



United Nations
Scientific and
Educational Organization



International Year
of the Periodic Table
of Chemical Elements

The periodic table of elements and IYPT2019



University
of
St Andrews

Passion for Science



Suzanne Issa
David Cole-Hamilton

EuChemS Task Group

Saskia van der Vies, Christof Coperet, **Nicola Armaroli**, Jelena Lazic, Alex Schiphors, David Cole-Hamilton (Chair), assisted by Elena Lenci, Katarzyna Josefowska, Robert Parker



EuChemS Projects



Women in their element. The Historic Role of Female Scientists in the (Pre)History of the Periodic Table edited by Annette Lykknes and Brigitte van Tiggelen.



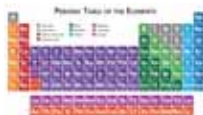
Setting their Table: Women and the Periodic Table of Elements. Murcia, Spain, 11-12th Feb.



EYCN Video Competition (Yacintha Vermeer) **>250 entries**



Video Game



Periodic Table for Schools

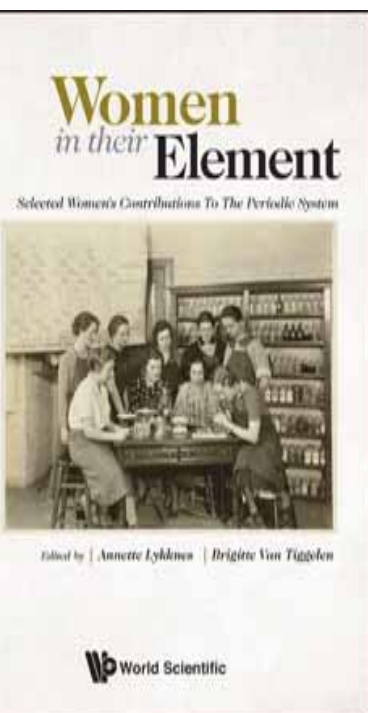


The Wilkinson
Charitable Foundation

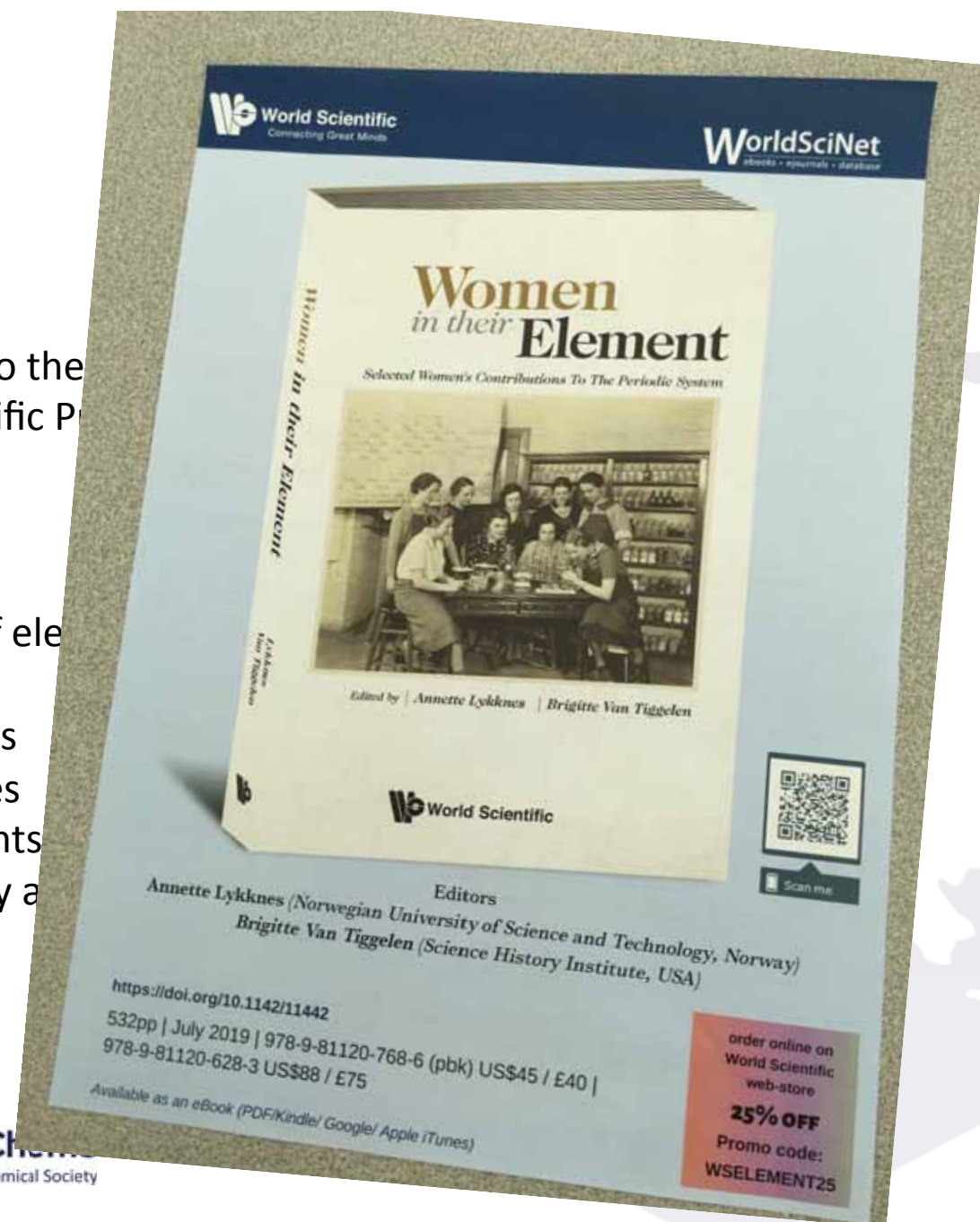
<https://wilkinsonfoundation.org>

Women in their Element

Women in Their Element Selected Women's Contributions to the
by: Annette Lykknes and Brigitte Van Tiggelen, World Scientific P
56 pages, <https://doi.org/10.1142/11442>.



- The 38 chapters include
- understanding the concept of elements
 - identifying properties
 - developing analytical methods
 - mapping the radioactive series
 - finding applications of elements
 - drawing attention to+ toxicity and



On a table ASC Fall meeting, San Diego

Setting their Table: Women and the Periodic Table of Elements International Symposium, Murcia February 11-12, 2019

- Global Women's Breakfast organized by IUPAC

Unveiling of 10 laureates of the IUPAC Periodic Table of Younger Chemists.



Working Party on the History of Chemistry

The leaky pipeline Chemistry UK



Paola Agostiano
President SCI



Elisa Cifarelli
President SIF



Francesca Orlandi
President FNCF



Donna Strickland
Nobel Prize 2018

Physics

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80

60

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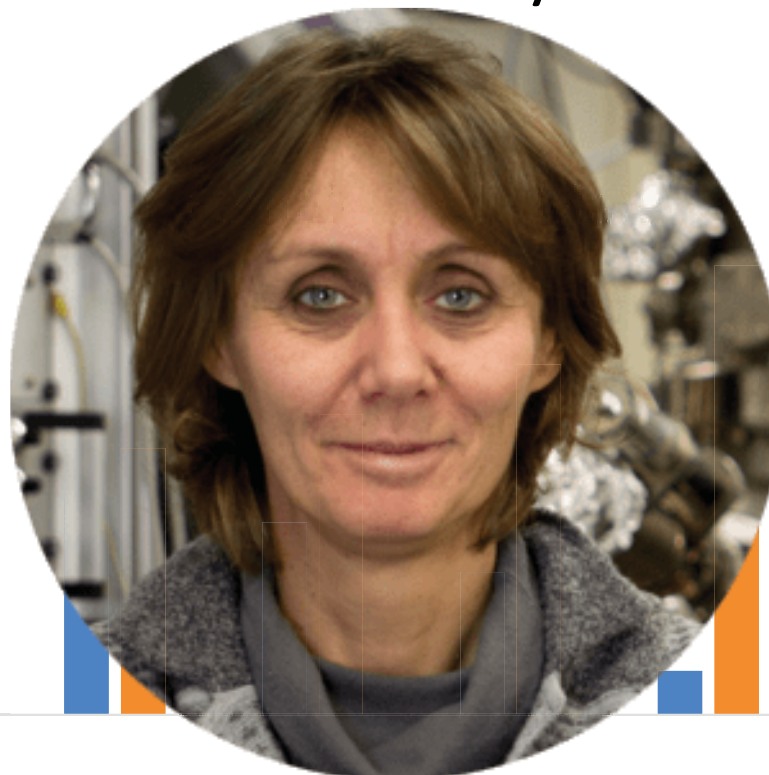
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School leavers

