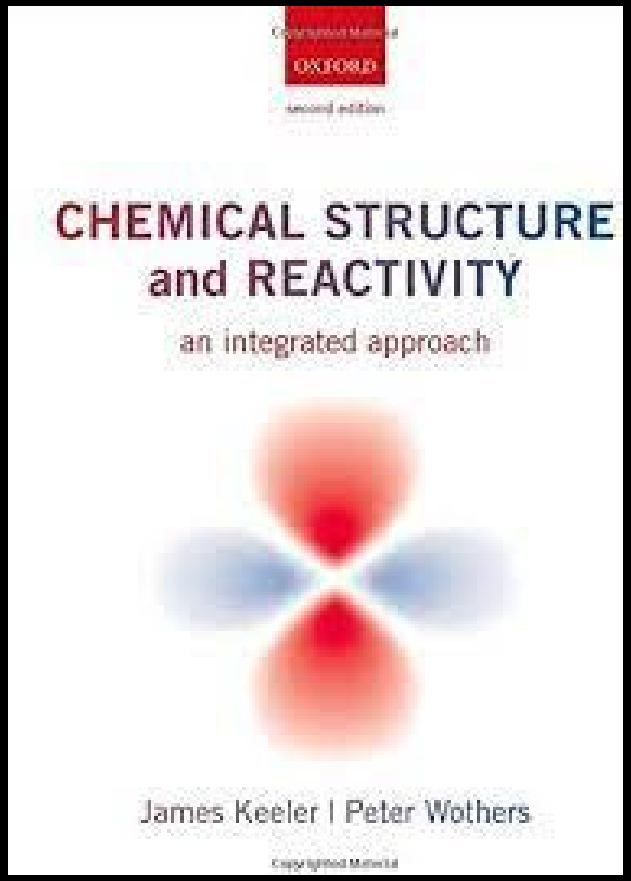
CH1101: Elements of Chemistry



Instructors: Soumyajit Roy & Supratim Banerjee

Teaching Assistants (Tas):
Group 1 (Roll No. 1-49): Nidhi and Khokan
Group 2 (Roll No. 50-94): Rounak and Pavithra
Group 3 (Roll No. 95-145): Vidhul and Suryagayathri
Group 4 (Roll No. 146-196): Isha and Tousif
Group 5 (Roll No. 197-247): Aritra and Debjyoti
Overall Class, Attendance, Office hours Arrangement: Nidhi, Khokan, Tousif and Isha.

Soumyajit Roy, Material Science Center.
Supratim Banerjee, W328, Third Floor TRC, X13121
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Office Hour: S.Roy on Tuessday 14:00-15:00 (By Appointment Please)

CH 1101: Elements of Chemistry: Class Schedule

Class			
Mon (2-3 PM)	Wed (9-10 AM)	Thu (4-5 PM)	Red denotes Holidays
August			Black: Classes by Soumyajit Roy
21	23	24	Blue: Classes by Supratim Banerjee
28	30	31 (T&Q)	T&Q: Tutorial and Quiz
September			
4	6	7	
11	13	14 (T&Q)	
18	20	21	
25	27	28	
October			
Mid-Term Examination (3-7 October)			
9	11	12 (T&Q)	
16	18	19	
Autumn Break (21-29 October)			
30			
November			
	1	2	
6 (T&Q)	8	9	
13	15	16	
20 (T&Q)			

Red denotes Holidays

Black: Classes by Soumyajit Roy

Blue: Classes by Supratim Banerjee

Q represents Quiz

SR 18 Classes

SB 9 Classes

Why Chemistry?

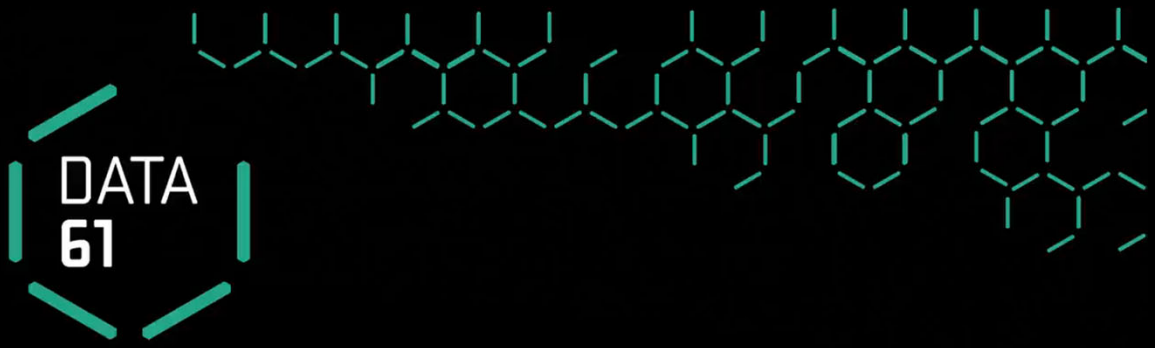
How Chemistry touches you?

How do you perceive Chemistry?

When did you touch Chemistry?

Chemistry touches you?

Chemistry relates to matter



Simulation of water turning to ice

Molecular and Materials Modelling Group

CSIRO

Matter matters! Chemistry matters!

Why Chemistry?

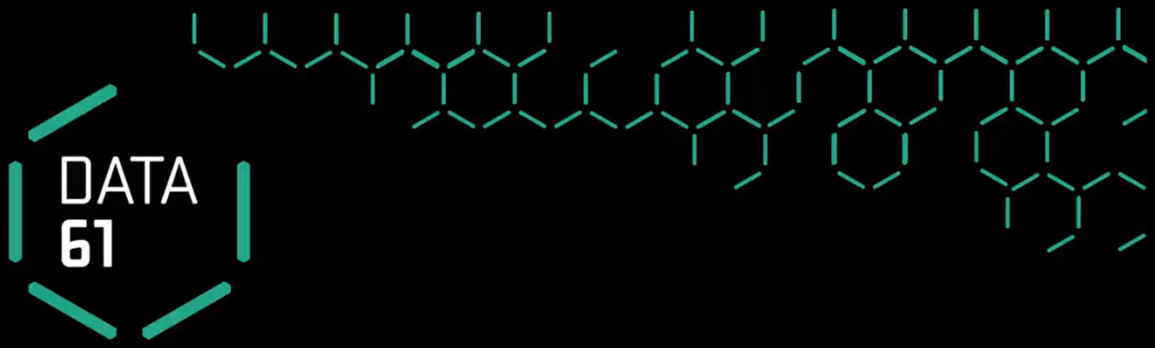
How Chemistry touches you?

How do you perceive Chemistry?

When did you touch Chemistry?

Chemistry touches you?

