Jane Goodall's roots&shoots New Zealand

Treasure hunt mobile phone: The adventurous journey of raw materials

Teaching material on:

Raw materials in our mobile phones

«Only if we understand, can we care.
Only if we care, we will help.
Only if we help, we shall be saved.»
Jane Goodall

the Jane Goodall Institute New Zealand

Dear teachers,

Thank you for showing interest in our environment and that you are going to use this teaching material on mobile phones.

More than 87% of all children and young people between 12 and 19 years old have their own mobile phone.[1] Multifunctional mobile phones have become an indispensable part of young people's lives. Multifunctional mobile phones have also become an important for adults in their private and business lives. Especially direct access to the internet makes the mobile phone to an "always-everywhere-online-tool".
Mobile phones have become much more than a means of communication; they enable us to be informed, to organise ourselves, to be entertained and to network wherever we are.
With the rise of the mobile phone the approach of modern pedagogy has changed regarding this topic: The mobile phone has become the object of media pedagogy in the last years. In the teaching material you now hold in your hands the topic is not conveyance of media competence, it is rather the definition of goals for global learning. These goals are to be conveyed by using the mobile phone as an example and can be presented on the basis of social and ecological consequences in the context of globalised production.
The strong connection of most young people to this product guarantees a high degree of previous knowledge and motivation for the topic which is the basis to be built on.

On behalf of the Roots & Shoots network we would like to encourage you to get active with your students for nature conservation. Start a small or a big project! Support our collection campaigns. Whenever you have questions, we are there for you to support you in implementing your projects.

Your
Roots & Shoots Team

[1] Media behaviour of young people mobile phone/smartphone, Upper Austria, Study on young people and media 2013 (Medienverhalten der Jugendlichen Handy/Smartphone, OÖ., Jugend-Medien-Studie 2013)

Roots & Shoots,
is a global, ecological and humanitarian programme for children and young people initiated by Jane Goodall Institutes world-wide.

"You cannot get through a single day without making an impact on the world around you. What you do makes a difference, and you have to decide what kind of difference you want to make."
Jane Goodall

Unit 1 | The journey of my mobile phone

Mobile phones are global products, not only when you use them, but throughout their whole life cycle. Mobile phones are typical examples for today's globalised production chains with their complex supply structures.
Today more than 4 billion people world-wide have a mobile phone. This incredible production volume creates jobs for many people, however, it also creates a lot of social and ecological problems.

Background: *Mobile phones are global products whose production needs a lot of resources and energy.*
Goal: *Production chains of mobile phones and their ecological and social impact*
What you need: *Wool or thread and print outs of the cards (Work Sheet 1)*
Possibly a world map and table of the elements

Content:

Together with your students you compile the life cycle of a mobile phone. Put a mobile phone in the centre and think about: where does this device come from, where do the raw materials come from and who was involved in producing it.

- Illustrate which stations a mobile phone has to go through in the course of its "life", from producing the raw materials to producing the device to selling it and disposing it.
- Discuss the "political origin" of the raw materials and the social, ecological and economic consequences.
- Make the students aware of the fact that producing a mobile phone is very complex and that this little thing contains a lot of material, work and extraordinary long distances.
- Raise awareness that their consumer behaviour has an impact on the environment, the wildlife in the respective mining regions and the people who produce their mobile phones.

Compile a production chain together with the participants. Print out the cards in the annex (Work Sheet 1, production chain) in order to illustrate the greater context. The mobile phone lies on the card "use". Then add the other cards one after the other:

- Production of raw materials
- Melting plant
- Distributor
- Producer
- Mobile phone company software licences
- Shop

You also can start a chain in the other direction.

- Recycling
- Production of raw materials (here the cycle is completed)

Questions:

- Who has a mobile phone?
- How old is this mobile phone?
- Where did you buy it?
- Where did this person get your mobile phone from, what do you think?
- Where do the shops get their mobile phones from?
- What is a mobile phone made of?
- Where do the raw materials come from? Who does the mining and who processes the raw materials?
- What kind of work needs to be done at the different stations?
- What do the different work places possibly look like?
- What kind of working conditions will you find there?
- How long do I use my mobile phone?
- What happens then?