First round

Staff



Roberta Sessoli
Discovered first molecular magnetic
RSC Centenary Award, 2019



Frances Arnold
Nobel Prize 2018
Chemistry



Pilar Goya
President EuChemS



Nineta Hrastelj
General Secretary
EuChemS



Alice Soldà
Past Chair EYOC



Video Game

Elemental Escapades – A Periodic Table Adventure

Launched European Parliament 22nd January 2019

Available at IYPT launch, Paris 29th January 2019

Updated April 2019

- 2489 downloads

International edition 30th September 2019

- French, German, Spanish, Italian, Croatian,
- Serbian, Dutch, Polish, Romanian, Greek and English

EYCN arranged the translations.

<http://bit.ly/euchems-pt>



EuChemS General Assembly, Bucharest 3rd October, 2019



The Wilkinson
Charitable Foundation



Nick Cole-Hamilton
Sandy Russell
Scott Darcy

Elemental Escapades. A Periodic Table Adventure



<http://bit.ly/euchems-pt>

<https://wilkinsonfoundation.>

Mendeleev Society Meeting

Celebrating D.I. Mendeleev's Periodic System. A Historical Perspective
September 10-13, 2019, St Petersburg,



Mendeleev's teaching wall chart, 1876

ПЕРИОДИЧЕСКАЯ СИСТЕМА ЭЛЕМЕНТОВ											
Д. И. МЕНДЕЛЕЕВА											
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2	He	Li	Be	B	C	N	O	F			
3	Ne	Na	Mg	Al	Si	P	S	Cl			
4	Ar	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni
5		Cu	Zn	Ga	Ge	As	Se	Br			
6	Kr	Rb	Sr	Y	Zr	Nb	Mo		Ru	Rh	Pd
7		Ag	Cd	In	Sn	Sb	Te	I			
8	Xe	Cs	Ba	La	Ce	Pr	Nd	Pl			
9		Sm	Eu	Gd	Tb	Dy	Ho	Er			
10		Tu	Yb	Lu	Hf	Ta	W	Re	Os	Jr	Pt
11		Au	Hg	Tl	Pb	Bi	Po	-			
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EICC-5

5th EUCHEMS
INORGANIC
CHEMISTRY
CONFERENCE

Moscow,
24-28 June
2019

eicc5.ru

ORGANIZERS



EuChemS
European Chemical Society



Russian Academy of Sciences



МИНИСТЕРСТВО НАУКИ
И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ

ИОНХ РАН



Mendeleev's first Periodic Table

Handwritten notes and calculations:

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17,5
30

2-3,5
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1209-12040
121

oldest known printed wallchart

Periodische Gesetzmässigkeit der Elemente nach Mendelejeff.

Reihen	Gruppe I $R^2 O$	Gruppe II RO	Gruppe III $R^2 O^3$	Gruppe IV RH^4 RO^2	Gruppe V RH^3 $R^2 O^5$	Gruppe VI RH^2 RO^3	Gruppe VII RH $R^2 O^7$	Gruppe VIII RO^4
1	H=1							
2	Li=7	Be=9,4	B=11	C=12	N=14	O=16	F=19	
3	Na=23	Mg=24	Al=27,3	Si=28	P=31	S=32	Cl=35,5	
4	K=39	Ca=40	Sc=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59 Ni=59, Cu=63
5	(Cu=63)	Zn=65	Ga=68	--=72	As=75	Se=79	Br=80	
6	Rb=85	Sr=87	Yt=88	Zr=90	Nb=94	Mo=96	--=100	Ru=104, Rh=104 Pd=106, Ag=108
7	(Ag=108)	Cd=112	In=113	Sn=118	Sb=122	Te=125	J=127	
8	Cs=133	Ba=137	Ce=137	La=139	--	Di=145?	--	-- -- -- --
9	(--)	--	--	--	--	--	--	
10	-- 165	-- 169	Er=170	-- 173	Ta=182	W=184	--	Pt=194, Os=195(?) Ir=193, Au=196
11	(Au=196)	Hg=200	Tl=204	Pb=206	Bi=210	--	--	
12	--	--	--	Th=231	--	U=240	--	-- -- -- --

Verlag v. Lesner & Fendler, Wien. Lith v. Auf. Kartegger & Zehn, Wien.

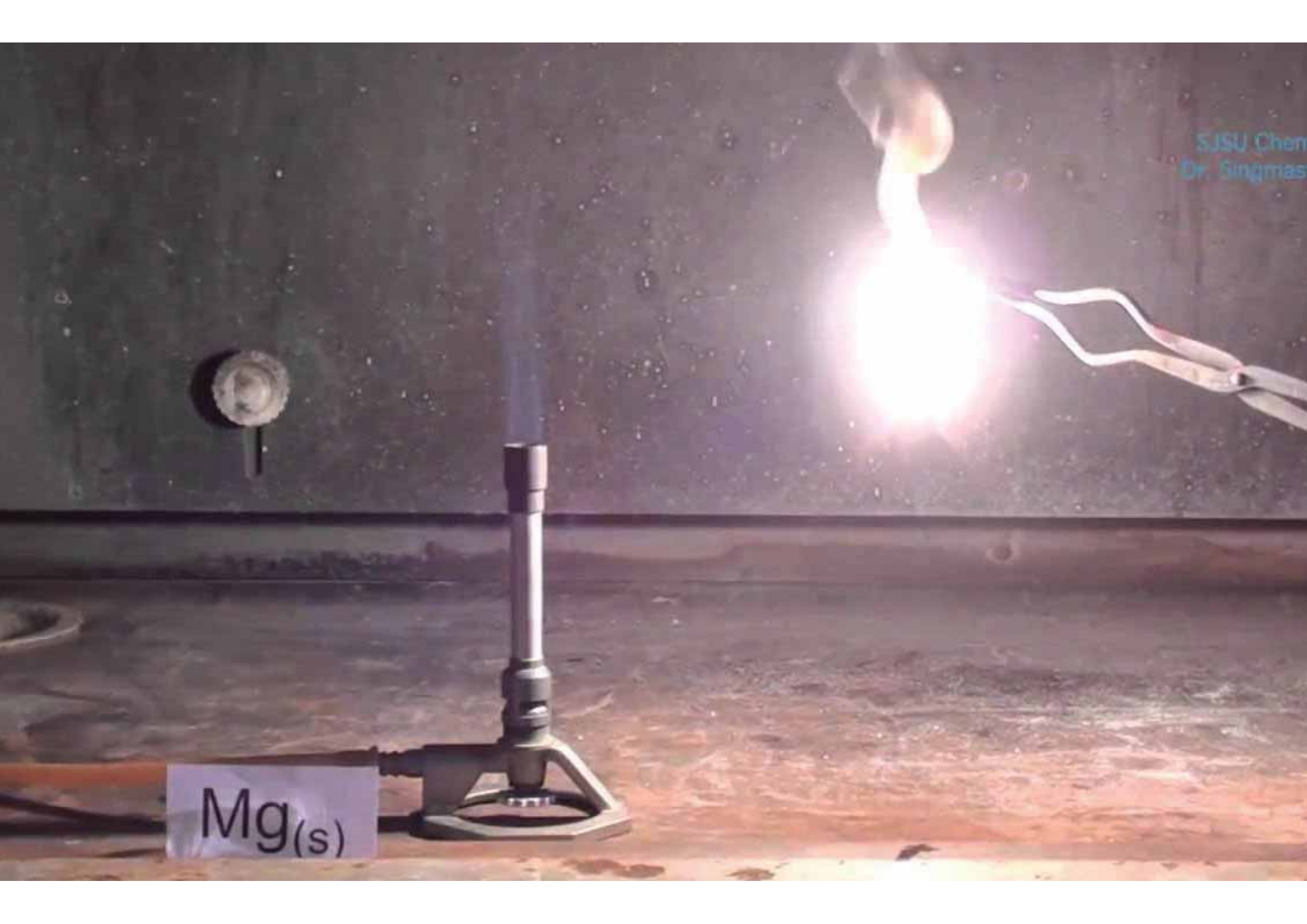
2014 Found rolled up
under a lecture Theatre
(Dr Alan Aitken)
2018 Conserved
2108-9 Researched by
Pilar Gil, University of
Andrews Special
Collections



