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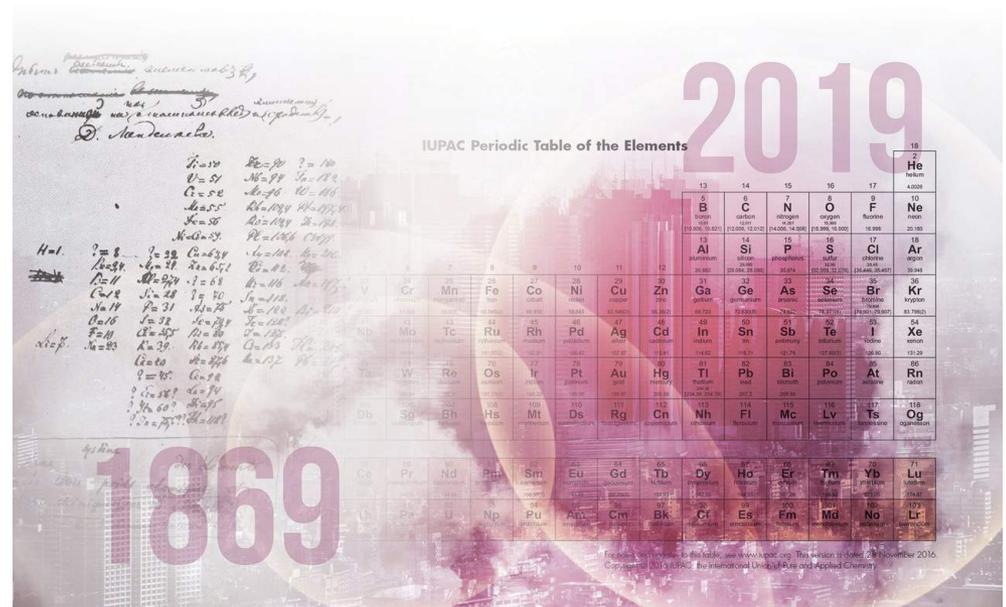
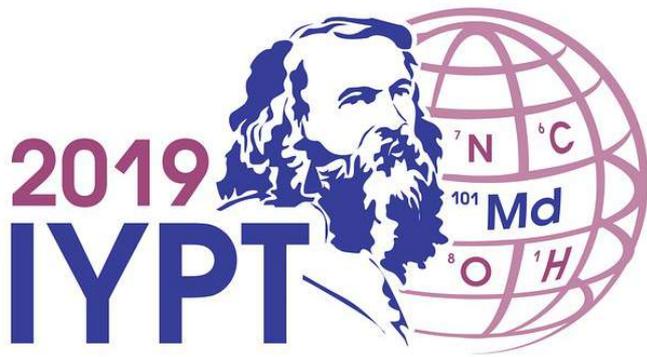
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La Tavola Periodica degli elementi: il documento cha ha rivoluzionato la scienza

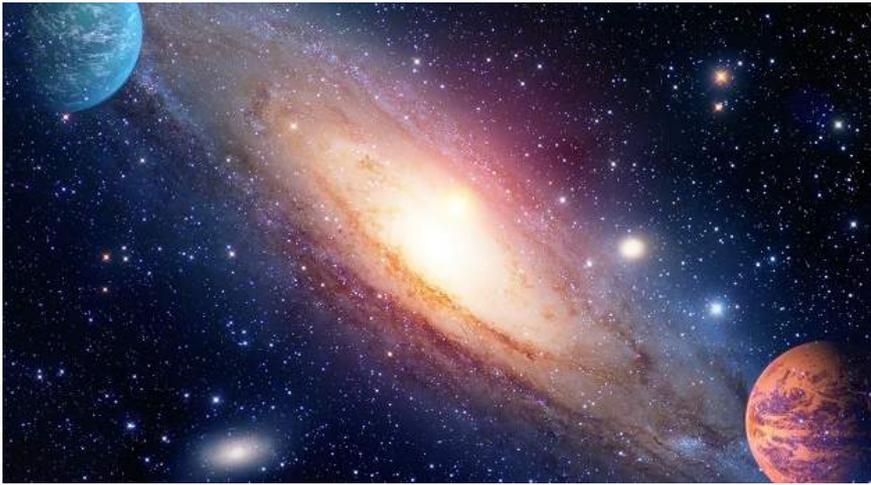
International Year
of the Periodic Table of Chemical Elements

