

Teachers' Card



Index

General Introduction.....	2
Extended background information.....	3
Learning Outcomes.....	7
Key Competence European Framework.....	7
United Nations' Sustainable Development Goals	8
Activity	9
Learning pathway.....	9
Evaluation.....	10
Sources.....	11

Teachers' Card

General Introduction

Type of activity: The toolkit Mixed Reality meets RM provides an introductory lesson about the topic of mining and raw materials. It serves as a first introduction lesson to prepare the students for following experiments, projects or as can also be held as a standalone lesson to teach about raw materials and mining. It can also be used as a different approach to talking about the more familiar concepts of climate change, recycling and circular economy.

The lesson can be held in a regular classroom, in a laboratory, outside or also remotely.

Audience: The lesson is designed for children from age 10-14. The lesson can also be used for older students if more difficult questions and tasks are given.

Problem or challenge: The 2 main questions to be asked and answered during this lesson are the following:

1. Why do we need mineral raw materials?
2. How does mining work nowadays?

Content of lesson: The toolkit Augmented reality meets RM provides an interactive introductory lesson about the topic of mining and raw materials. The students learn about mineral raw materials and their importance in our everyday lives and see how mining is done today and in the future. Just like the modern mining activity, our lesson has a digital component and uses modern technology – namely augmented reality. The students only need a smartphone in order to see a mining truck and can visit a modern mine right in the classroom. During the course of the lesson, the students will get the chance to reflect on their own impression of mining and what they imagine the mining activities entail. In addition, by using the example of the smartphone, the students get a direct link to how mining is related to the tools we use in our everyday lives and the effects it has on our world.

Organization: The activity is designed for a 50-minute time slot. It starts with a pre-activity, dives into the main topic and ends with a reflection and concluding session, including an evaluation.

Key words:

Raw materials, augmented reality, minerals, circular economy, mining

Teachers' Card

Extended background information

The two main questions to be asked and answered during this lesson are the following:

1. Why do we need mineral raw materials?
2. How does mining work nowadays?

The importance of raw materials:

The metals and minerals we rely on in our everyday life is incredible. When we take a moment to think about it and look around to observe the objects we are surrounded by, we realize that only a small portion of that is built with plant-based resources. From the cement we walk on to the computer screen, our world and our way of life depends on the products of modern mining practices. We would not even be able to eat our breakfast without the results of mining: The salt, the plate and mug, as well as, the coffee machine all rely on mineral mining.

As we learn about our environment and the damages mankind has done to it in the past century, mining is usually named as one of the main responsible activities that led to the damage. But can we think about a more sustainable way of life without mining? Sustainable power, renewable energy, electric vehicles, advanced engineering will all rely on an increased source of the materials we already depend on. Each solar panel and each wind turbine needs various different mineral raw materials. The mining industry supports our everyday life but also provides the foundations of engineering achievements for the decades to come.¹

Our modern society needs huge quantities of mineral resources. Having a high living standard made our life comfortable, but humans slowly pay the price for the system they created. As it is not possible to remove mineral raw materials from our life anymore, we have to improve the things we have and make everything more sustainable. The term „mining“ refers to the exploration and extraction (mineral mining) as well as production (from mining to transport) and the processing of these materials from the ground. Our predecessors only found ores by accident, however, today highly scientific and technical methods help to explore and mine new, promising deposits.

As we rely on mineral raw materials and our primary resources are finite, it is important to look for alternative ways. One option is reprocessing, which is important because we can use recycled products in many everyday situations. In order to recycle, however, it is first of all necessary to collect old products and this is where every consumer can contribute to a sustainable future. Mineral resources are indispensable in today's world for they are an essential part of everyday life.²

Therefore, it is of great importance that we understand the relevance of mining and raw materials for our lives. Only when we know the process of the creation of a product we can understand the need for recycling, for ethical correct mining and for sustainability.

¹ <https://mineralseducationcoalition.org/mining-minerals-information/importance-of-mining/>

² <https://www.eumicon.com/en/topics/the-role-of-mineral-resources-in-today-s-world/>

Teachers' Card

Circular economy:

What is a circular economy?

The standard Circular Economy model, as described by the European Commission, has the following definition: **“Managing the life cycle of natural resources”**, from extraction through the design and manufacture of products, to what is considered as waste **is essential to green growth and part of developing a resource-efficient, circular economy where nothing is wasted**. Smarter design allowing products to be repaired, re-used, remanufactured and then recycled again should become the norm.”³

This means that the process of a product should not be linear – starting from the extraction or harvest of the raw materials and then ending at waste sites as it is currently. It should be circular, where each part links to the other and the product, once it breaks or is not used anymore is kept in the cycle.

