Australia was the largest producer of tantalum. However, between 2008 and 2012 some large mines in Australia closed due to, among other reasons, competition from cheaper regions (i.e. artisanal mining in the DRC). During this period, the DRC had a very large role in the global supply of tantalum. In the last couple of years however, Brazil joined the DRC as a leading coltan producer.

Inside our phones: Where is the mineral and what's its function?

Tantalum is used in small capacitors, located on the PCB. One of the main functions of the capacitor is to maintain the voltage of the circuit at a certain level, by only releasing stored energy when necessary. Tantalum works well in capacitors as it continues to function in a wide temperature range (-55°C to 125°C). It is estimated that approximately 40 milligrams of tantalum is used in a phone.

Beyond electronics - where else is tantalum used?

Miner's Guide page 8: Examples of tantalum in other products

So what happens to the rest of the world's tantalum production? Lucky for us, tantalum is non-toxic, making it safe for doctors to use in medical implants and prosthetics (such as for skull plates). It's even used to repair bones! Tantalum is also used to manufacture jet engine turbines, missiles and space rockets.

Answers to the quiz in the Miner's Guide highlighted in green

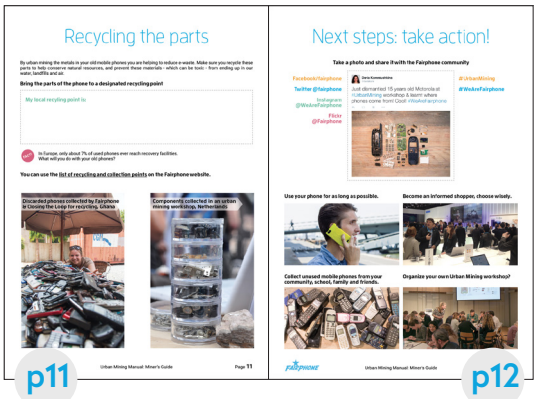
- ☐ Door locks
- ■ Turbines
- ☐ Textiles
- ■ Prosthetics
- ■ Missiles
- ■ Medical implants

Tantalum in the Fairphone

Miner's Guide page 9: You've got the world in your pocket!

Fairphone uses conflict-free tantalum for one of the capacitors inside the first generation Fairphones. This comes from the DRC via the Solutions for Hope (SfH) initiative. The SfH tantalum program started in 2011 and was established by Motorola Solutions and AVX, who developed a closed tantalum supply chain in cooperation with mines in Katanga and North Kivu. Thanks to this initiative and its members, it's possible to guarantee the minerals are extracted and traded without supporting armed groups. This demonstrates that it's possible to source conflict-free tantalum from the DRC.

Next steps



Recycling the parts

By urban mining the metals in your old mobile phones you are helping to reduce e-waste. Make sure you recycle these parts to help conserve natural resources, and prevent these materials - which can be toxic - from ending up in our water, landfills and air.

Bring the parts of the phone to a local designated recycling point

Find your local recyling point. You can use the list of recycling and collection points on the Fairphone website.

Read up on recycling on the Fairphone website:

- Fairphone Recycling Program
- Responsible e-waste recycling project
- Circular Economy

Take action!

Take a photo and share it with the Fairphone community with the hastags #UrbanMining and #WeAreFairphone

Facebook/fairphone

Twitter @fairphone

Instagram @WeAreFairphone

Flickr @ Fairphone

There is an "Urban Mining" album containing all of the images in these manuals. Under the Creative Commons license you are free to use them non-commercially. This should help you cater this workshop to your student's needs, for example you can project some of the photos onto a wall.

Encourage your students

- Use their phones for as long as possible.
- Become an informed shopper, choose wisely.
- Collect unused mobile phones from their community, school, family, friends.
- Organize their own Urban Mining workshop.

Well done! You've done it!

We'd love to hear how it went!
Feel free to share your feedback with us, email:
communications@fairphone.com