SCIENCE – SOCIETY – WORLD – SUSTAINABLE DEVELOPMENT



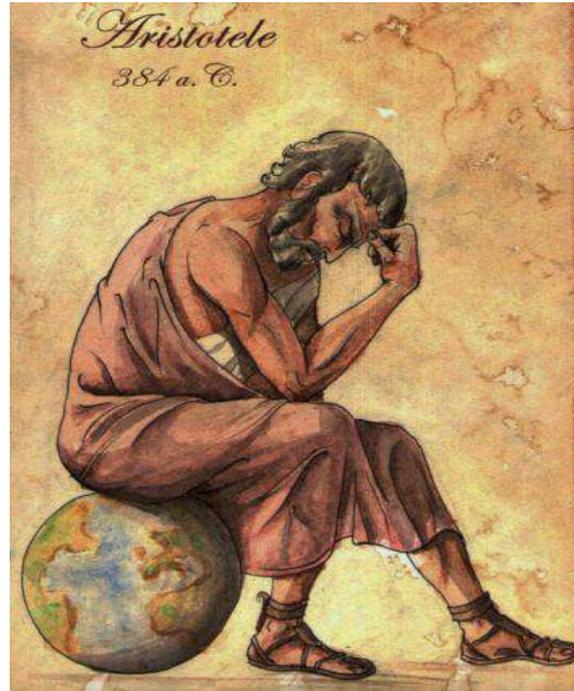
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**È la risposta ad una domanda
molto antica**



**Di cosa è fatta la
materia?**

I primi tentativi di interpretazione della natura e della composizione della materia



Acqua

Fuoco



Terra

Aria

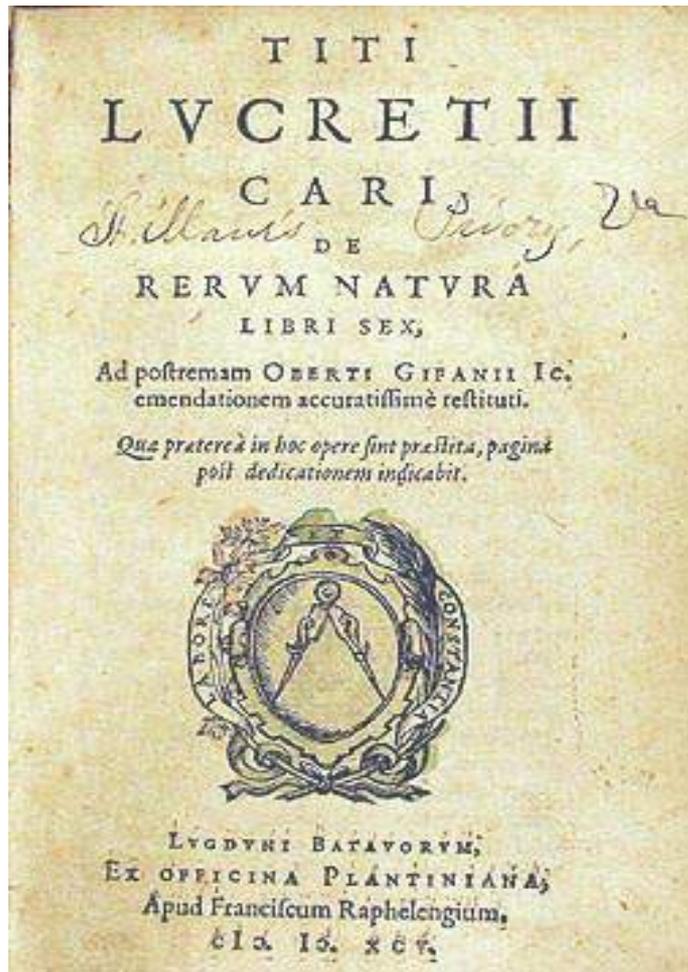
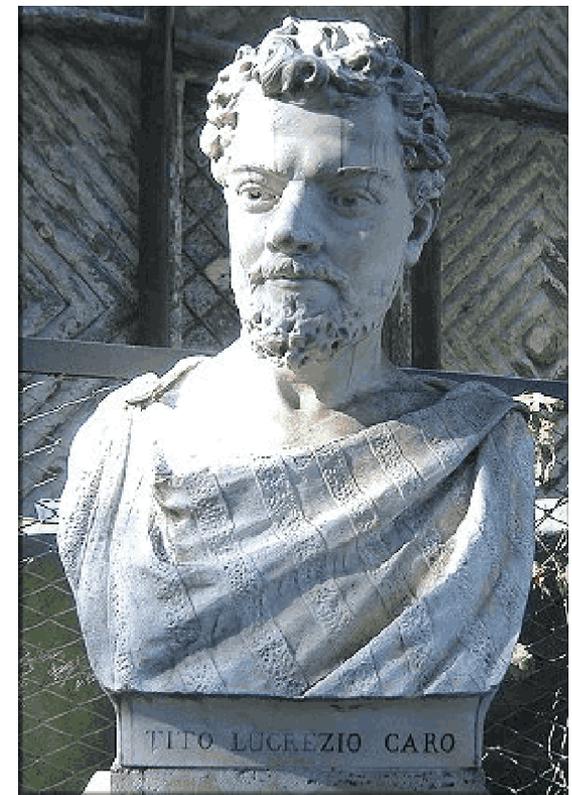