1885 Printed in Vienna
1888 Purchased by
Professor Purdie from
German supplier

Ga and Sc added some
other changes
65 elements

$\text{Mg}_{(s)}$





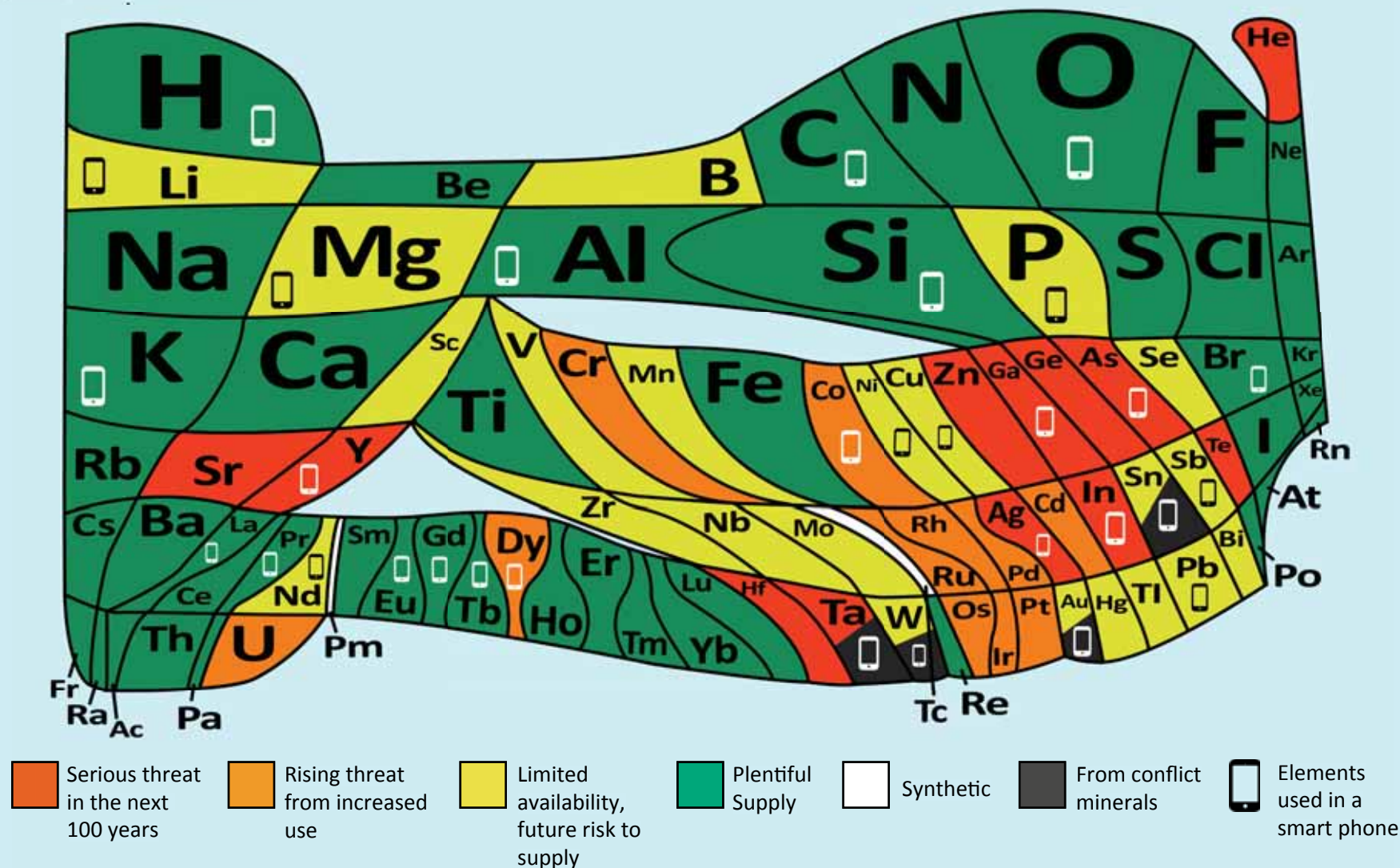
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Educational, Scientific and
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International Year
of the Periodic Table
of Chemical Elements

The 90 natural elements that make up everything

How much is there? Is that enough?



Read more and play the video game <http://bit.ly/euchems-pt>



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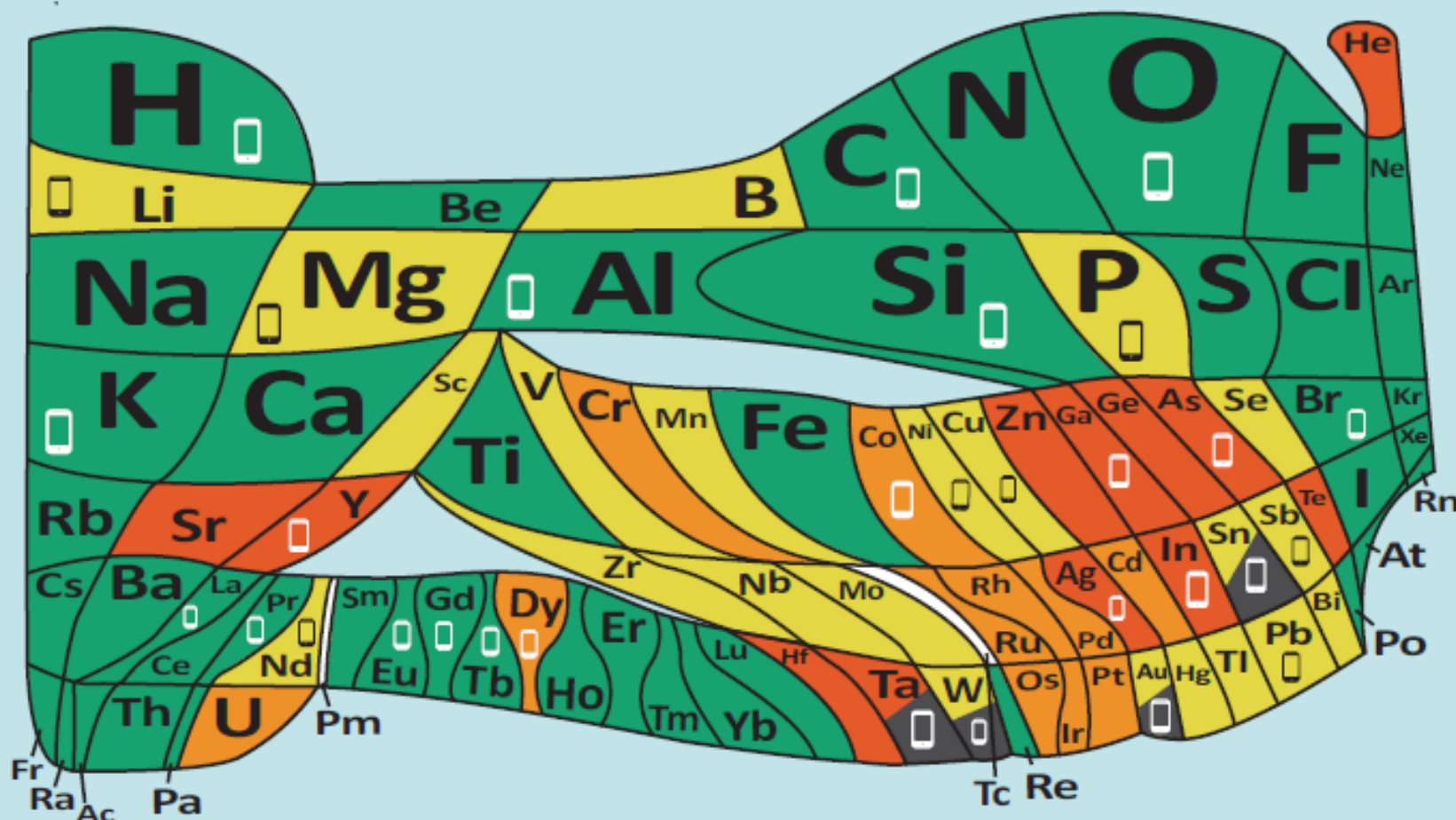


