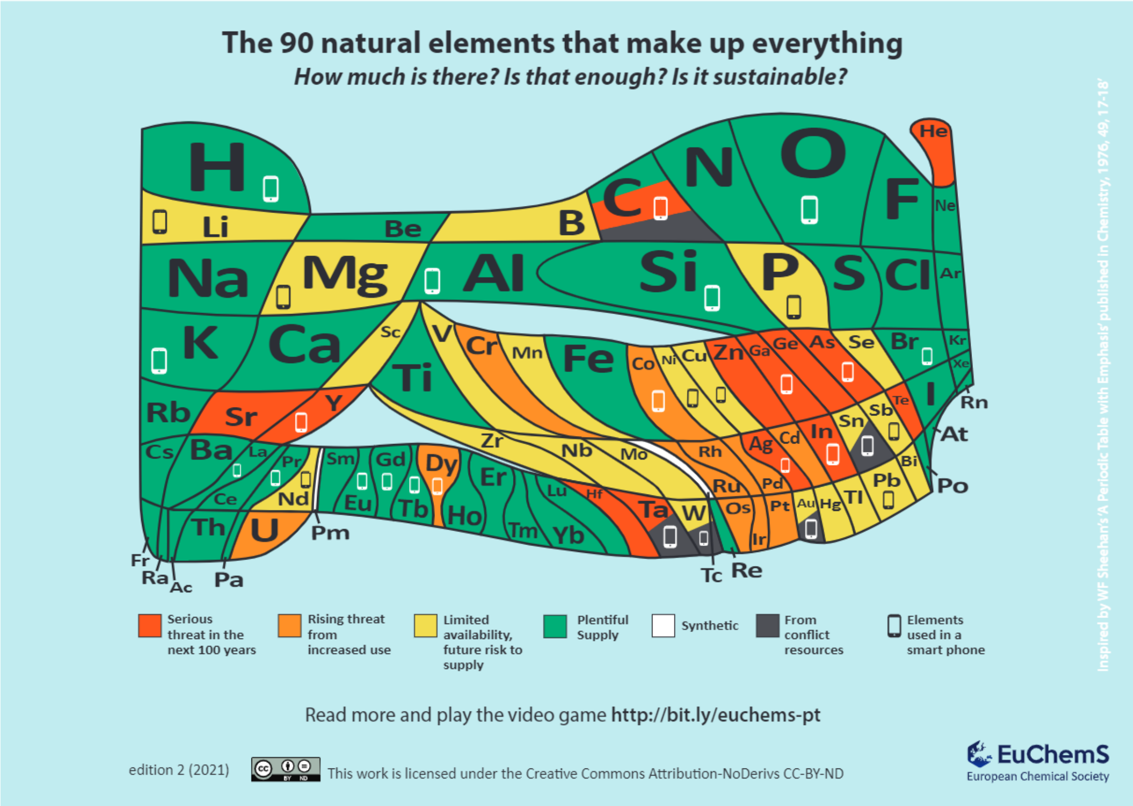
Elements at risk. Scarcity or not scarcity: That's the question

Because there is not a planet B, in this course we will investigate how limited are our resources.



1. **TO GET INTO MATTER. Interactive activities**

Previously to enter in detail about the scarcity or not of certains materials, let's discover the agency names that alert us about it.

1.1 Find which the functions of these organizations are. You can also search at their official webs.

File:iupac-197.h5p

1.2Different chemical societies

A few more descriptions that will help you to achieve the final task of this initial activity.
File: different-chemical-societies-198.h5p

1.3 What does IUPAC mean?

You should now write and share your opinion, definition for IUPAC, ... in this forum

1.4 What does SDGs mean?

You should now write and share your opinion, definition for SDGs, ... in this forum

1.5 Which are the seventeen SDGs?

You should now write and share your opinion, definition for the 17 SDGs, ... in this forum

1.6 What does EuChems mean?

You should now write and share your opinion, definition for EuChemS, ... in this forum