Chemistry relates to matter



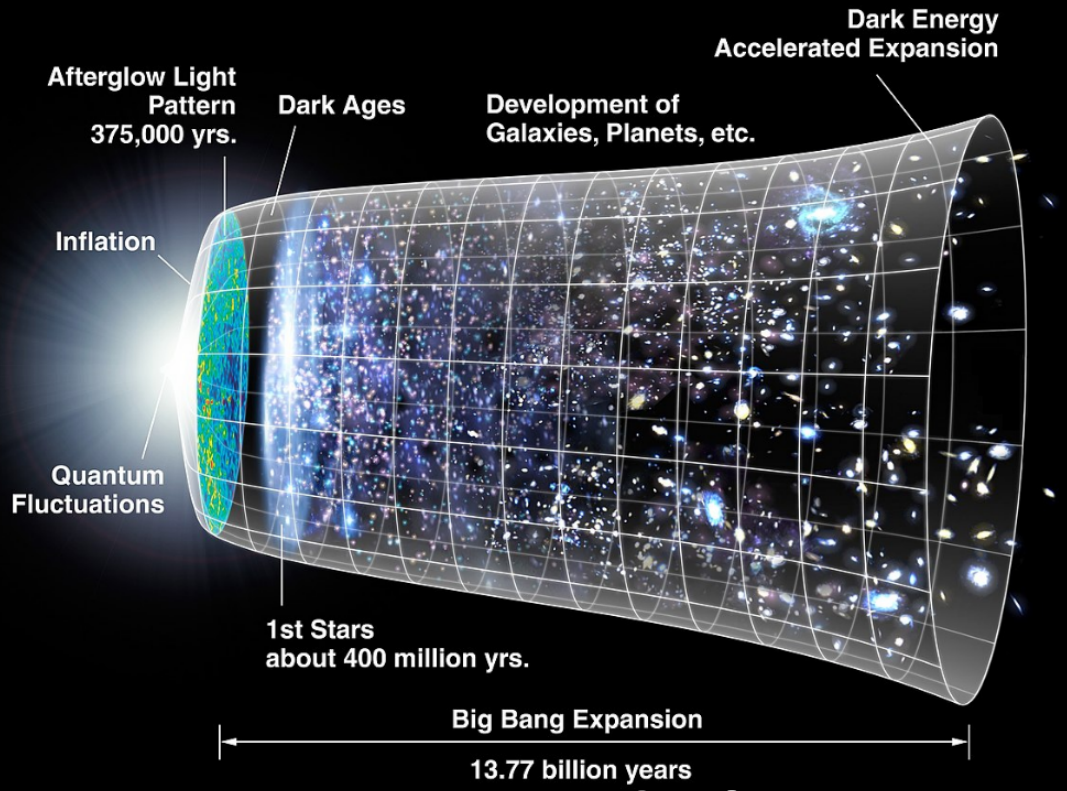
Simulation of water turning to ice

Molecular and Materials Modelling Group

CSIRO

Matter matters! Chemistry matters!

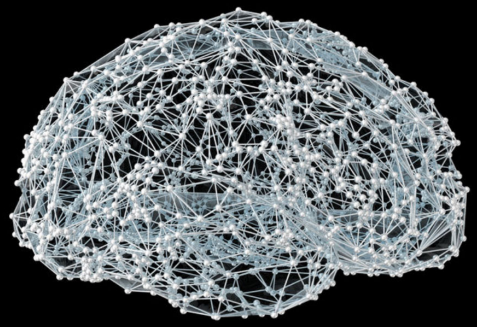
What is Matter? How it came to being?



Cosmic Cooking

Parsimony

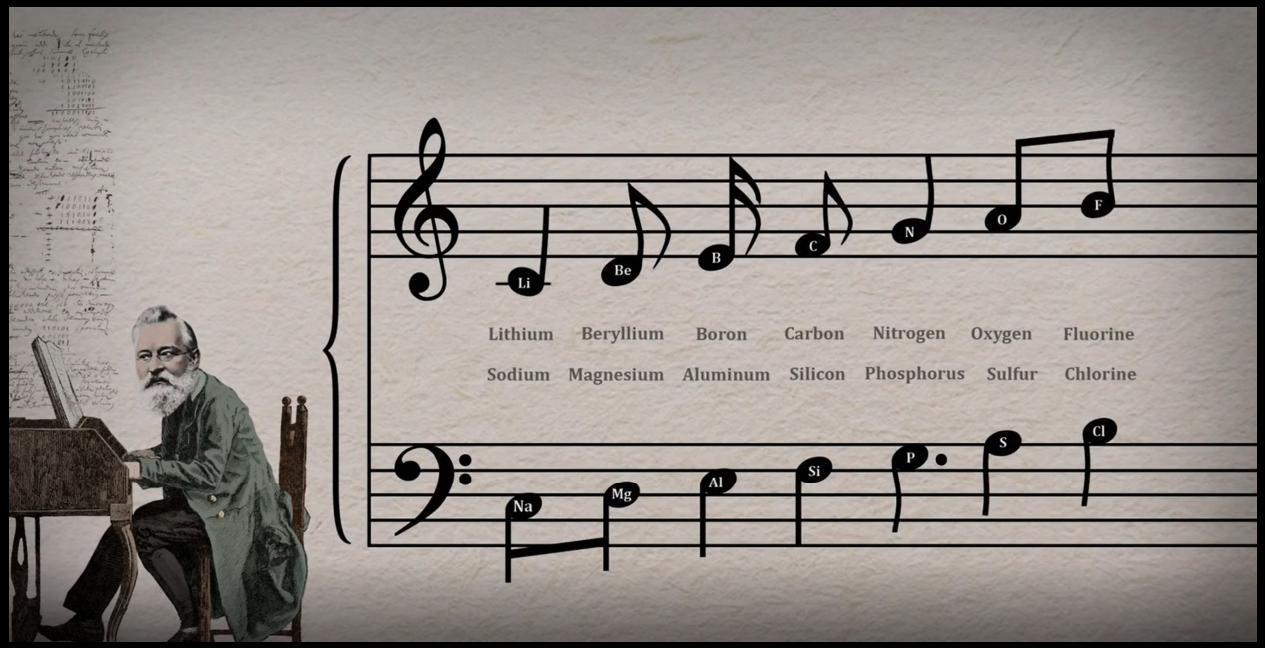
Music of Chemistry: Periodicity



Thinking Matter!

Matter matters! Chemistry matters!

What is Matter? How it came to being?



Cosmic Cooking

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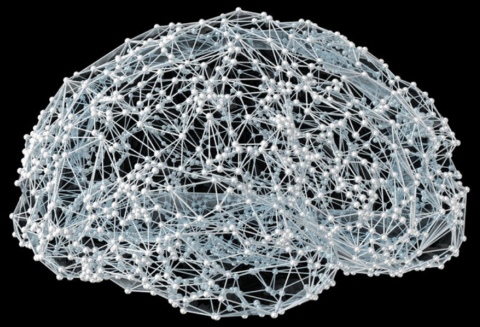