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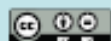
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90 elementi chimici e la loro disponibilità relativa sulla Terra *Ci basteranno?*



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 ■ Sempre più a rischio per il crescente utilizzo
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 Di sintesi
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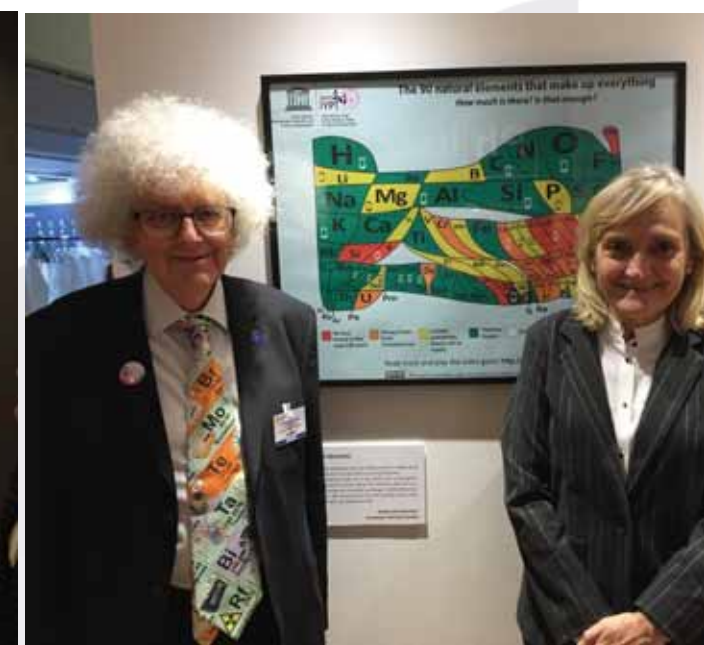


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EuChemS
European Chemical Society



Launch European Parliament 22nd January 2019,
 Gerine Stihler and Clare Moody MEPs Publicity in 6 continents



IYPT Launch, Paris, 29th Jan



Historical landmark
 EA Crete



Travelling Exhibition
 Japan

Nicola Armaroli

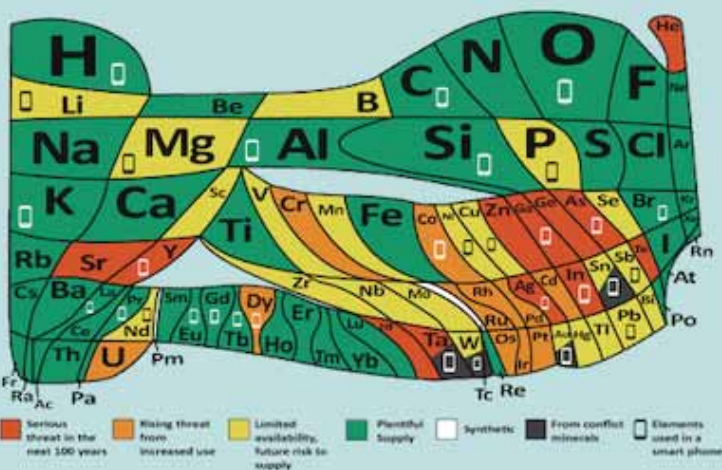
Italian Roadshow >3000 teachers and students



Dutch teachers' event

Israeli teachers' event





Swiss Platform to celebrate the 2019 International Year of the Periodic Table of Chemical Elements