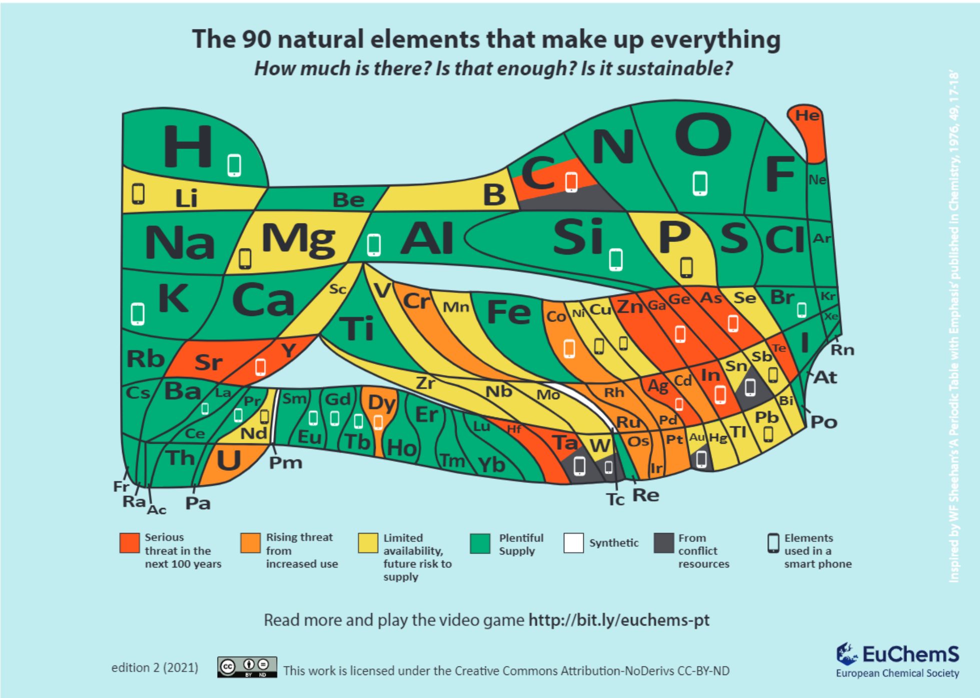
1.7 What does ISC3 (ISCCC) mean?

You should now write and share your opinion, definition for ISCCC, ... in this forum

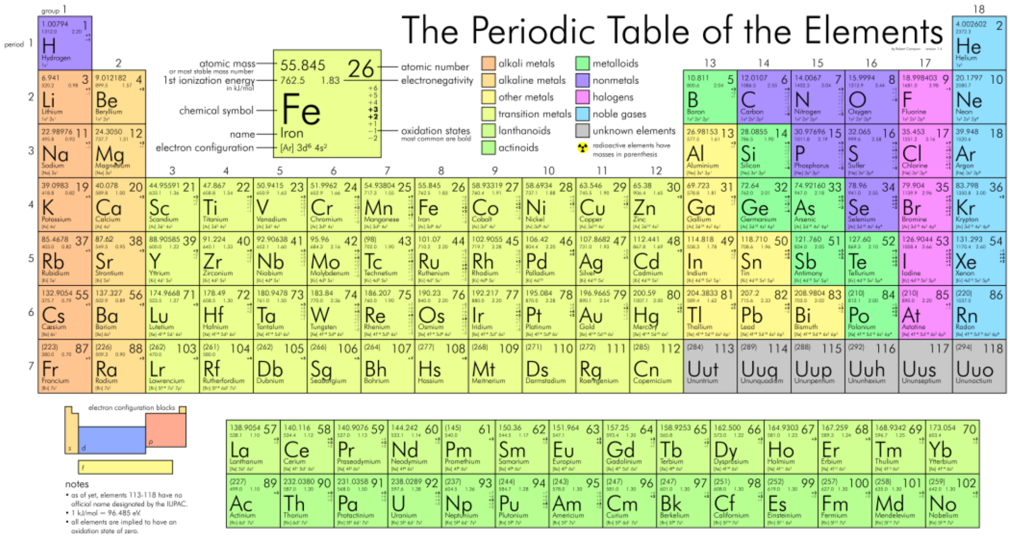
2. DISCOVER THE SCARCITY OF ELEMENTS OF YOUR SMARTPHONE

The Periodic Table showed here, thanks to the European Chemical Society (Element Scarcity - EuChemS Periodic Table - EuChemS), has been drawn so that the area occupied by each element gives an indication of the amount of that element in the earth's crust and atmosphere. From now, that will be named “Scarcity Periodic Table”. Click the image to learn more....

https://www.euchems.eu/euchems-periodic-table/



Compared to a conventional periodic table, such as the following, try to find the main differences and which elements do not appear.



Observe both periodic tables and complete the following activities.

Interactive activity, file: scarcity-elements-199.h5p

Take note of the following questions previously to answer them.

3. ELECTRONIC COMPOUNDS

"The usual phrase is, there's about 60 elements of the periodic table that sit in front of us when we use our smartphone or laptop computer," said Avtar Matharu, a professor of chemistry at the University of York in the United Kingdom.

"Manufacturing all kinds of electronics is extremely chemical intensive," said Benoit Cushman-Roisin, a professor of engineering sciences at Dartmouth College.