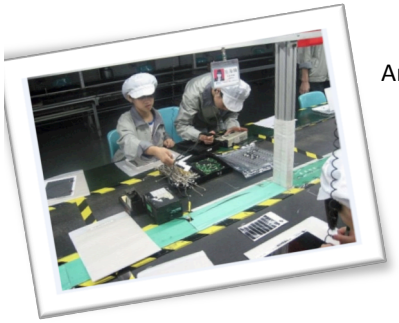
Background knowledge: Production:

Production of raw materials:

Mobile phones contain more than 50 different materials (amongst others cobalt, copper, zinc, gold). Furthermore, they contain the metal tantalum, which is produced from the rare and valuable crude ore coltan (short for columbite-tantalite). This metal is used in the production of mobile phones, games consoles and laptops. After Australia, the Congo is the second largest producer of coltan. Illegal mining of coltan by rebel groups is not the only problem which causes criticism. Child and forced labour, as well as wide-ranging, sustainable impacts on nature are the reason for much criticism, as well.

The ecological consequences of the mostly illegal mining, as well as the destruction of the rain forest and the pollution through improper disposal of waste are not even taken into account. And the habitat of our closest relatives, the chimpanzees, is dangerously narrowing.

There are, however, initiatives which are supported by the mobile phone industry and are based on buying only "ethically correct" coltan. Since it is supplied and processed by third countries a proof of origin is usually very difficult. There are first attempts to have a flawless proof of origin by taking its geochemical "fingerprint".



Production:

An increasing part of consumer electronics is produced in developing countries. In the last years the producers relocated their production sites from one country to the next, increasingly more to Asia in order to save costs and to be present in the emerging markets. Most of the time companies do not produce their devices themselves, but assign it to contractors and suppliers.

The most frequent problems in mobile phone production concerning social topics and workers' rights are low wages, excessive overtime, the violation of the right to organise, problems regarding the protection of health and safety at work, as well as the increasing job insecurity due to fixed term contracts and temporary employment agencies. The electronic industry is traditionally very hostile against unions in the production countries which leads to a very low level of union organisation and there are hardly any wage settlements.

For the producers of mobile phones it is very difficult, even impossible to find out at which distributor the supplying manufacturers buy their material. The distributors buy the necessary material at different melting plants and they purchase their minerals and raw materials from different mines. Transparency is very low in this industry.

Use:

Resource consumption of mobile phones when they are in use is primarily limited to their energy consumption, which is not very relevant regarding their short time of usage compared to their energy consumption during their production. However, when in use they indirectly consume additional energy by using the mobile network (basic stations, antennas, switching centres, wiring systems), which makes the usage phase ecologically relevant for the life cycle.

Disposal:

What happens to a mobile phone when it is not used anymore? Most of them get into a drawer and stay there, others are given to friends or relatives or are sold. Only a few are recycled – some even are thrown into the domestic waste.

Mobile phones are much too precious for that due to their resource intensive production. Recycling helps to bring back at least part of the raw materials into the production cycle. (More on recycling in part 3)

Additional ideas:

The journey of a mobile phone

Material: world map, thread

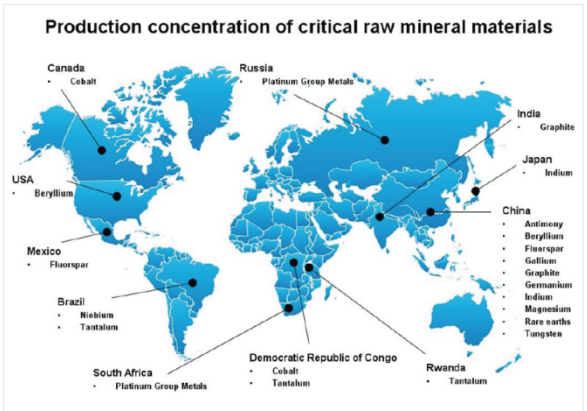
How to: The text on the possible journey of a mobile phone below is read together with the students. Use the thread for simulating the transport and production network on the world map.