SCS
Swiss Chemical Society

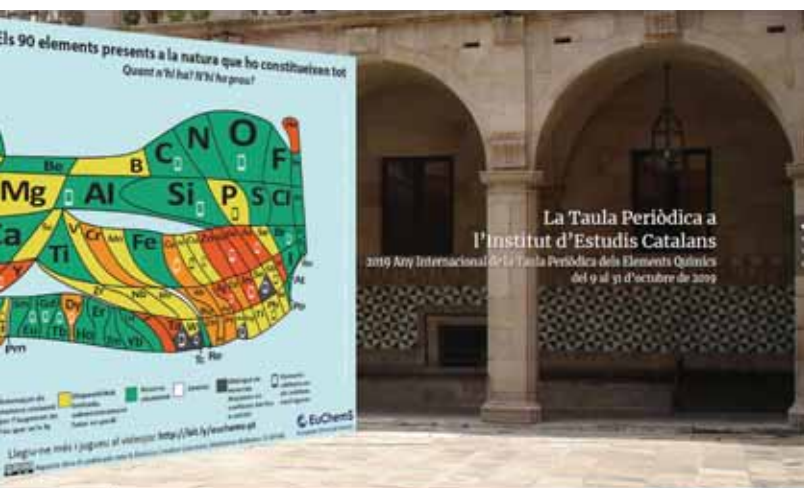
VSN
SSPSN
ASISN

ChemistryViews

EuChemS
European Chemical Society



IYPT 2019 Initiatives in Switzerland ▾ Initiatives Worldwide Submit Initiative



Catalan Conference on the Periodic Table



Sent to 50.000
RSC members



RSC Summer Party and Exhibition

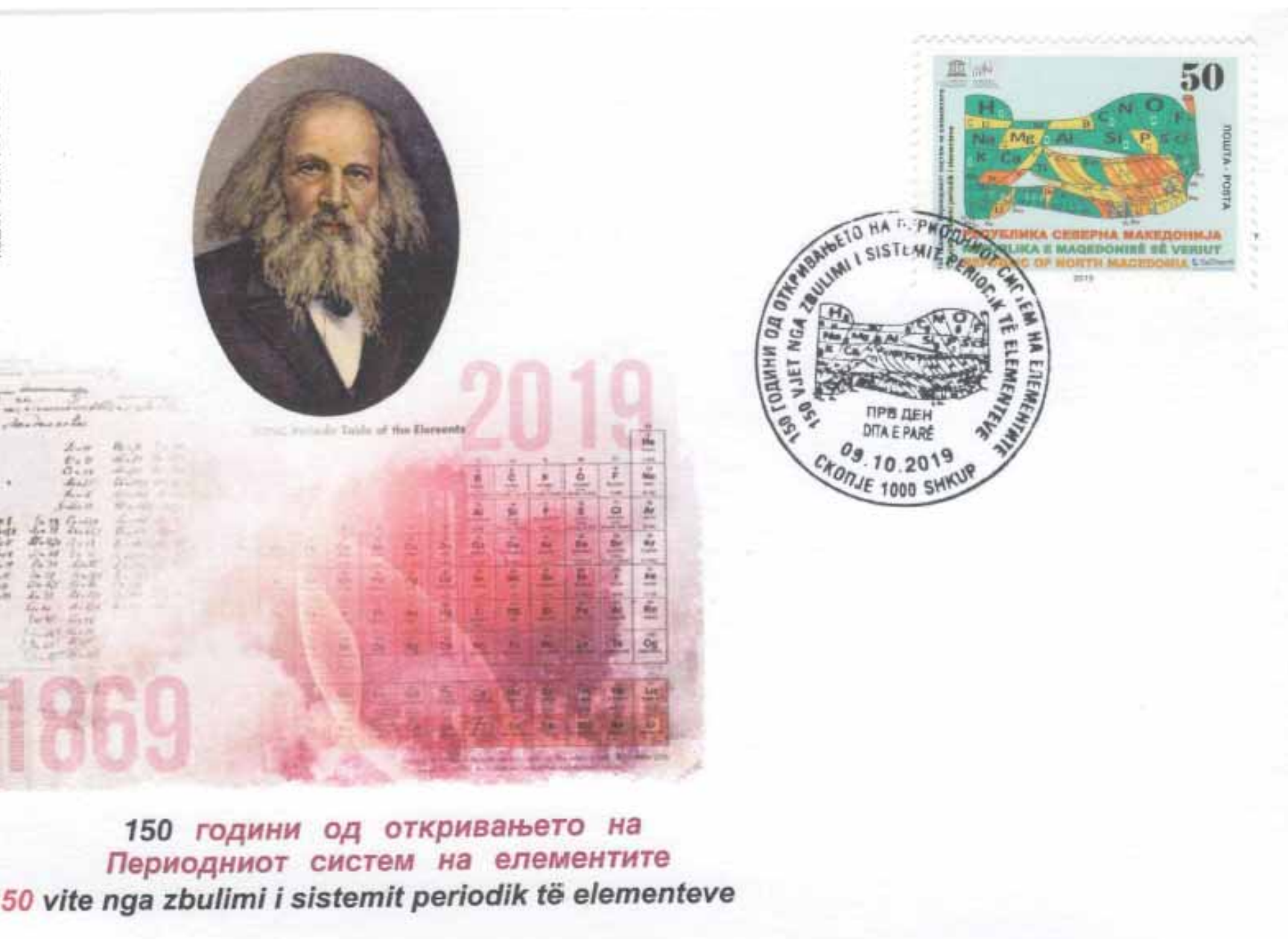
0 lectures EuChemS Professional Networks: Education, Green and Sustainable Chemistry, EYCN (EYCM); ACS Exhibitions IYPT opening ceremony, RSC, Edinburgh Festival, Royal Society of Edinburgh, Scottish Parliament

RSC IYPT Exhibition



The Scores
St Andrews
3rd – 27th October
2019

Macedonian stamp



First day cover

9th October, 2019



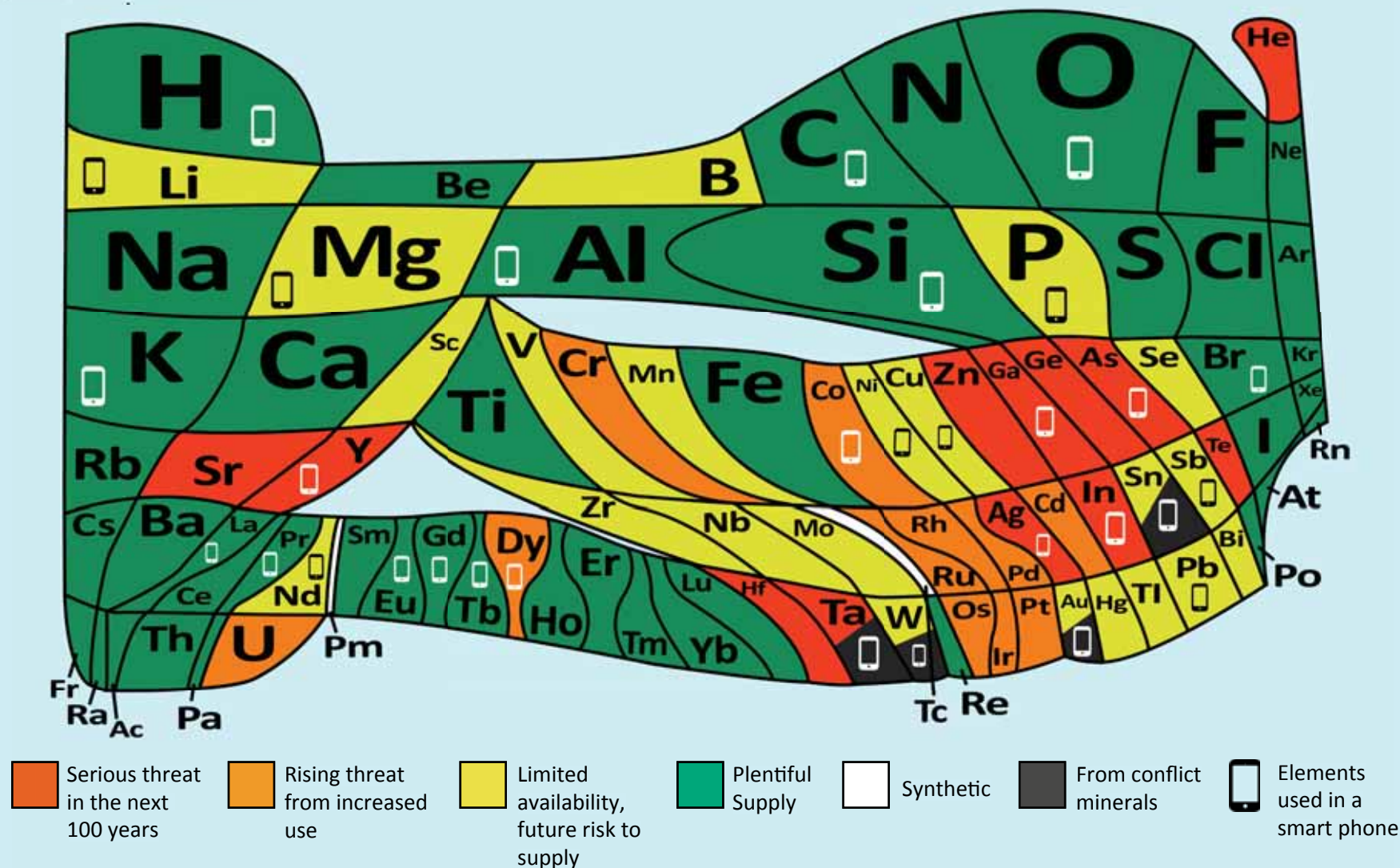
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Avoid conflict minerals