Source : Four Materials Illustrate Hazards Of Electronics Manufacturing | WisContext

3.1 INDIUM

Click at INDIUM word and read the four articles proposed. Try to figure out possible future scenarios regarding our electronics consumption

Interactive activity, file: indium-200.h5p

ENDANGERED ELEMENTS

'Indium is one of the most critical elements because of the way that we use it,' says Mike Pitts, from the UK's Chemistry Innovation Knowledge Transfer Network. For example, every liquid crystal display screen contains indium components. About 45 per cent of all indium extracted is used for the indium tin oxide that lines solar cells and flat panel displays. The Earth's crust contains roughly three times as much indium as silver, although silver can be mined far more efficiently. In 2007 the US Geological Survey estimated that we will run out of indium for extraction in less than two decades, although the indium industry tends to dispute such figures.

Chemistry World | January 2011 | 52

[Chemistry news, research and opinions | Chemistry World]

USES AND TOXICITY

A relatively scarce element in the Earth's crust, indium has a few possible uses in LCD screens and other devices. Indium tin oxide is often used as a coating for screens, and can be used to make transparent electrodes inside the glass layers of an LCD screen.

LCD manufacturing largely drives demand for indium, though it's also used in photovoltaic cells. The metal's compounds can be toxic, and people who have inhaled its indium tin oxide form in an occupational setting can contract a rare disease called indium lung.

[Four Materials Illustrate Hazards Of Electronics Manufacturing | WisContext]

LONG TERM SCARCITY

The demand for indium could intensify significantly if thin-film materials relying on this element—specifically, copper-indium-gallium-selenide (CIGS) and III-V thin-films—become preferred photovoltaic (PV) materials. Yet the indium supply is potentially fragile for several reasons:

• Markets for metallic forms of indium are small, (about 1000 tonnes per annum [tpa] of world production and use. Any new, widespread use could dramatically alter overall demand, which could grow faster than production capacity for up to about a decade, given the length of time needed to significantly increase production capacity. During this decade, indium prices could be high and volatile enough that thin-film manufacturers find it uncompetitive compared to competing PV materials.

• Indium is currently produced almost solely as a byproduct of zinc smelting and refining.1 As a byproduct, indium benefits from sharing some production costs with its associated main product. Thus, costs of producing indium as a byproduct are undoubtedly lower than if it were produced by itself. If future demand for indium exceeds the quantities available as a byproduct, more costly sources of indium will be necessary to satisfy demand from thin-film producers, raising the possibility that indium prices could be much higher than current and recent prices.

• Relevant for the long term, indium is one of the scarcer elements, at least in terms of average abundance in the Earth’s crust. Thus, even if indium were available in the short to medium term at prices making CIGS materials competitive with competing photovoltaic materials, such competitiveness could be short lived.

The Availability of Indium: The Present, Medium Term, and Long Term (nrel.gov)

RECYCLING

Besides is primary production, indium is also produced from secondary production. World secondary refined indium production resulted almost exclusively from the recycling of manufacturing waste rather than recovery from end-of-life (EOL). Only around 1 % of indium is recycled from these products because of indium is usual used only in minor concentrations. Overall, the secondary supply has been a significant contributor to the total supply.

Indium can be considered a critical material for display technology because there are few substitutes.

02/11/2020 https://www.esmfoundation.org/material-of-the-month-indium/

3.2 SHARING YOUR IDEAS

In this forum you should treat the following questions:

The uses of indium.

Indium lung disease.

Ist or ist not indium a renewable source? Why?

Percent of indium recycled nowadays

Consequences of a possible exhaustion of indium.

4. CRITICAL RAW MATERIALS

Critical raw materials - CRM

Raw materials are crucial to Europe's economy. They form a strong industrial base, producing a broad range of goods and applications used in everyday life and modern technologies. Reliable and unhindered access to certain raw materials is a growing concern within the EU and across the globe. To address this challenge, the European Commission has created a list of critical raw materials (CRMs) for the EU, which is subject to a regular review and update. CRMs combine raw materials of high importance to the EU economy and of high risk associated with their supply.

- **First list of CRMs - in 2011, a list of 14 CRMs was published in the communication on raw materials.**
- **Second list of CRMs – in 2014, a first revised list of 20 CRMs was published in the communication on the list of critical raw materials 2014.**
- **Third list of CRMs – in 2017, a third list of 27 CRMs was published in the communication on the list of critical raw materials 2017**
- **Fourth list of CRMs - in 2020, a fourth list of 30 CRMs was published in the communication on critical raw mate**

https://ec.europa.eu/growth/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en