An incredible journey

Copper (Cu) is excavated in Chile consuming a lot of energy. Gold (Au) comes from South Africa and silver (Ag) from Russia. These raw materials are transported to China.
There semi-finished products, i.e. single parts, are produced by machines and by people. These semi-finished products are transported then to Malaysia. There the mobile phones are assembled and packed. Then the mobile phone travels to Finland to one of the big mobile phone producers. From there it finally comes to your country and you can buy it at one of the mobile phone providers.
The copper parts have travelled then from Chile to e.g. Austria for approx. 38,000 km.

Discussion:

- Which transport means could be used for raw materials, single parts or the finished mobile phone?
- What do you think: How much damage is done to our environment by using so many different means of transport and the many production steps?
- What do you think why the mobile phone needs to travel this far?
- What kind of impact does this journey have to the environment and humanity?



Source: European Commission, 2013

An old mobile phone tells its story

Material: Possibly a frame made of carton to simulate a TV set, a brush or anything else that could be used as a microphone, newspaper or paper

How to: The person leading the group of students takes his/her mobile phone out and tells a short, but inspiring story, such as:

My old mobile phone

"May I introduce you to - my mobile phone. If it could talk, there would be a lot it would tell you: for example it would tell you that its owner sometimes forgets where she put it, she once even forget it in the train and only by a lot of luck she got it back. What happened to your mobile phone? Where does it come from? How was it produced? What kind of people worked on it? How far did it travel? Who owned it and what happened to it there, what kind of things did it hear? How and where will it finally go to?"

Now split into three groups:

The first group takes on the role of the mobile phone producers and thinks about how they could create a mobile phone which could be used longer and more sustainably. The second group thinks about the time when it is in use and the third group thinks about the "end" of the mobile phone. – Is it going to be given away to somebody else? Will it end up in the residual waste? Is it going to be disposed of the right way or will some of its parts continue their lives in other mobile phones?

Every group now has ten minutes for collecting ideas what the mobile phone would have to tell you. Everything goes – the more creative, the better. Every group writes down a little story which is then read to the class.

Alternative:
The different groups do not write down a story but create a whole show or theatre play, interview the mobile phone, draw a comic strip or something of that sort. If the class decides on making a big show, then you could either film it or perform for other classes or parents.

Unit 2 | The treasures in my mobile phone

Mobile phones contain about 60 different, precious raw materials. Many of these materials are extracted in the rain forests of Africa. The (partly illegal) mining destroys these jungles, bereaving the wild animals and plants of their habitat and brings about enormous social problems. Armed groups fight against each other in order to get control over different resources. Trading of the precious minerals finances their political and military activities.

Goal: *Awareness raising for the topic raw materials, their impact and their value*

What you need: *old mobile phones, tools, work sheets*

Content:

The students learn about raw materials and their impact on our daily life by the example of a mobile phone. In this unit they work on finding out which parts a mobile phone is made of and which raw materials are contained in the different parts. The students realise that the raw materials in mobile phones are finite on this planet and precious.

Parts of a mobile phone

What you need: An old mobile phone, tools (screw driver, pliers...), a sheet of paper for labelling, work sheet with table of the elements + work sheet of the "Anatomy of a mobile phone".

How to: In this task the students can prove their handicraft skills.
The participants disassemble an old mobile phone in pairs or in a group but without doing too much damage to the individual parts and put them in front of them.
At least 4 parts need to lie in front of them (display, circuit board, battery, case). Label them.

By using work sheet 2 the students work out which raw materials are in which parts of the mobile phone and label those, too.
All raw materials used in the mobile phone are entered into the table of elements (work sheet 3).

Where are you, raw material?

What you need: Work sheet, scissors

How to: The individual cards of work sheet 4 are cut out and are stacked in two piles. The participants try individually or in groups (by using work sheet 4) to find the cards which go together.

The journey of the mobile phone

How to:
First you show the disassembled mobile phone to everybody and explain the different parts. Now the students get into groups, one for every part of the mobile phone. Depending on in how much detail the parts are described, there are many small groups or fewer, but bigger groups.