Traceability

Smart phone companies trace source of metals from mining to phone

Tantalum

Used in microcapacitors

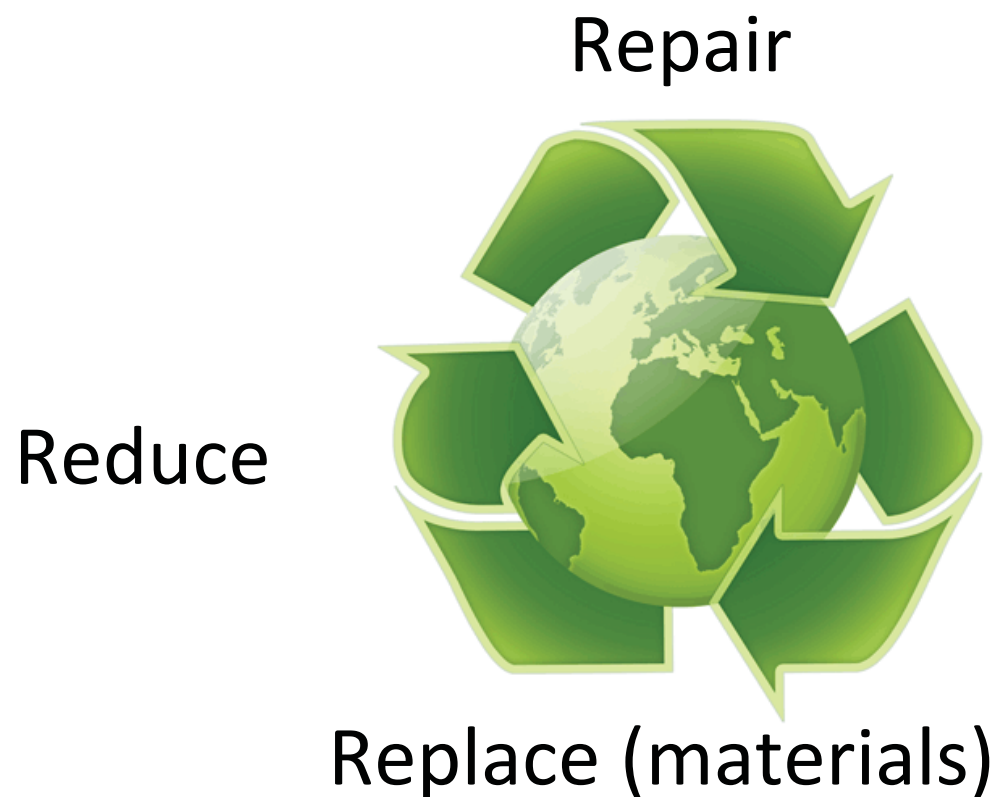
< 50 years left

2002-6 only 1 % from conflict zones

As it gets scarcer, temptation increases



The Circular Economy



Reuse/recycle

Smart phones use and discard



EU 10 M phone upgrades / month

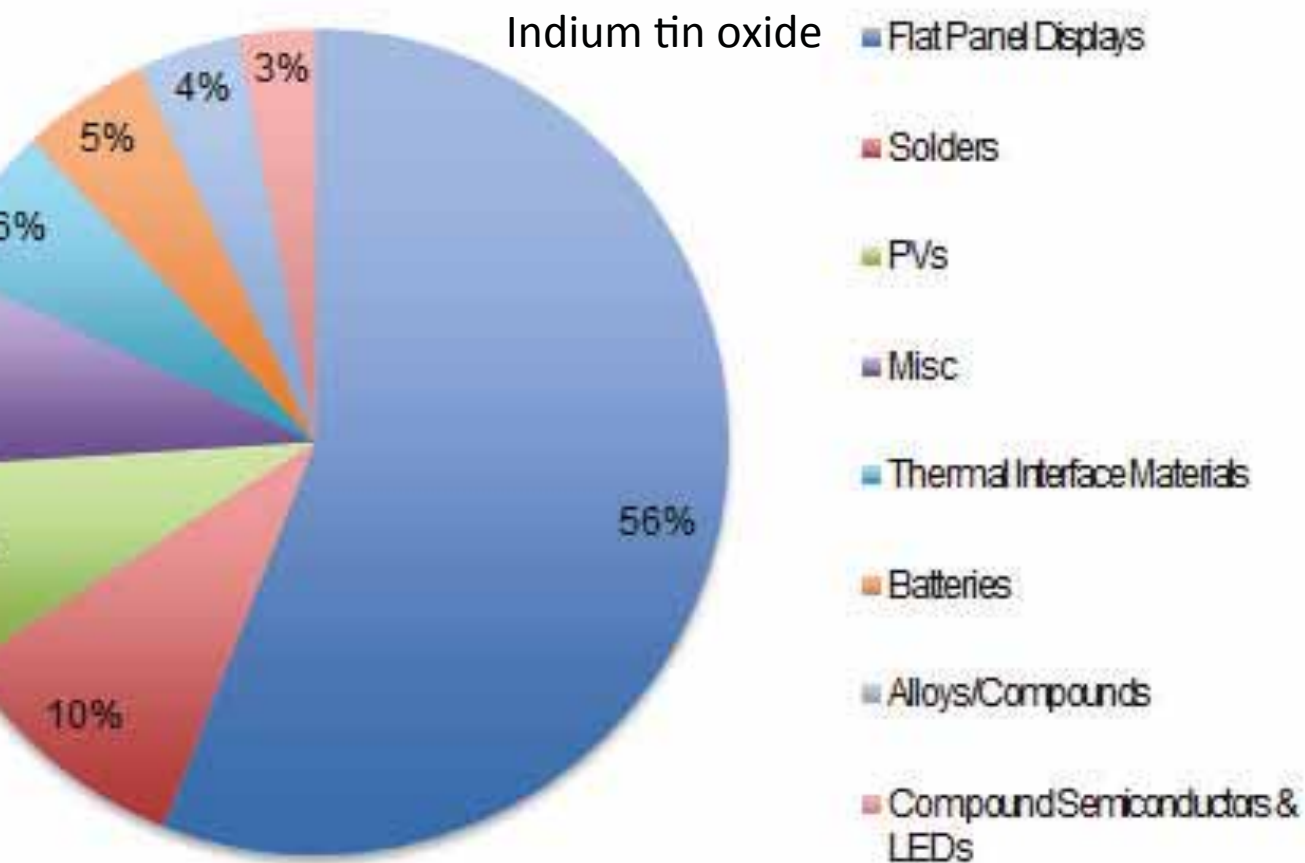
Many lie around at home (40 % from survey) wasting valuable resources

Most reused in developing countries (Reuse) and then trashed or mined for some metals under appalling conditions often by children

Modular phones where parts can be replaced are available (Repair)

Can ***YOU*** justify changing your phone every 2-3 years (Reduce)

Indium



GaAsInP/InP
Fibre optic telecommunications

Indium Corporation

Indium is already very widely dispersed (by-product of zinc mining)

Annual demand

- 770 tonnes

World reserves (easily mined)

- 15,000 tonnes

Lifetime (current usage)

- **20 years**
- Much more difficult to extract; price rises

Recycle, Replace, Reduce

Recycle

- Small amounts of ITO on every computer / phone screen
- We need companies that will do ethical recycling of elements in electrical goods (**opportunity**)
- We need incentives to hand in our electronic devices