Raw materials	Main global producers (2010/14)	Main importers to EU (2010/14)	Sources of EU suply (2010/14)	Import reliance rate*	Substitution indexes EI/SR**	End-of-life recycling input rate***
Cobalt	D.R. of Congo (64%)	Russia (91%)	Finland (66%)	32%	1.0 / 1.0	0%
	China (5%)	Democratic Republic of Congo (7%)	Russia (31%)			
	Canada (5%)					
Gallium 15	China (85%)	China (53%)	China (36%)	34%	0/95 / 0.96	0%
	Germany (7%)	United States (11%)	Germany (27%)			
	Kazakhstan (5%)	Ukraine (9%)	United States (8%)			
		South Korea (8%)	Ukraine (6%)			
			South Korea (5%)			
			Hungary (5%)			
Indium	China (57%)	China (41%)	China (28%)	0%	0.94 / 0.97	0%
	South Korea (15%)	Kazakhstan (19%)	Belgium (19%)			
	Japan (10%)	South Korea (11%)	Kazakhstan (13%)			
		Hong Kong (8%)	France (11%)			
			South Korea (8%)			
			Hong Kong (6%)			
Magnesium	China (87%)	China (94%)	China (94%)	100%	0/91 / 0.91	9%
	United States (5%)					
Phosphorus	China (58%)	Kazakhstan (77%)	Kazakhstan (77%)	100%	0.91 / 0.91	0%
	Vietnam (19%)	China (14%)	China (14%)			
	Kazakhstan (13%)	Vietnam (8%)	Vietnam (8%)			
	United States (11%)					
Silicon metal	China (61%)	Norway (35%)	Norway (23%)	64%	0.99 / 0.99	0%
	Brazil (9%)	Brazil (18%)	France (19%)			
	Norway (7%)	China (18%)	Brazil (12%)			
	United States (6%)		China (12%)			
	France (5%)		Spain (9%)			
			Germany (5%)			
Tantalum 16	Rwanda (31%)	Nigeria (81%)	Nigeria (81%)	100%	0.94 / 0.95	1%
	D.R. of Congo (19%)	Rwanda (14%)	Rwanda (14%)			
	Brazil (14%)	China (5%)	China (5%)			
Tungsten 17	China (84%)	Russia (84%)	Russia (50%)	44%	0.94 / 0.97	42%
	Russia (4%)	Bolivia (5%)	Portugal (17%)			
		Vietnam (5%)	Spain (15%)			
			Austria (8%)			
Heavy Rare Earth Elements	China (95%)	China (40%)	China (40%)	100%	0.96 / 0.89	8%
		USA (34%)	USA (34%)			
		Russia (25%)	Russia (25%)			
Light Rare Earth Elements	China (95%)	China (40%)	China (40%)	100%	0.90 / 0.93	3%
		USA (34%)	USA (34%)			
		Russia (25%)	Russia (25%)			

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52017DC0490

Question to ponder:

Regardeless of the fact that Europe is a large consumer, and we are dealing with high risk of exhaustion materials, what do you think about the recycled % of tantalum and indium, for instance?
Scaring, istn't it?
Well, keep looking at the following video and articles, and you will be even more surprised.

> **Tantalum source: Coltan**
> Boston University
> https://www.youtube.com/watch?v=F5VZtJDYWNM

4.1 SCARCITY AND CONFLICT

These articles aim to awaken young readers to our individual responsibility as final consumers of products based on scarce raw materials and, worse still, in armed conflicts. The question is: Is the war in the Democratic Republic of Congo created by internal conflicts, or are the internal conflicts created by the excessive consumption of developed countries? Here I post some articles, yours are the conclusions.

Interactive activity, file: scarcity-and-conflict-204.h5p

5. GROUP A: DRAWN YOUR FINAL CONCLUSIONS AND THINKINGS

Submit the answers to these few questions:

What is Coltan?

Which chemical elements can we get from Coltan?

Which are the main uses of Tantalum?

Who are the final consumers of this raw material?

Why is Coltan named “Blood mineral”?

Now you are going to deep into matter, reading the pages 15 to 20 of the work:

DEMOCRATIC REPUBLIC OF CONGO: A REVIEW OF 20 YEARS OF WAR

And drawing your conclusions in the next final activity.

6. GROUP B: DEMOCRATIC REPUBLIC OF CONGO - DRC

From a fragment of the text, DEMOCRATIC REPUBLIC OF CONGO: A REVIEW OF 20 YEARS OF WAR:

“In any case, it can lead to the conclusion that while some countries have considered inappropriate to sell weapons to the DRC, considering that the country was in conflict, under sanctions and embargo, under the risk of not preserving the region’s peace or of that defense material being transferred to the places and actors of the conflict, others have not done so and can be claimed responsible, with full knowledge of the facts, of feeding the conflict in the DRC with weaponry or any other type of defense material.”

Has your country sold weapons to DRC? (Check p.15 to 18)

Which have been the highest Europeans exporters of weapons to DRC?

Why are there countries selling weapons to the DRC despite promoting war in that country?

Do you think that when Tantalum scarcity arrives at the end, DRC’s war will end?