The following groups can be built:

- Plastics case (rigid plastic): *biggest group*
- Display (glass)
- Buttons (soft plastic)
- Battery
- Camera lense
- Loudspeaker
- Circuit board
- Metals: iron, aluminium, etc.
- Precious metals: silver, gold, etc.

When all students found a group they want to join, they start assembling the mobile phone. They place the plastic case around all the other parts which are put together just as they feel. When they are done with the mobile phone, all say the name of their group aloud. Then they let themselves fall down (the mobile phone falls apart).

But which parts are now used in which form? Every group is now analysed in detail step by step. It's now your turn to accompany the groups as an expert.

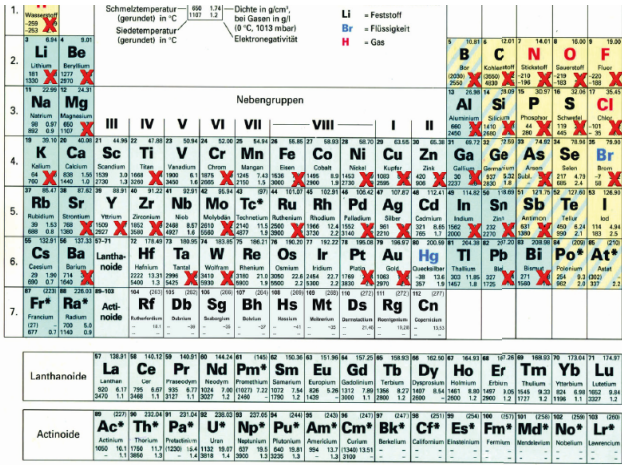
Tip:
With older students you can discuss global processes or you can do more research and exercises.

Background knowledge raw materials

Mobile phones are made of plastics (on average approx. 50 %), different metals (about 28%; 15% of which are copper and many more) and glass and ceramics (approx. 15 %). They contain about 4 % carbon and approx. 3 % other substances (Reller et al., 2009). Roughly speaking, the plastics is needed for the case, the buttons and the printed circuit board. The metals are needed for cables, contacts, the printed circuit board and the battery. Glass and ceramics are needed for the LCD display and the embedding of the liquid crystals.

Mobile phones contain the following elements:
Carbon (C), hydrogen (H), copper (Cu), aluminium (Al), ore (Fe), silicon (Si), tantalum (Ta), nickel (Ni), tin (Sn), chromium (Cr), lead (Pb), neodymium (Nd), zinc (Zn), silver (Ag), palladium (Pd), gold (Au), antimony (Sb), titanium (Ti), bismuth (Bi), cobalt (Co), beryllium (Be), lithium (Li), boron (B), nitrogen (N), oxygen (O), fluorine (F), magnesium (Mg), phosphorus (P), sulphur (S), chlorine (Cl), potassium (K), calcium (Ca), manganese (Mn), gallium (Ga), arsenic (As), bromine (Br), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), molybdenum (Mo), ruthenium (Ru), indium (In), barium (Ba), lanthanum (La), cerium (Ce), tungsten (W), platinum (Pt)

Cadmium (Cd) and mercury (Hg) should not be contained.



Many parts of the mobile phone such as gold, silver, palladium, copper, zinc and coltan (columbite-tantalite, tantalum is extracted from it) are mined in the rainforests of Africa without taking care of any ecological, health or social consequences – what remains is a barren moonscape. Through the destruction of the jungles the local population, the wild animals and the plants lose their habitat. This can be seen very clearly at the drastic reduction of the numbers of apes in the Congo, Uganda and 18 other African states: 50 years ago 1.5 million chimpanzees lived there, today their number is an estimated 200,000. The second largest coltan deposit of the world is situated in the Congo. Extracting this mineral and more than 50 other raw materials is very laborious, needs a lot of space, energy and water and has a dramatic impact on this ecologically sensitive area.
However, these are the raw materials which are contained in the devices we use every day such as computers, TV or the mobile phone. With this project we would like to make clear to the young people that they *can* have an impact on these processes, which are apparently so far away, since they are involved in all this as consumers.
In total about 60 different materials are contained in a mobile phone.