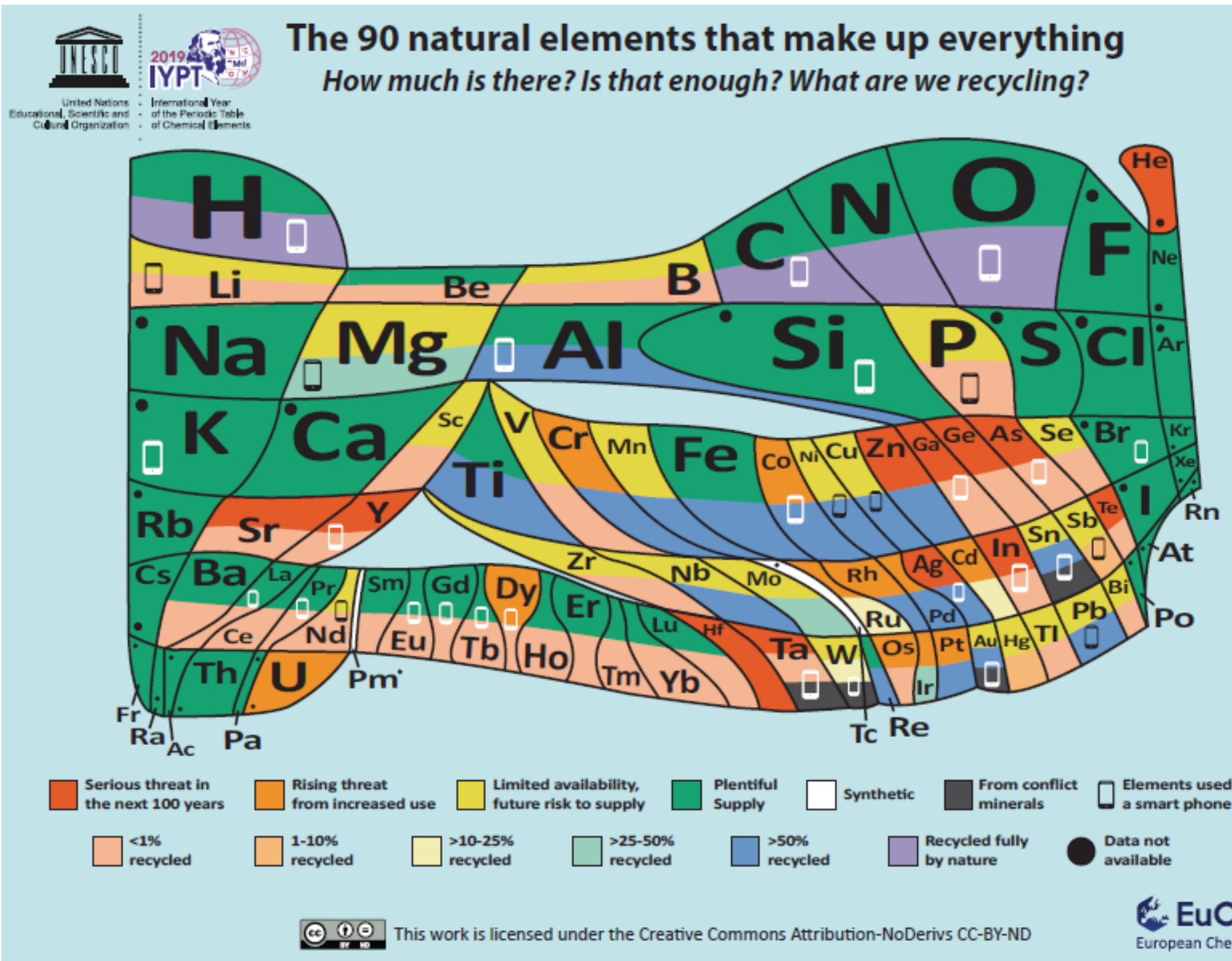
Replace

- Must find equivalent materials using earth abundant metals (graphene, SbSnO_x , CaMoO_3)
- Requires huge research effort

Reduce

- Change your phone and computer less often

recycling?



Helium

MRI Imaging



Liquid helium cooled

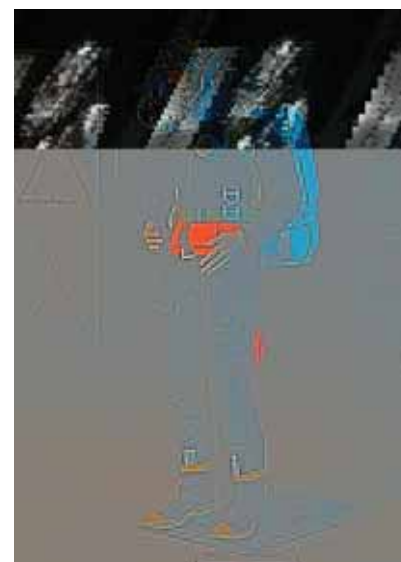
Once released into the atmosphere
it will be lost into outer space forever

Deep sea diving

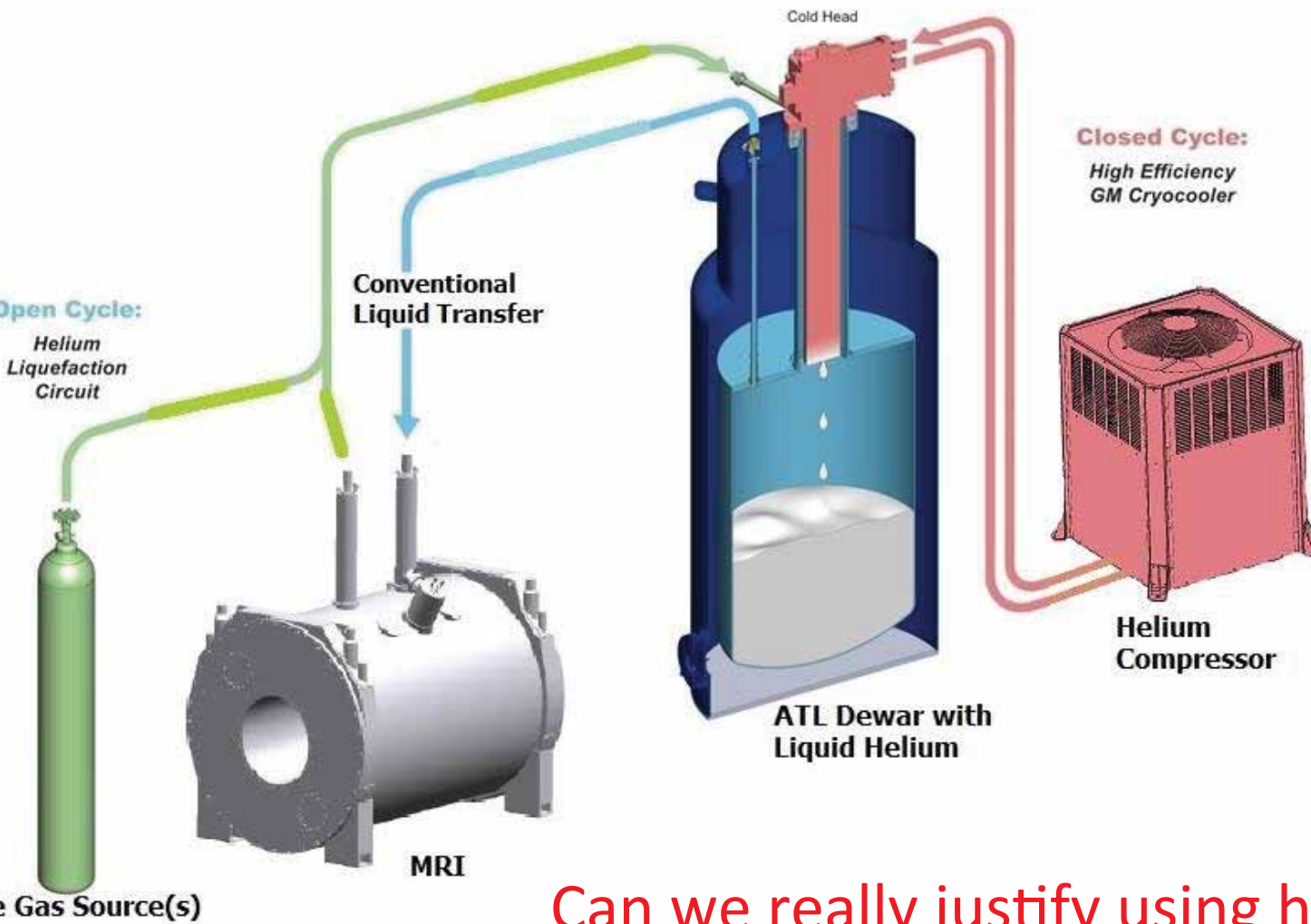


Helium/oxygen reduces "the Bends"

Helium recycling



Helium



Main suppliers

Qatar – Closed


USA – Closing 2021

Tanzania – Opening 2020

Enough for 8-12 years



Can we really justify using helium celebration balloons
when this precious resource will be lost forever?