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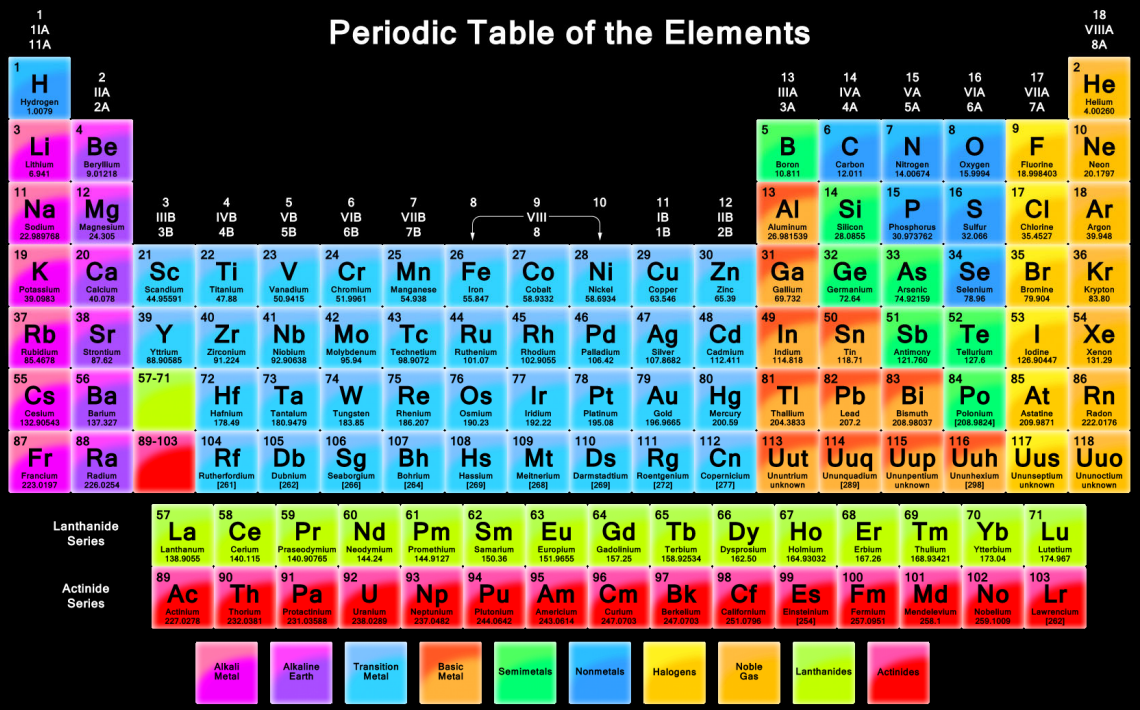
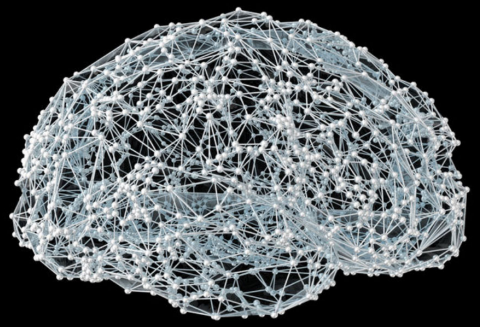


Cosmic Cooking

Parsimony

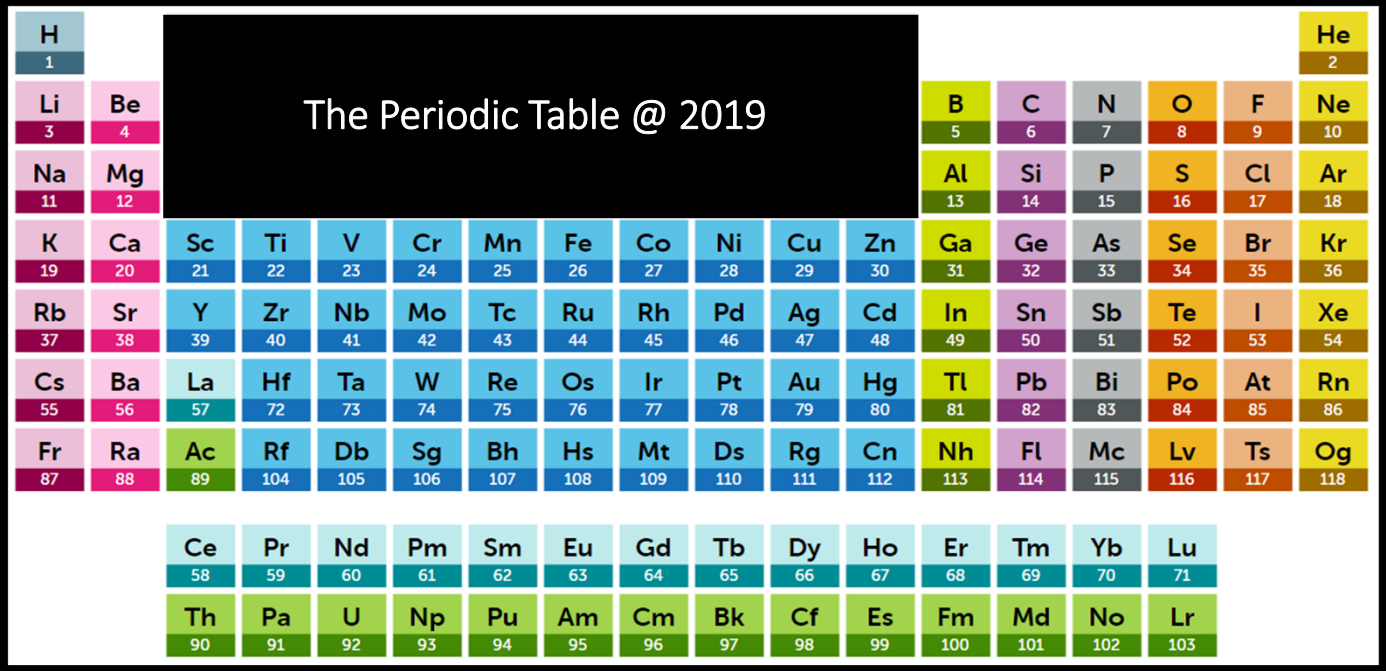
Music of Chemistry: Periodicity



Thinking Matter!