Etere

Aristotele e i cinque elementi alla base di tutto

Tito Lucrezio Caro

(98 a.C. - 55 a.C.)



I corpi semplici, o "atomi", sono indistruttibili proprio per la loro semplicità: essi resistono a ogni forza che cerchi di scomporli, non essendo composti. ... dunque, gli atomi devono essere immortali, per permettere il farsi e disfarsi delle cose

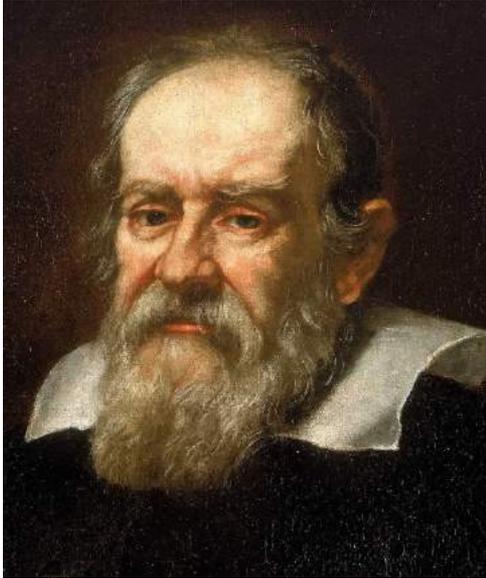


L'Alchimia nel Medio Evo



Il libro dei Sette Sigilli e gli alchimisti al lavoro per trovare la pietra filosofale

Nasce la vera scienza e il metodo scientifico



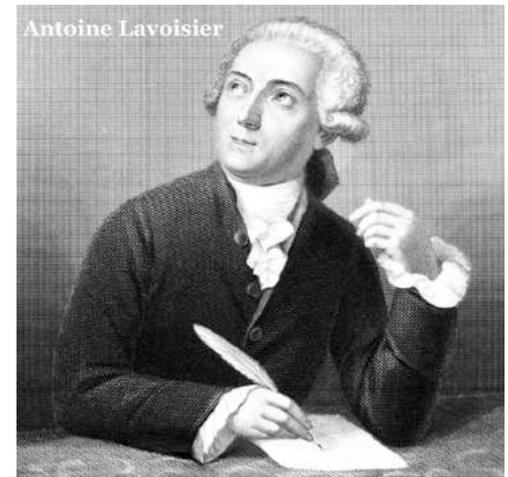
Galileo Galilei
(1564 - 1642)