Source: school kit by
Elektroaltgeräte Koordinierungsstelle Austria GmbH

Additional ideas for your lessons:

Shortage of resources: Active game

Material and preparation:
Before you start with the game, make rings out of ropes or spring lines in different sizes. The number of rings should be the same as the number of players and should be of the following sizes:

- One ring should big enough so that two thirds of the participants can stand within it very closely together (approx. 6 m).
- Several rings the size of 5 participants (approx. 3.5m);
- Even more rings the size of holding 2 to 3 people (approx. 2.20m);
- About 60% of all rings are the size that they can be put around one pair of feet (approx 1.10 m);

Tip: If neither ropes nor spring lines are available, you can also use rings (hula hoop rings).

All rings are distributed in a distance of about 40 cm over the floor.

Introduction:
"I would like to do an exercise with you in order to show to you what a shortage of resources and dealing with it means. Imagine that the ring you are standing in is an important resource (a raw material, your habitat). In order to stay in the game both your feet need to be within the ring after the phases where you change places and they are not allowed to touch the rope/ring or the floor outside of the ring." Take a look now if all the students are standing correctly.

Start the game:
"The second I say CHANGE, everybody needs to find a new place in another ring. When all of you stand correctly according to the rules, then I will say again: CHANGE and you change. Understood? Okay, CHANGE!" Wait and take a look, if all found a new place.

Course of the play:
Whenever the students change their places, one or more of the smaller rings are taken away as soon as nobody stands in them anymore. Now the students will get restless, since there are not enough rings so that every student has one for him/herself. The rings need to be shared.

You, as game master, now can say: "The resources are getting scarcer!"

Whenever the students change, try to take away one or more of the rings.
If only 1 or 2 bigger rings remain on the floor, it will not be possible to accommodate all students. Some of the participants will then stand outside of the rings.
Perhaps you want to say: "Do think it fair that the success of a few leads to failure of the others?" or "Is it acceptable for you that the success of a few is causing failure of the others?" Usually this question will lead to a lot of efforts to accommodate all students in the remaining rings. Very often they ask if it is okay to stand on the tip of the toes. A good answer is: "Anything that is not prohibited and not dangerous is okay." This brings out a lot of creativity in the students, e.g. some will sit down outside of the ring and will only keep their heels in the ring.

As game master it is important to watch how these strategies begin, who is the first initiating them, if they are observed or ignored. The game is over when all participants have both feet in the ring and it is not possible to take away another ring. When the students realise that the rings are only taken away whenever there is nobody standing in there, and start only leaving the ring whenever somebody else has "taken over", then the game is over, as well, and you congratulate the students on their strategy.

Talk about the game.

Unit 3 | Recycling pays off

In the previous units the students were taught about the precious contents of a mobile phone. In the last unit they should think about what will happen to a mobile phone when it is not needed anymore.

***Goals**: Raising awareness for the correct treatment of mobile phones which are not needed anymore.*

***What you need:** 4 sheets of flipchart paper, markers*

Contents:

The increased use of electronic devices such as mobile phones has at the same time increased the amount of products not needed anymore. Although mobile phones are very small, they contain a lot of potentially dangerous substances, as well as very precious metals. Therefore it is important that they are recycled carefully and entirely. If more mobile phones were recycled, less metals would need to be extracted and less dangerous substances would contaminate the environment.

In this unit the participants try to reflect on their personal use of their mobile phones, to find possibilities to keep their phone for a longer time and to discuss, what should happen to the mobile phone when it is not used anymore and how to recycle it correctly.

World Café "The life of a mobile phone"

The group is split in four smaller groups. Every group has a flipchart and gets one topic to work on:

Group A: Which measures come to your mind in order to prolong the life of your mobile phone?

Group B: Think about a typical mobile phone commercial in the media. What is the goal of the provider? Imagine that you get the task to advertise sustainable use of a mobile phone. What will your commercial look like?

Group C: What shall I do with my mobile phone when I won't use it anymore?

Group D: You have a mobile phone recycling box in your class. The recycled mobile phones protect the environment. The Jane Goodall Institute, every recycled mobile phone helps the implementation of projects on protecting chimpanzees. What can you do in order to make this campaign as successful as possible?