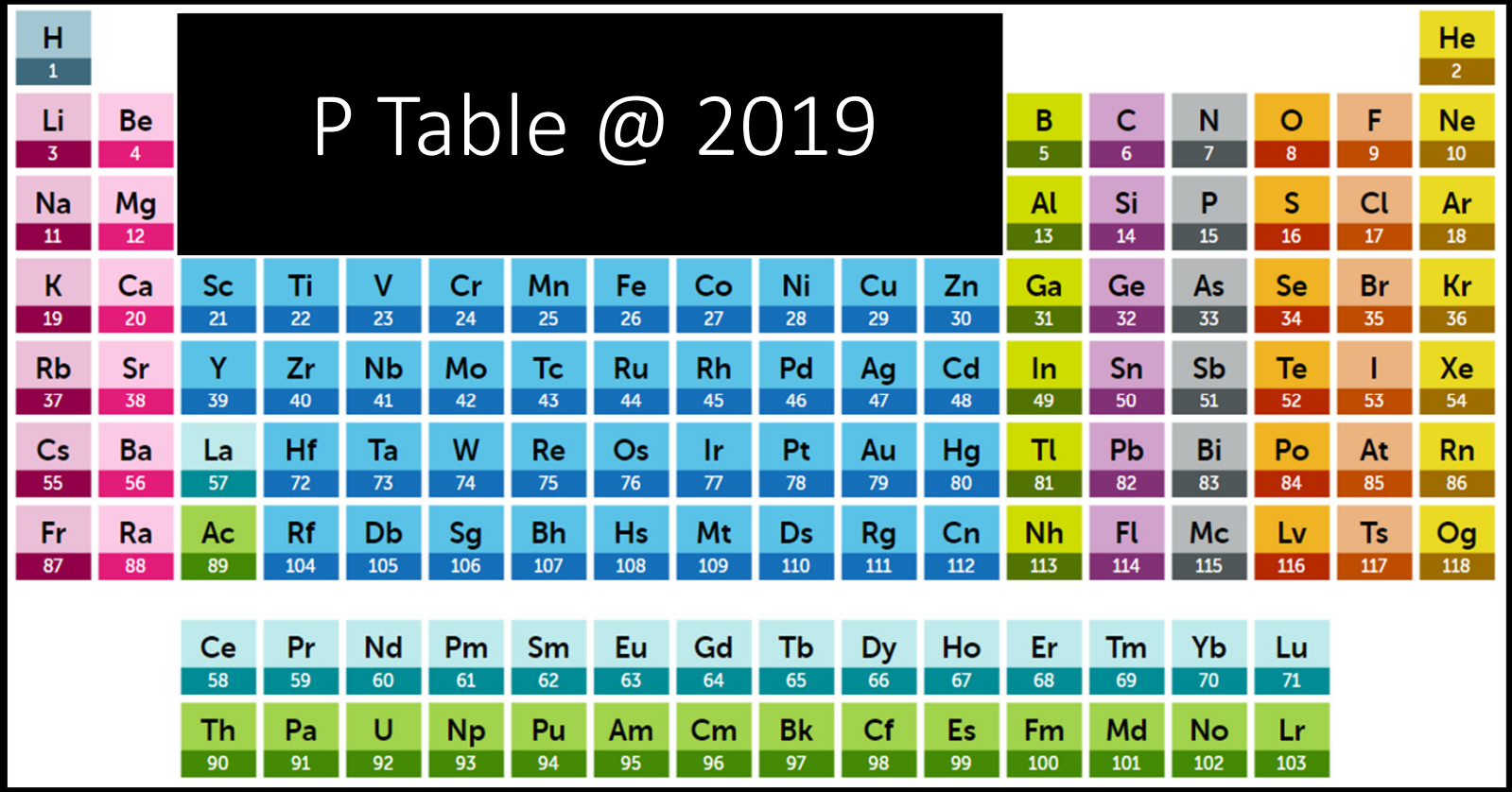
Matter matters! Chemistry matters!

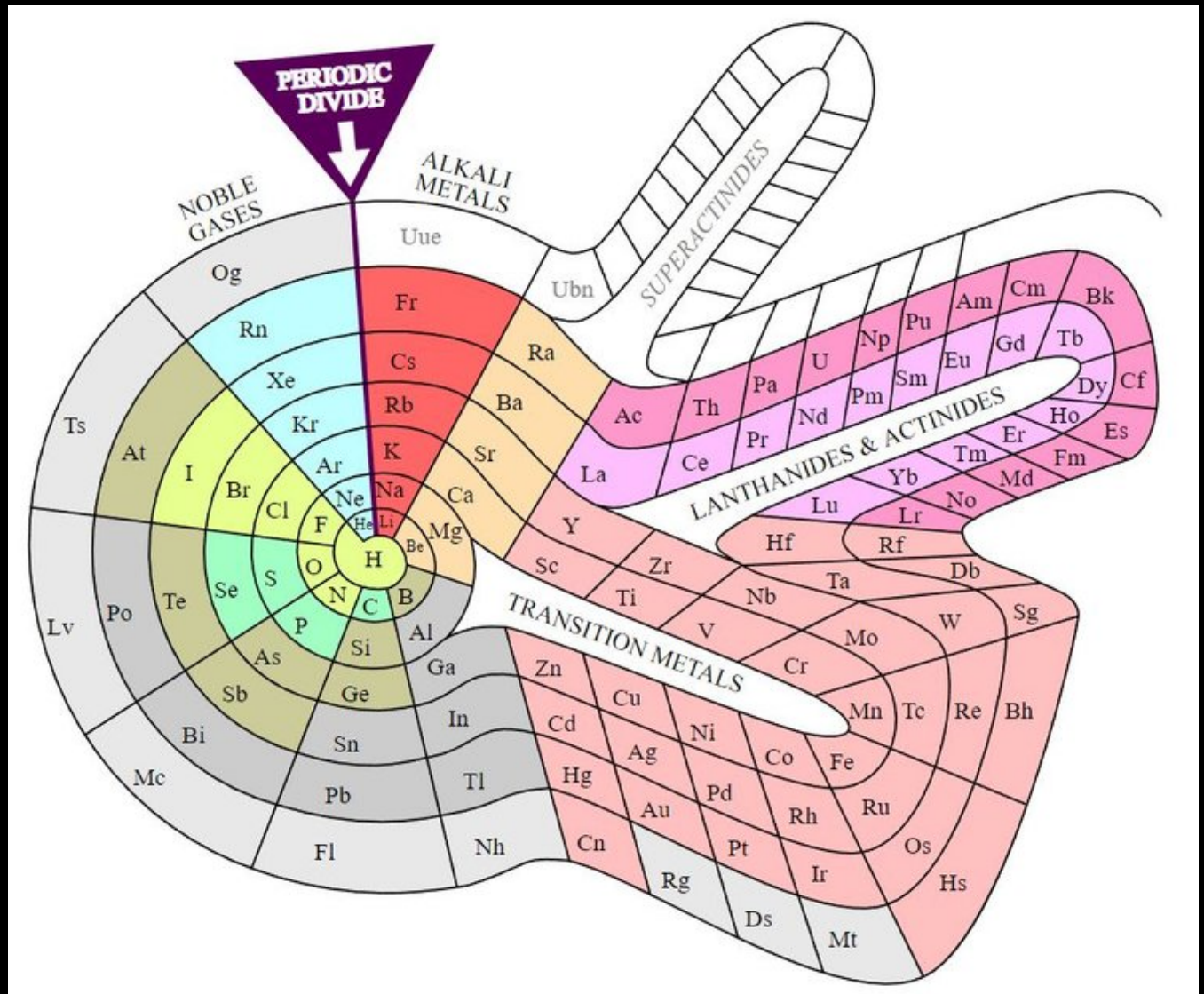
- The periodic table of the elements is a wonderful mnemonic and a tool that serves to organize the whole of chemistry
- It is neither a “theory” nor a “model” but more akin to an “organizing principle”- a new scientific entity which does a lot of useful work without being a theory