Glossary

Artisanal mining	Informal mining activities usually carried out with minimal or no machinery or technology – meaning it relies primarily on manual labor. Artisanal mining still occurs widely in many parts of the world particularly in Africa and Asia.
Component	A small part inside your phone or electronic device required to perform a specific function. For instance, the battery is a component in your phone, so are individual conductors, chips and capacitors.
Conflict minerals	Minerals *"whose control, exploitation, trade, taxation or protection contribute to, or benefit from the context of, armed conflict"* [10] Mineworkers in this case are often severely exploited and working conditions are harsh.
Conflict-free minerals	This term refers to the minerals that come from a mine where the revenue is **NOT** used to fund a war or conflict. But here's the twist: conflict-free minerals can come from conflict zones. The key difference is that their profit is not used to support the war.
Industrial mining	This is carried out using predominantly heavy machinery and mechanisation. Instead of narrow tunnels, often industrial mining is carried out using surface-mining methods, creating terraces.
Metal	The element that is extracted from minerals. For example, tantalum is the metal extracted from the mineral columbite-tantalite.
Mineral	Naturally occurring inorganic solid substance, usually in crystal form. It has definite physical and chemical properties. For example, tantalite is the mineral extracted from the ore columbite-tantalite.
Ore	A mineral is considered an ore when it contains a high enough concentration of a metal or valuable mineral to be extracted at a profit.
Printed Circuit Board (PCB)	This is a thin board composed of alternating layers of different materials, such as fiberglass and copper. The PCB can be considered the heart of an electrical device as most components are soldered to this thin board. Conductive pathways are etched or "printed" onto the board, connecting the different components, such as transistors, resistors, and integrated circuits. PCBs can be a single-layer for simple electronic devices but for complex hardware, such as mobile phones, a PCB may have more than 12 layers! PCBs are most often green but they can come in any color.
Refined product	This is created from metals and minerals. For instance, cassiterite (ore) is taken to a smelter. The raw cassiterite is then smelted and becomes tin (a metal). The tin is then turned into tin powder (a refined product).
Semi-industrial mining	This is carried out using some machinery and mechanisation, but manual labor is still the biggest part of the work. Mining and mineworkers tend to be more organized and structured in semi-industrial than in artisanal mines.
World production	The total sum of the quantity of the mineral that is actually being extracted per any given time period in the world, often indicated and measured per country.
World reserve	The available and economically mineable stock of a mineral resource. To be considered "minable" the reserve must be checked if extraction can be justified. It is tested for its economic, metallurgical, mining and processing possibilities. [11]

References

[1] Basel Convention, Mobile Phone Partnership Initiative (2012) Guidance Document on the Environmentally Sound Management of Used and End-of-life Mobile Phones http://www.basel.int/Implementation/TechnicalAssistance/Partnerships/MPPI/MPPIGuidanceDocument/tabid/3250/Default.aspx

[2] SOMO (2012) Voices from the inside. Local views on mining reform in Eastern DR Congo http://somo.nl/publications-en/Publication_3586

[3] Le Billon, P. (2003) Getting it done: Instruments of enforcement. In Ian Bannon & Paul Collier (Eds.), Natural Resources and Violent Conflict: Options and Actions, pp. 215– 286. Washington, DC: World Bank.

[4] European Commision (2013) Report on Critical Raw Materials for the EU Non-Critical Raw Materials Profiles http://ec.europa.eu/enterprise/policies/raw-materials/files/docs/crm-non-critical-material-profiles_en.pdf

[5] Global Witness (2015) La Paix Sous Tension http://www.globalwitness.org/sites/default/files/pdfs/Under-Mining%20Peace%20French%20Final.pdf

[6] Global witness (2014) European Companies Able to Reap Rewards from Deadly Conflict Mineral Trade http://www.globalwitness.org/library/european-companies-able-reap-rewards-deadly-conflict-mineral-trade

[7] European Commission (2014) Directorate-General for Trade. Assessment of Due Diligence, by Bohme, Bugajski-Hochriegl and Dos Santos http://trade.ec.europa.eu/doclib/docs/2014/march/tradoc_152230.pdf

[8] United States Government Accountability Office (2008) The Democratic Republic of the Congo: Major Challenges Impede Efforts to Achieve U.S Policy Objectives; Systematic Assessment of Progress is Needed http://www.gao.gov/new.items/d08562t.pdf

[9] Tantalum Niobium Study Center (2010) Tantalum Mineral Supply From Central Africa http://tanb.org/sites/tanb.org/files/webfmroot/ASM/Coltan%20DRC%2020100812.pdf

[10] Le Billon, P. (2003) Getting it done: Instruments of enforcement. In Ian Bannon & Paul Collier (Eds.), Natural Resources and Violent Conflict: Options and Actions, pp. 215– 286. Washington, DC: World Bank.

[11] Please note: political and economic bias can influence the numbers of mineral reserves. Figures also change over time depending on the national rate of mineral depletion. Statistics on world reserves should be understood as an estimate.

Learn more

Fairphone videos

Fairphone research trip: Visiting tin, tantalum and tungsten mines
http://vimeo.com/107812653

Fairphone: 2011 DRC Trip
http://vimeo.com/27764234

Fairphone blog

Conflict-free Mineral Legislation in the US and EU
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