This process starts at the very beginning of a product’s lifecycle: smart product design and production processes can help save resources, avoid inefficient waste management and create new business opportunities.

The circular economy model has been taking up and adapted to particular processes, as the model is general and can be applied to any process. In this case, the model focuses on raw materials. It demonstrates the cycle of raw material extraction, product design and finally recycling. A circular economy is an economic system aimed at eliminating waste and the continual use of resources. As the majority of the products and tools we use daily contain mineral raw materials, the same amount ends up at garbage piles or in our backyard once the product is thrown away. Therefore, EIT RawMaterials concluded that, waste, or also called “end-of-life” products “must be considered as resources for another cycle, while losses and stocks of unused materials must be minimised all along the value chain. In addition, interactions between materials must be considered in order to define the best circular solution from a systemic standpoint”.⁴ The image below shows the circular economy model of mineral raw materials:



Figure 1 https://eitrawmaterials.eu/innovation-themes/03_06_ce-draft-1/

³ https://ec.europa.eu/environment/green-growth/index_en.htm

⁴ <https://eitrawmaterials.eu/innovation-themes/>

Teachers' Card

A further model that is the “three R” model, which is based on the waste management priority list.

The three Rs stand for the words “reduce, reuse and recycle” and focus on waste prevention. Reduce means that an item shouldn’t even be produced and therefore, we should avoid buying a new product. Often items can be bought second hand which means that they don’t go to waste and no new material has to be used.

Reuse ties in to the idea of giving something another purpose, such as by upcycling it. Lastly, recycle means that the product will be broken up into the various materials that it is composed of and those materials will then be used for new products.



Figure 2 <https://www.e-education.psu.edu/emsc297/node/700>

Mining: a general overview

Mining is the branch of industry concerned with the search for, and extraction of, minerals from the Earth. The site in which minerals are found is usually called a mine. There are two exceptions: Oil wells and rock quarries, where building stone, slate, and the like are extracted. The kinds of minerals dug from the Earth vary widely and are used for a wide range of items. However, what connects them is the fact that they are the primary element for almost all tools and products we use in our society. The following four categories are the fields, which heavily rely on mineral raw materials: Electronics, cell phones, batteries and cars. Most of them actually rely on combinations of many mineral elements.⁵

There are three different ways of mining: Open-pit mining, which is one of the most common mining methods and takes place on the surface. The sequence of events to excavate material at an open-pit mine is the following: drill, blast, load, haul and dump. Then the material will be processed and the desired minerals are separated from the rest. Another form of mining is underground mining, which takes place below the surface. This is more difficult but many ores and minerals can only be found underground. The third method is underwater mining.⁶

Today, apart from food, paper, and some clothing, there is hardly a product that is not derived from the Earth’s store of minerals. The main objective and challenge in any kind of mining is not only to excavate the material from the ground, but also, to remove the valuable material economically and safely with minimum damage to the surrounding environment. Metals and minerals usually occur in nature as ores—that is, combined with other materials. This means that they must be treated, usually with chemicals or heat, to separate the desired metal from its host material.

⁵ <https://mining.komatsu/blog/details/uses-of-minerals-in-everyday-life>

⁶ <https://www.angloamerican.com/futuresmart/stories/our-industry/mining-explained/digging-deeper-mining-methods-explained>

Teachers' Card

After all the desired material has been taken from the mining site, it has to be closed. Thankfully, many countries provide laws and regulations guaranteeing environmental protection. Of course, some temporary disruption to the environment is unavoidable when taking minerals from the ground and turning them into useful products. Therefore, before a mine can be officially closed, some activities that will restore the site to its most environmentally desirable state must be done. These activities may include removal of hazards, recontouring, and planting where possible.⁷

A teacher can find all additional background information for the toolkit in the RM@Schools Teachers' Resources (on Website) in sections:

Section 2: Learning about Raw Materials and the Circular Economy;

Section 3: Exploration and Mining

Section 4: Recycling

Section 5. Substitution

⁷ <https://kids.britannica.com/students/article/mining/275852>

Teachers' Card

Learning outcomes

Learning outcomes - By the end of the lesson the students will be able to:

- Recall the principles of circular economy
- Explain the importance of raw materials in everyday life
- Repeat how mining is done today and in the future

Key Competence European Framework

















Literacy competence
S4. Ability to interact in an appropriate and creative way in any situation.
Multilingual competence
S1. Ability to understand and interpret concepts, feelings, facts or opinions in oral and written form.
S4. Ability to interact in an appropriate and creative way in any situation.
S5. Knowledge of vocabulary, grammar and language.
Digital competence
S4. Ability to use and handle technological tools and machines
Citizen competence
S1. Ability to effective interaction with other people
S3. Ability to work effectively and collaborate with other team members

Teachers' Card

United Nations' Sustainable Development Goals

The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including those related to poverty, inequality, climate change, environmental degradation, peace and justice.