The Periodic Table in many ways

The Periodic Table @ 2019




PERIODIC DIVIDE
NOBLE GASES
ALKALI METALS
SUPERACTINIDES
LANTHANIDES & ACTINIDES
TRANSITION METALS
Uue
Ubn
Og
Rn
Xe
Kr
Ar
Ne
He
Ts
At
I
Br
Cl
F
Li
Lv
Po
Te
Se
S
O
Be
Mc
Bi
Sn
Pb
Fl
Sb
Ge
As
P
N
Nh
In
Ga
Si
C
Tl
Al
B
H
Fr
Cs
Rb
K
Na
Ra
Ba
Sr
Ca
Mg
Ac
La
Ce
Th
Pa
U
Np
Pu
Am
Cm
Bk
Pr
Nd
Pm
Sm
Eu
Gd
Tb
Dy
Cf
Ho
Es
Er
Fm
Tm
Md
Yb
No
Lu
Lr
Y
Sc
Zr
Ti
Hf
Rf
Nb
V
Ta
Db
Mo
Cr
W
Sg
Mn
Tc
Re
Bh
Zn
Cd
Hg
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Co
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Ir
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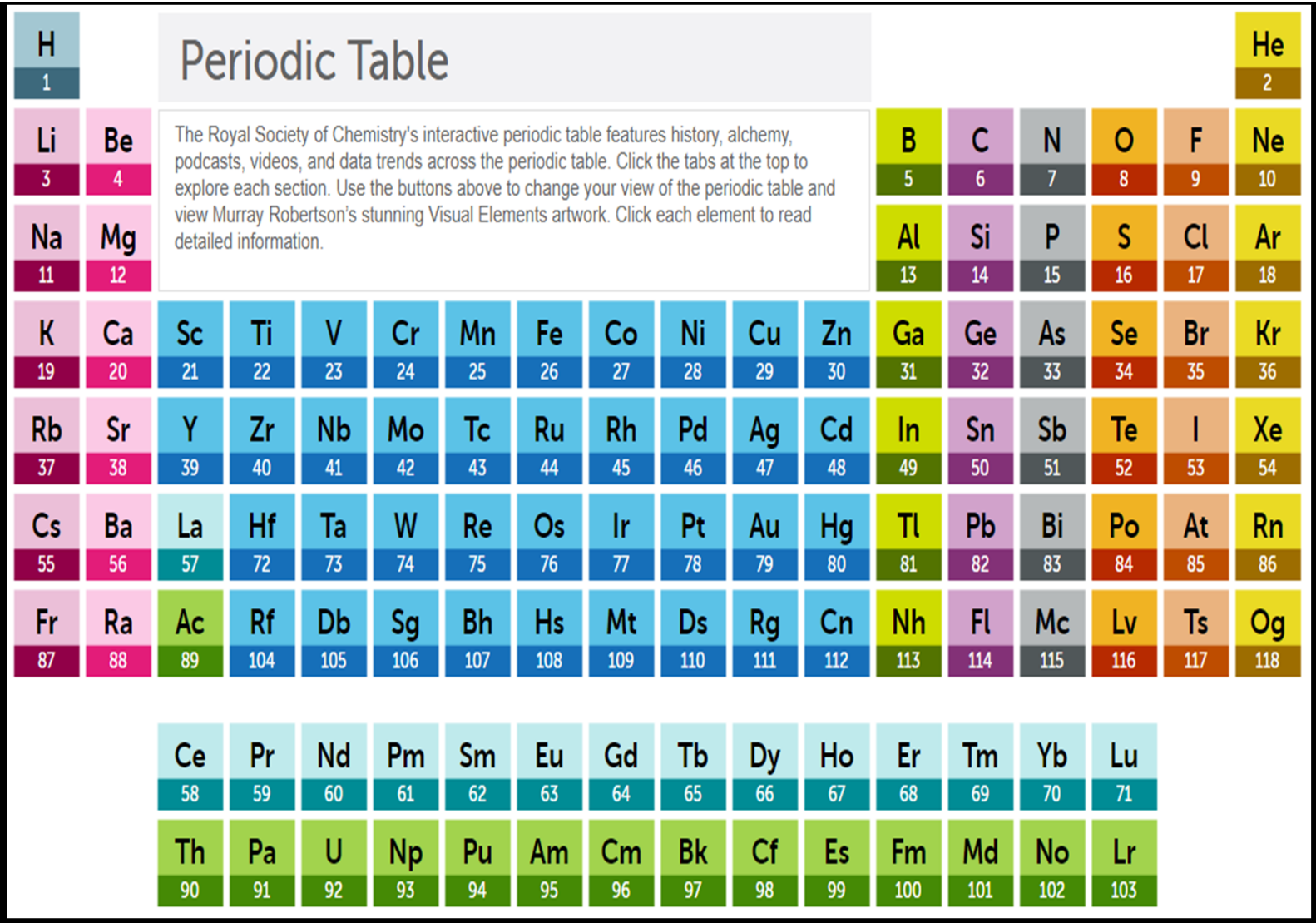
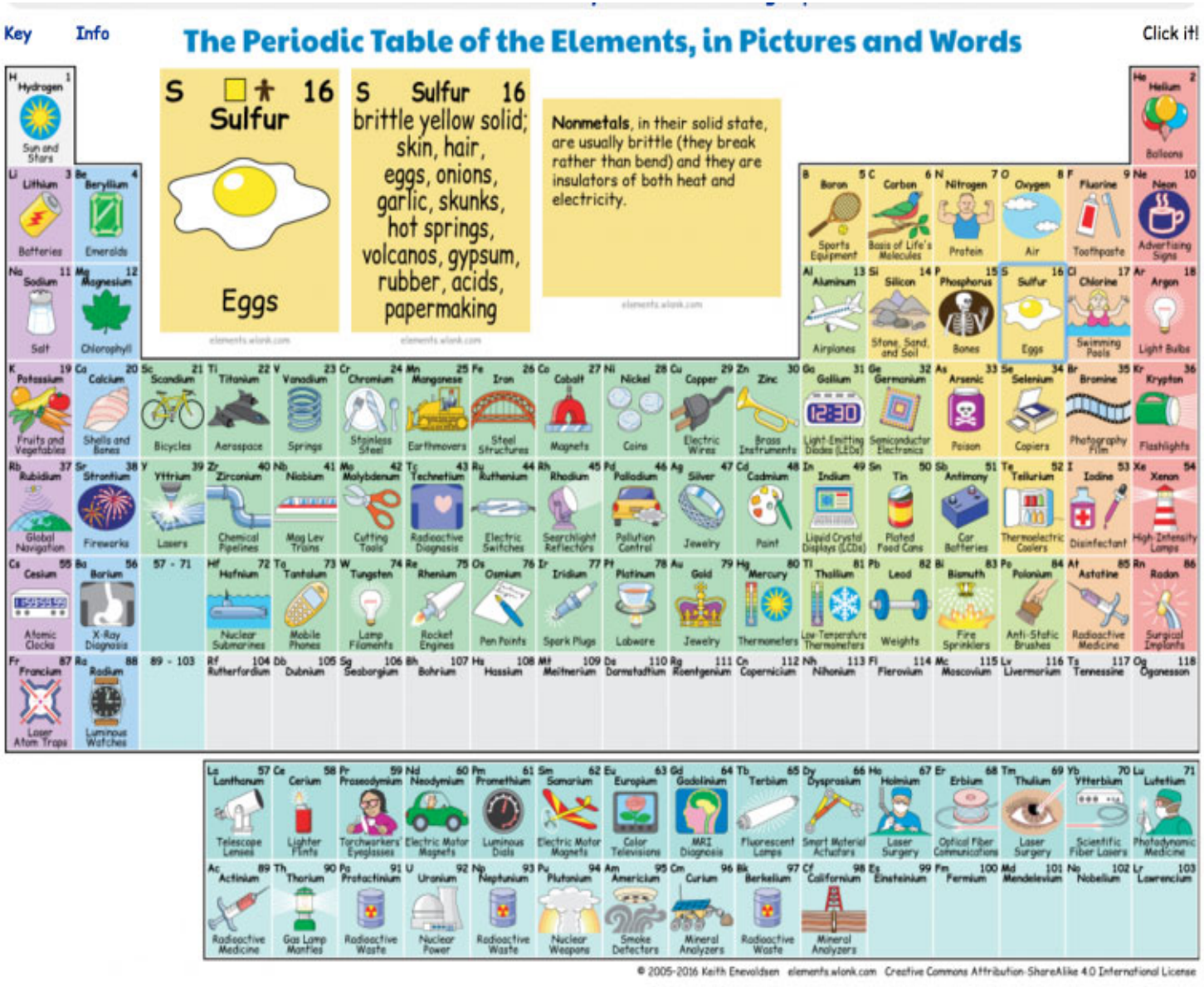
Fe
Ru
Os
Hs