- 
- 10 % of helium is used in party balloons (47 % in Russia)
 - “Dirty” helium recycled from MRI scanners, “cannot be used in science and academic applications”
 - “Re-liquefying is currently considered uneconomical from the locations of where the filling application take place”
 - Helium concentration is ~95 %; Tanzanian field <10 %)
 - In < 100 years **ALL** the Tanzanian helium will be lost

Can we really justify using helium celebration balloons when this precious resource will be lost forever?

Trains delayed by balloons



Network Rail: 619 balloon related incidents in last year - many dangerous.

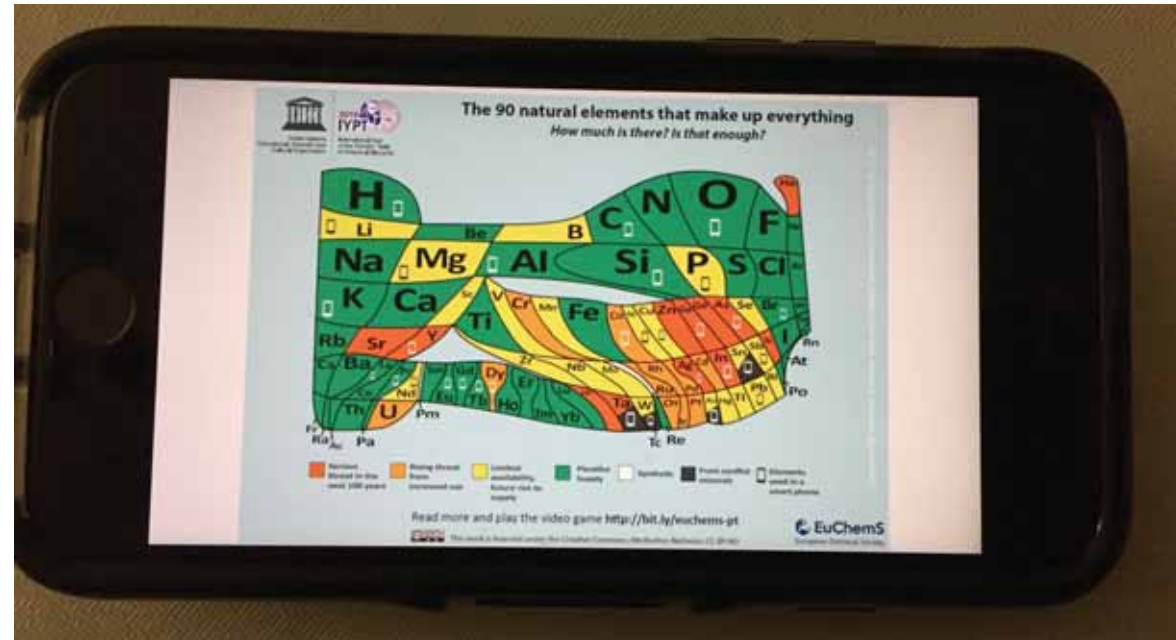
und on a
ach in
Andrews



ibraltar National Day



Rare Earth Elements



ed the make colour for your smart phone screen

prosium (Dy) used in magnets for windmills
potential problem in the longer term

Fears about long term supply

Large find in sea off Japan in 2011
Off the danger list



To keep your phone
for longer

To hand in your
phone at the end of
its life

Never to use
helium balloons

Why can you never trust elements?

Because they make up absolutely everything!

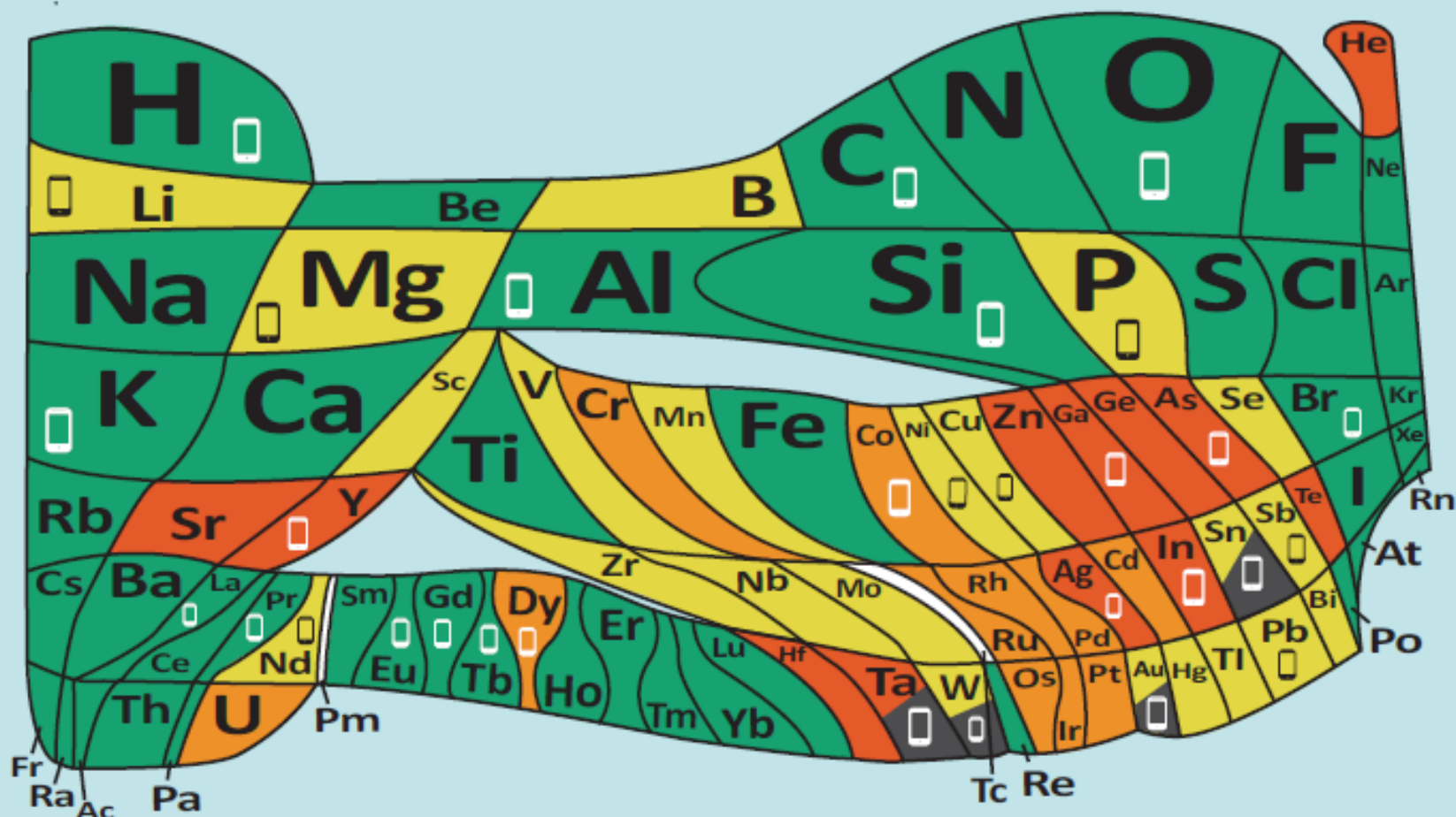


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Comparison of subjects - Leaky Pipeline