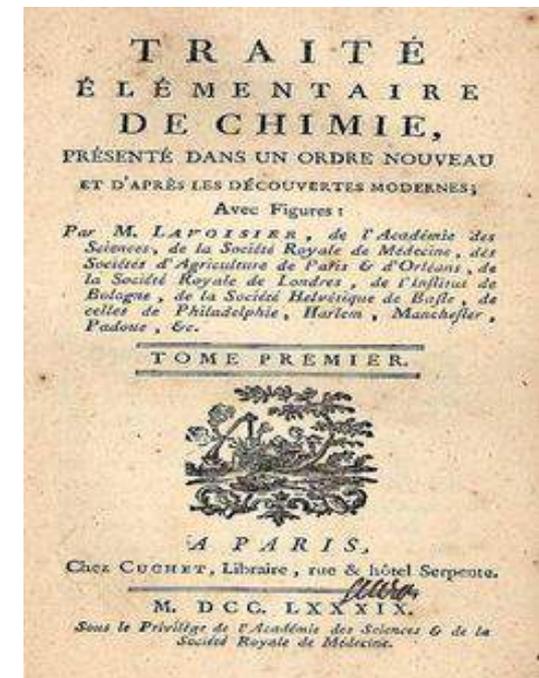
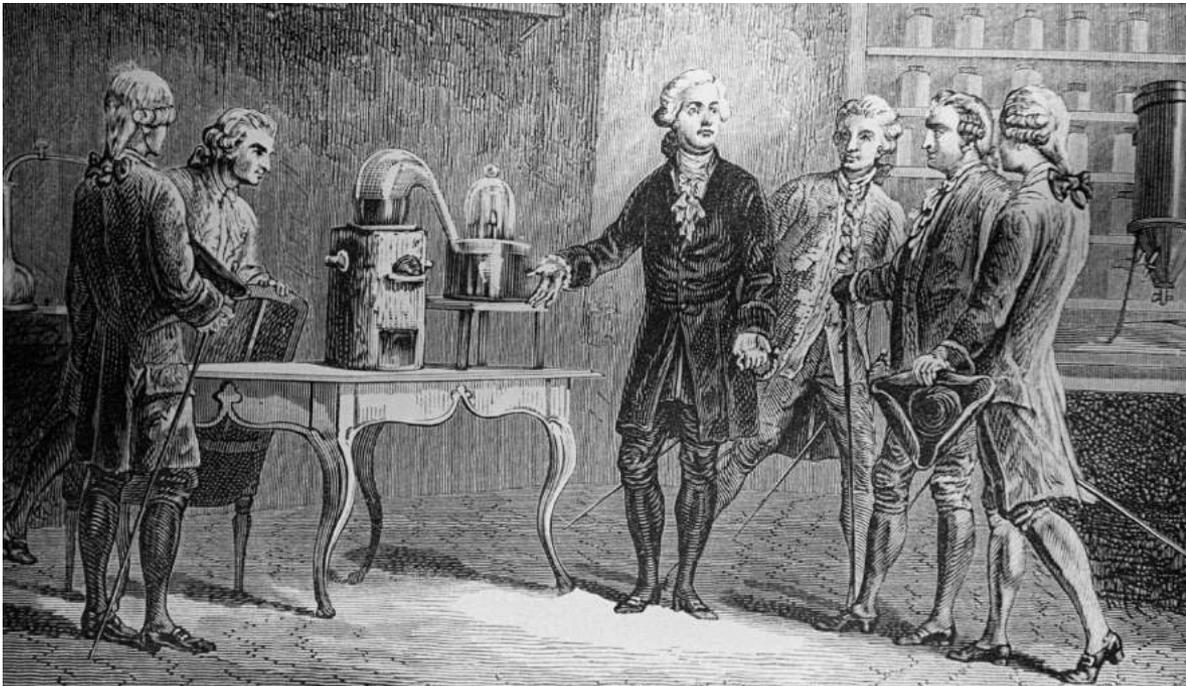
*Palazzo Bo,
Padova*

Nasce la Chimica "moderna"

Antoine Lavoisier (1743-1794)
è il padre della chimica

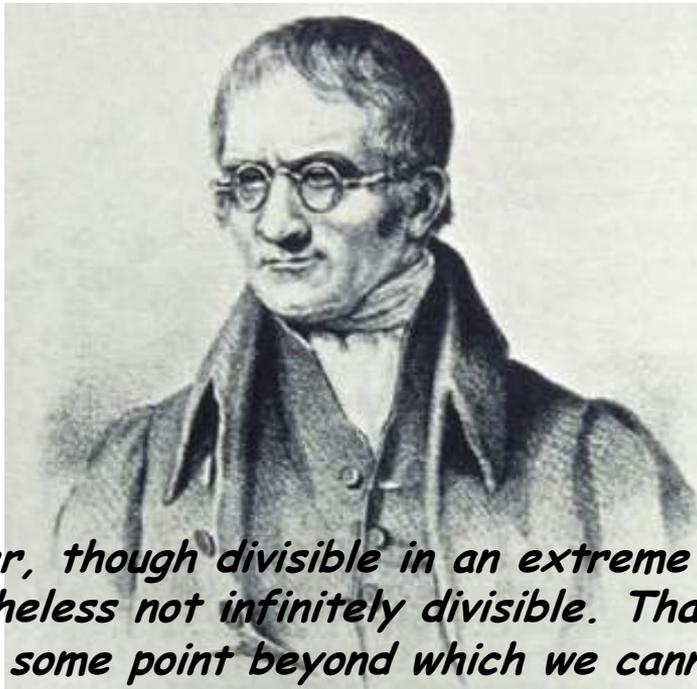


*Nulla si crea, nulla si
distrugge, ma tutto si
trasforma*



La teoria atomica

John Dalton (1766-1844) fu il primo a parlare di teoria atomica e di natura discontinua della materia su basi scientifiche