https://elements.wlonk.com/ElementsTable.htm https://www.ptable.com/


Key
Info
The Periodic Table of the Elements, in Pictures and Words
Click it!
S 16 Sulfur
Eggs
S Sulfur 16
brittle yellow solid; skin, hair, eggs, onions, garlic, skunks, hot springs, volcanos, gypsum, rubber, acids, papermaking
Nonmetals, in their solid state, are usually brittle (they break rather than bend) and they are insulators of both heat and electricity.
elements.wlonk.com
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IUPAC Periodic Table of the Elements

1	2											13	14	15	16	17	18
1 H hydrogen 1.008 [1.0078, 1.0082]			Key: atomic number Symbol name conventional atomic weight standard atomic weight														2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122											5 B boron 10.81 [10.806, 10.821]	6 C carbon 12.011 [12.009, 12.012]	7 N nitrogen 14.007 [14.006, 14.008]	8 O oxygen 15.999 [15.999, 16.000]	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305 [24.304, 24.307]	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 26.982	14 Si silicon 28.085 [28.084, 28.086]	15 P phosphorus 30.974	16 S sulfur 32.06 [32.059, 32.076]	17 Cl chlorine 35.45 [35.446, 35.457]	18 Ar argon 39.95 [39.792, 39.963]
19 K potassium 39.098	20 Ca calcium 40.078(4)	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845(2)	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546(3)	30 Zn zinc 65.38(2)	31 Ga gallium 69.723	32 Ge germanium 72.630(8)	33 As arsenic 74.922	34 Se selenium 78.971(8)	35 Br bromine 79.904 [79.901, 79.907]	36 Kr krypton 83.798(2)
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224(2)	41 Nb niobium 92.906	42 Mo molybdenum 95.95	43 Tc technetium	44 Ru ruthenium 101.07(2)	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60(3)	53 I iodine 126.90	54 Xe xenon 131.29
55 Cs caesium 132.91	56 Ba barium 137.33	57-71 lanthanoids	72 Hf hafnium 178.49(2)	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23(3)	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38 [204.38, 204.39]	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89-103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium	113 Nh nihonium	114 Fl flerovium	115 Mc moscovium	116 Lv livermorium	117 Ts tennessine	118 Og oganesson

57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium	62 Sm samarium 150.36(2)	63 Eu europium 151.96	64 Gd gadolinium 157.25(3)	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.05	71 Lu lutetium 174.97
89 Ac actinium	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

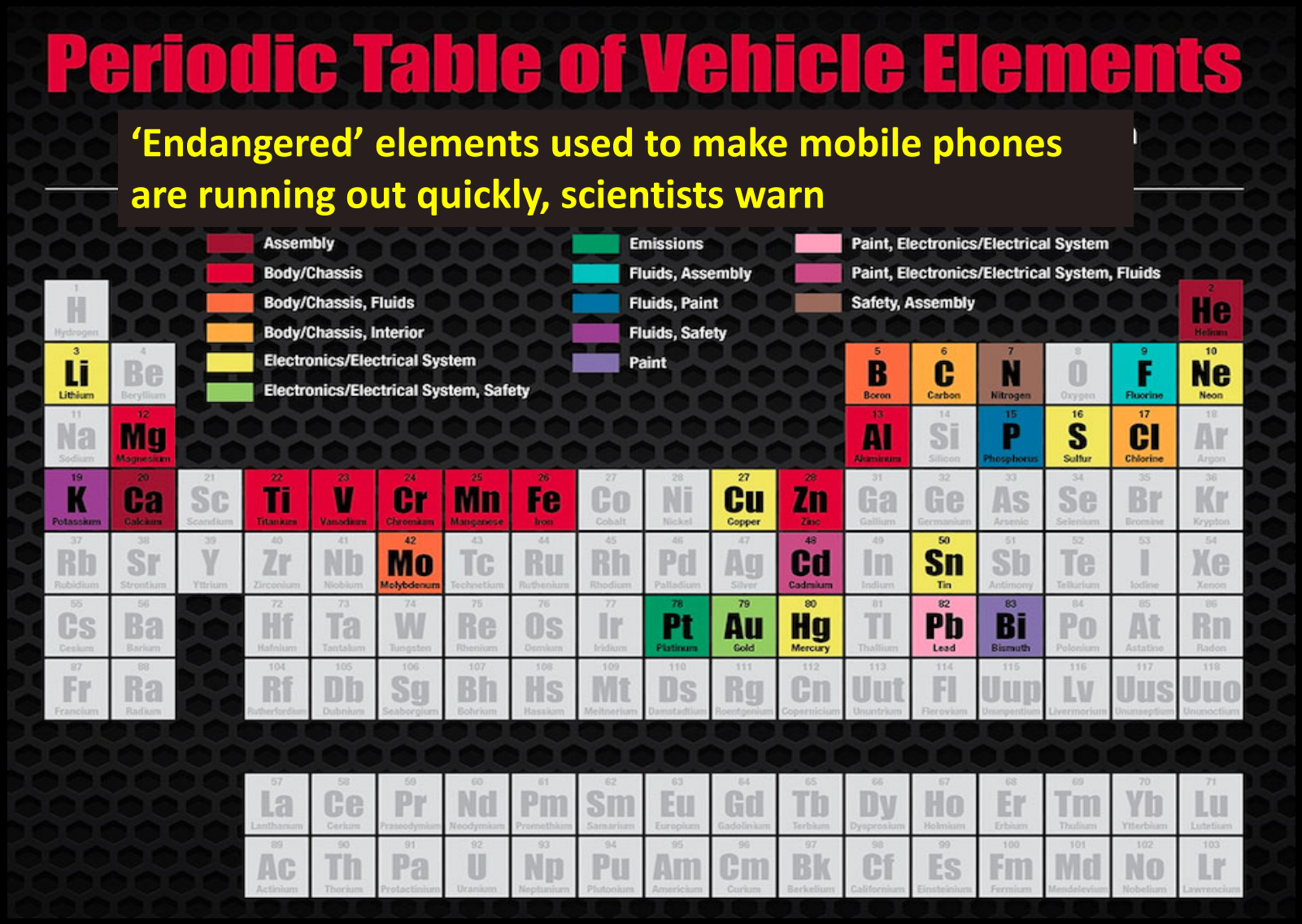
INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

For notes and updates to this table, see www.iupac.org. This version is dated 1 December 2018.