Goals linked to this activity:

	  Enable access to basic services		 Equal access to global expertise
	 Safe medical devices		 Sustainable urbanization
	 Access to education		 Responsible consumption and production
	 Less hardship, more opportunities		 Strengthen resilience, reduce disaster impact
	 Safe and affordable water		 Reduce marine pollution
	 Energy – the golden thread		 Sustainable use of terrestrial ecosystems
	 Safety of workers and economic growth		 Promote peaceful and inclusive societies
	 Resilient infrastructure and sustainable industrialization		 Better access to technology and innovation

Teachers' Card

Activity

The toolkit Mixed reality meets RM provides an introductory lesson about the topic of mining and raw materials. The students learn about mineral raw materials and their importance in our everyday lives and see how mining is done today and in the future. Just like the modern mining activity, our lesson has a digital component and uses modern technology – namely mixed reality.

The students only need a smartphone in order to see a mining truck and can visit a modern mine right in the classroom. Then they will discover how the minerals are extracted from the ground until they are processed into metals and finally become part of our devices, roads, buildings and tools.

Appendix 1_Teacher Support

Appendix 2_Feedback form for Students and Teachers

Learning Pathway

Step 1- Time & Activity:

10 minutes

Mixed reality – brainstorming:

The students will have downloaded an app before the lesson. The teacher can use PowerPoint slides to guide the lesson.

App – if the trigger is paper based:

https://www.dropbox.com/sh/5wwupvv1197y4vx/AAC-EJZwqhjeKC46XiDwOtiga?dl=0&preview=RIC_HaulUsingTheTriggerOnPaper.apk

App – if the trigger is scanned from a screen (home schooling):

https://www.dropbox.com/sh/5wwupvv1197y4vx/AAC-EJZwqhjeKC46XiDwOtiga?dl=0&preview=RIC_HaulUsingTheTriggerOnThePc.apk

The lesson is started and the students will open the Unity app on their phones. They will see the trigger picture provided by the teacher and will scan it with their phone camera within the Unity app.

They will see a mining truck in 3D. The following questions can be posed to the students:

- What is the name of this machine?
- Where can you find this machine?
- What does this machine do?
- What does that have to do with us?

Step 2 – Time& Activity:

30 minutes

World Café Method:

Teachers' Card

The students are divided into groups and will be sent into breakout rooms. The teacher already prepared the tasks, which can be found in the PowerPoint presentation. Ideally, there are 4 groups and each group have 7 minutes for each station.

- Task A: Draw a picture about mining (e.g. MIRO board)*
Explanation: The students might have an outdated image of mining in their heads or cannot imagine anything at all. Therefore, this task gives them the chance to visualize what they know about mining.
- Task B: Each group defines three key words about mining and shares them in the chat. The students also have to explain their choice for the selected words. The teacher will collect all the words and discuss them with the students. He or she could also create a word cloud with the given words.
- Task C: Mining countries on the world map.
In the PowerPoint slides is a blank world map, where the students have the task to search the internet for mining sites around the world. The found countries should then be coloured in on the map.
- Task D: Mobile phone
 - o How many mobile phones does your family have?
 - o What do you do with your old ones?
 - o Why do you think it is necessary to recycle your old mobile phone?

The students should discuss these questions within their groups and take some notes. At the end of the lesson these answers and ideas serve as a final discussion about recycling in the plenary session.

Step 3 – Time& Activity

10 minutes

Closing:

The students are being brought back into the main room and share all the results with each other. The teacher can draw a conclusion and summarize the main points. In addition, he or she can broaden the task from task D.

***MIRO** (or a similar platform)

This is a collaborative board, where your pupils can work on tasks together in real time. They can work on separate tasks within the one board by using breakout rooms within your video conferencing platform to create groups. Prior to the lesson they can create a free account.

They will use this collaborative board for carrying out the tasks in the World Café exercise.

Link: <https://miro.com/>

Teachers' Card

Evaluation



Example: true/false, matching, cloze, multiple choices + **solutions**, compendium, open questions + **short answers**, ask to realize a presentation – ppt or a lab report

Kahoot quiz:

Link for hosting this kahoot:

<https://create.kahoot.it/share/augmented-reality-meets-rm-english/0ed0ed2f-a294-47a0-b5c5-d2eee40694a1>

Sources

<https://www.angloamerican.com/futuresmart/stories/our-industry/mining-explained/digging-deeper-mining-methods-explained>

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Figures:

Figure 1 https://eitrawmaterials.eu/innovation-themes/03_06_ce-draft-1/

Figure 2 <https://www.e-education.psu.edu/emsc297/node/700>