The students think about possible answers to all the questions. The leader of the group writes down all ideas on the flipchart. After 5 to 10 minutes the students change the group, the leaders stay in their group.
The leaders inform the new "guests" on the ideas their predecessors had, they discuss the topic from a different point of view and new ideas are written down. If there is enough time, change once more. Then the individual posters are presented to the big group. Start a discussion.

Possible answers:

Group A:
Longer use
- Keep mobile phone in a case.
- Protect it against moisture
- Protect it against bump and falls

Tips for a longer life of your battery
- Charge battery before it is drained to 0%, best you charge it in different states
- Charge the battery fully
- Leave it plugged in only until it is fully charged
- Always unplug the charger
- Take the battery out of your phone if you do not use it for a longer time (more than a month)

Have it repaired

Group B:
Product design and advertising
- Create an ecological design
- Advertise "cascade" use
- Make upcycling a trend, i.e. advertise longer and re-use by others
- Advertise "SIM-only" (the owner keeps his/her mobile phone and gets a new SIM card)

Group C:

- **Give away your mobile phone to friends or relatives** for longer use
- **Recycling boxes of JGI New Zealand:** Old mobile phones, plus batteries and chargers if available are collected and recycled. The proceeds are used for projects protecting chimpanzees.
- **Disposal via the mobile phone provider:** All big network providers take back their mobile phones via mail or in the shop.
- **Disposal by recycling centres**: Old mobile phones can be disposed of in community recycling centres for free.

Group D:

- Ask your relatives and friends, if they have old mobile phones, they don't use anymore.
- Create collection boxes which can be positioned in public buildings.
- Raise awareness of the campaign at school events.
- Write and publish an article for the school newspaper and school webpage.
- Go to the closest mobile phone shops and ask what is going to happen to old mobile phones.

Background knowledge recycling

Disposal

65 – 80 % of an average mobile phone are recyclable. Usually the metals are recycled and the plastic parts are partially used for energy. Recycling helps the water and energy balance compared to new production of the same amount of materials.
Only a small share of used mobile phones are recycled and the disposal is done in threshold countries where recycling and disposal is very often severely damaging the environment. The high-tech parts are in general very difficult to recycle. The diversity and limited separability makes recycling very difficult. (Nokia 2001).

Recycling saves primary costs and thus conserves the environment

Recycling can ecologically and economically make sense. In general it has a lot of advantages compared to the use of primary raw materials such as reduction of the use of primary raw materials and thus a reduction of dependency of imports, conservation of natural resources, reduction of energy consumption compared to primary raw materials and greenhouse gasses. *(DERA, 2011)*. Some metals can be used almost as often as possible, e.g. recycled gold, palladium or copper have the same chemical/physical properties as the metal used in primary production (Hagelüken 2009a). Additionally the metal concentration in recycled material is much higher than in mining.

EU law requires that the costs for disposal need to be borne by the producer and that the share of the most dangerous substances must be reduced. These framework conditions have caused the mobile phone producers to produce products which are more environmentally friendly and easier to recycle and it brought about a stronger focus on ecological topics in the Western markets. The efforts of the producers are only at the very beginning, though.

Sustainable production of mobile phones by an increase of resource efficiency

Resource efficiency is one of the mega trends of the 21st century. The reasons for this intensive debate are virtual shortage in resources, increasing resource costs and sustainable management.

Resource efficiency potentials can be realised by a longer use of the product. The average time of use for mobile phones lies between 18 and 24 months, although most of the devices would work much longer. It is not about how long a mobile phone can be used or how robust it is, what counts is that you get a new mobile phone with every extension of your contract – sometimes even months before the old contract expires.
Every year about millions of mobile phones are purchased. But only a fraction are recycled. This means that millions of mobile phones disappear in drawers or are disposed of in the residual waste each year.

One of the central keys to an increase of the number of mobile phones to be recycled is to improve the collection infrastructure. If it were possible to recycle them properly and efficiently, several tonnes of raw materials would be retrieved.