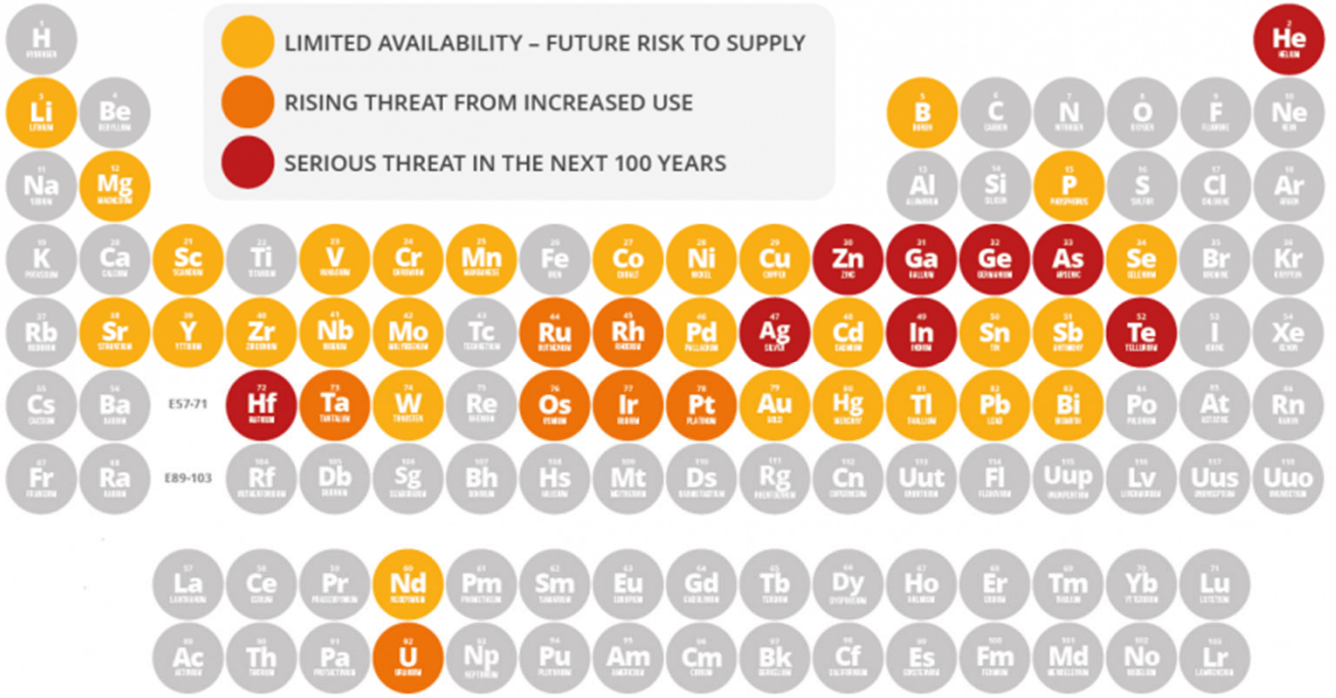
United Nations Educational, Scientific and Cultural Organization

2019 IYPT International Year of the Periodic Table of Chemical Elements

100 IUPAC


Periodic Table of Vehicle Elements
'Endangered' elements used to make mobile phones are running out quickly, scientists warn
Assembly
Body/Chassis
Body/Chassis, Fluids
Body/Chassis, Interior
Electronics/Electrical System
Electronics/Electrical System, Safety
Emissions
Fluids, Assembly
Fluids, Paint
Fluids, Safety
Paint
Paint, Electronics/Electrical System
Paint, Electronics/Electrical System, Fluids
Safety, Assembly
H Hydrogen
He Helium
Li Lithium
Be Beryllium
B Boron
C Carbon
N Nitrogen
O Oxygen
F Fluorine
Ne Neon
Na Sodium
Mg Magnesium
Al Aluminum
Si Silicon
P Phosphorus
S Sulfur
Cl Chlorine
Ar Argon
K Potassium
Ca Calcium
Sc Scandium
Ti Titanium
V Vanadium
Cr Chromium
Mn Manganese
Fe Iron
Co Cobalt
Ni Nickel
Cu Copper
Zn Zinc
Ga Gallium
Ge Germanium
As Arsenic
Se Selenium
Br Bromine
Kr Krypton
Rb Rubidium
Sr Strontium
Y Yttrium
Zr Zirconium
Nb Niobium
Mo Molybdenum
Tc Technetium
Ru Ruthenium
Rh Rhodium
Pd Palladium
Ag Silver
Cd Cadmium
In Indium
Sn Tin
Sb Antimony
Te Tellurium
I Iodine
Xe Xenon
Cs Cesium
Ba Barium
Hf Hafnium
Ta Tantalum
W Tungsten
Re Rhenium
Os Osmium
Ir Iridium
Pt Platinum
Au Gold
Hg Mercury
Tl Thallium
Pb Lead
Bi Bismuth
Po Polonium
At Astatine
Rn Radon
Fr Francium
Ra Radium
Rf Rutherfordium
Db Dubnium
Sg Seaborgium
Bh Bohrium
Hs Hassium
Mt Meitnerium
Ds Darmstadtium
Rg Roentgenium
Cn Copernicium
Uut Ununtrium
Fl Flerovium
Uup Ununpentium
Lv Livermorium
Uus Ununseptium
Uuo Ununoctium
La Lanthanum
Ce Cerium
Pr Praseodymium
Nd Neodymium
Pm Promethium
Sm Samarium
Eu Europium
Gd Gadolinium
Tb Terbium
Dy Dysprosium
Ho Holmium
Er Erbium
Tm Thulium
Yb Ytterbium
Lu Lutetium
Ac Actinium
Th Thorium
Pa Protactinium
U Uranium
Np Neptunium
Pu Plutonium
Am Americium
Cm Curium
Bk Berkelium
Cf Californium
Es Einsteinium
Fm Fermium
Md Mendelevium
No Nobelium
Lr Lawrencium

THE PERIODIC TABLE'S ENDANGERED ELEMENTS



SOURCE: CHEMISTRY INNOVATION KNOWLEDGE TRANSFER NETWORK

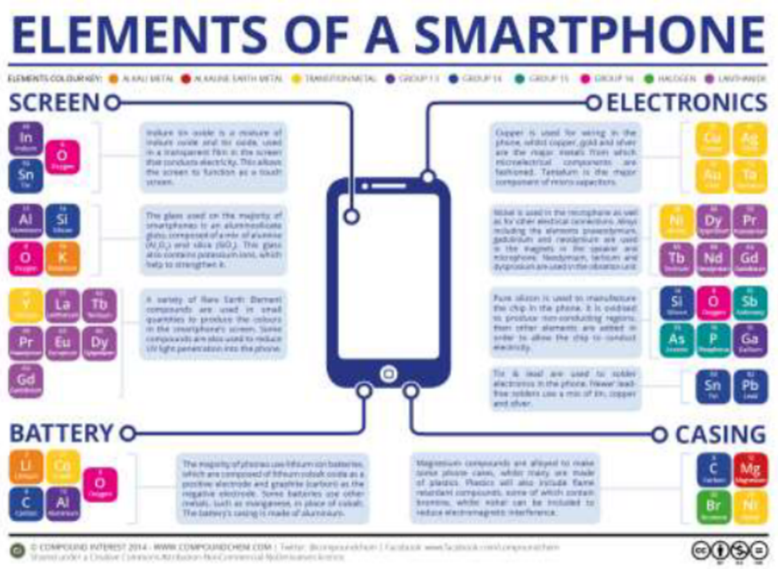
ACS Chemistry for Life

ACS Green Chemistry Institute

Ci

Endangered METALS

- Endangered species : Cu, Zn, Pt
- Strategic Shortage : Ga, In, Hf, Li
- Geopolitical risks : Re, Co, Li, Pt (90% Re : China; 90 % Pt : S. Africa; 90 % Li : Chile; 90 % Co : Republic of Congo)
- Fuel Cell: Pt at cathode; 25 reactions /sec/site; Pt cost alone is $3000 per cost of engine
- 36 mg of gold is contained in every iPhone
- Mobile phones : 40 elements
- A semiconductor chip on PC: 60 elements



One ton of mobile phones would deliver 300 times more gold than a ton of gold ore and 6.5 times more silver than a ton of silver ore

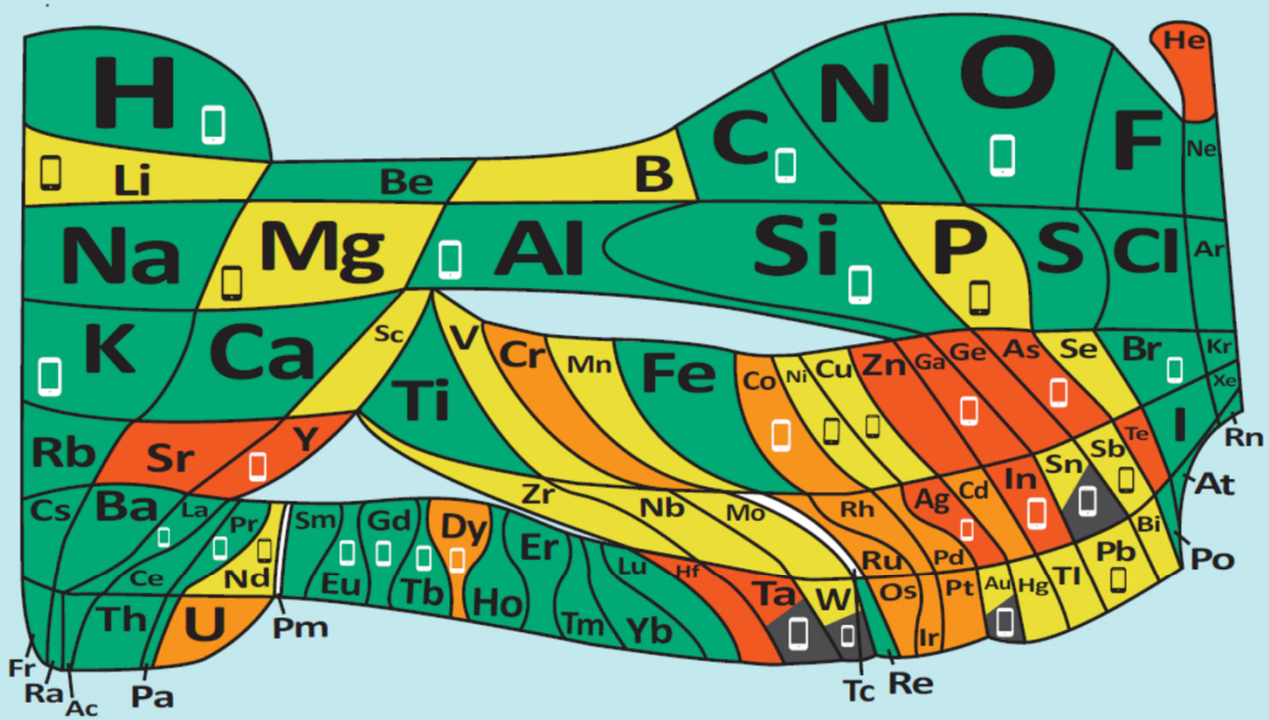
Endangered elements, critical raw materials and conflict minerals, C.J. Rhodes, Science Progress, 2019, 102(2), 304-350

United Nations Educational, Scientific and Cultural Organization

2019 IYPT International Year of the Periodic Table of Chemical Elements

The 90 natural elements that make up everything

How much is there? Is that enough?



Serious threat in the next 100 years

Rising threat from increased use

Limited availability, future risk to supply

Plentiful Supply

Synthetic

From conflict minerals

Elements used in a smart phone

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

EuChemS
European Chemical Society

Inspired by WF Sheehan's 'A Periodic Table with Emphasis' published in Chemistry, 1976, 49, 17-18'

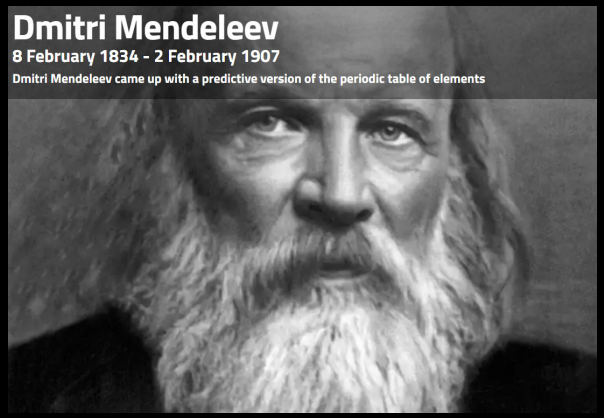
What is Matter? How it came to being?

			Ti = 50	Zr = 90	? = 180
			V = 51	Nb = 94	Ta = 182
			Cr = 52	Mo = 96	W = 186
			Mn = 55	Rh = 104,4	Pt = 197,4
			Fe = 56	Ru = 104,4	Ir = 198
		Ni =	Co = 59	Pd = 106,6	Os = 199
H = 1			Cu = 63,4	Ag = 108	Hg = 200
	Be = 9,4	Mg = 24	Zn = 65,2	Cd = 112	
	B = 11	Al = 27,4	? = 68	Ur = 116	Au = 197?
	C = 12	Si = 28	? = 70	Sn = 118	
	N = 14	P = 31	As = 75	Sb = 122	Bi = 210?
	O = 16	S = 32	Se = 79,4	Te = 128?	
	F = 19	Cl = 35,5	Br = 80	J = 127	
Li = 7	Na = 23	K = 39	Rb = 85,4	Cs = 133	Tl = 204
		Ca = 40	Sr = 87,6	Ba = 137	Pb = 207
		? = 45	Ce = 92		
		?Er = 56	La = 94		
		?Yt = 60	Di = 95		
		?In = 75,6	Th = 118?		

Cosmic Cooking

Parsimony

Music of Chemistry: Periodicity



Matter matters! Chemistry matters! Thinking Matter!