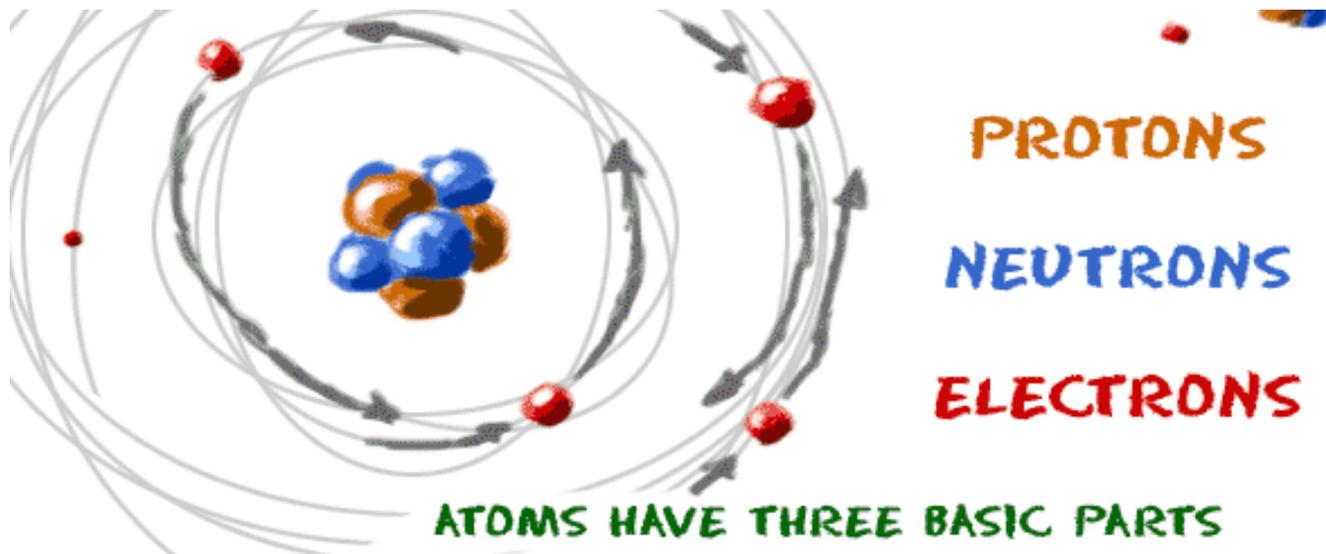
Matter, though divisible in an extreme degree, is nevertheless not infinitely divisible. That is, there must be some point beyond which we cannot go in the division of matter. I have chosen the word "atom" to signify these ultimate particles - John Dalton

ELEMENTS					
○	Hydrogen	1	⊕	Strontian	46
⊖	Azote	5	⊕	Barytes	68
●	Carbon	5	⊖	Kon	50
○	Oxygen	7	⊖	Zinc	56
⊕	Phosphorus	9	⊕	Copper	56
⊕	Sulphur	13	⊖	Lead	90
⊖	Magnesia	20	⊖	Silver	190
⊖	Lime	24	⊕	Gold	190
⊖	Soda	28	⊖	Platina	190
⊖	Potash	42	⊕	Mercury	167

Atomo

L'atomo è la più piccola particella della materia

Nonostante il suo nome "α-τομοζ" significhi non divisibile, oggi sappiamo che ha una struttura intima



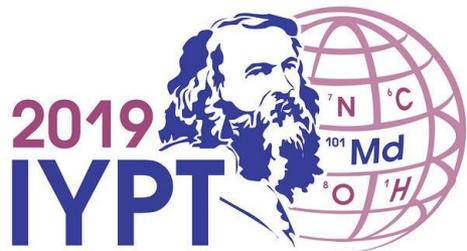
Atomo

Gli atomi di uno stesso elemento sono tutti uguali, ma diversi da quelli di un altro elemento



In natura esistono ca. un centinaio di specie atomiche elementari (H, C, O,...)

International Year
of the Periodic Table of Chemical Elements



Gli elementi sono ordinati nella Tavola Periodica

SCIENCE – SOCIETY – WORLD – SUSTAINABLE DEVELOPMENT

PARTNERS

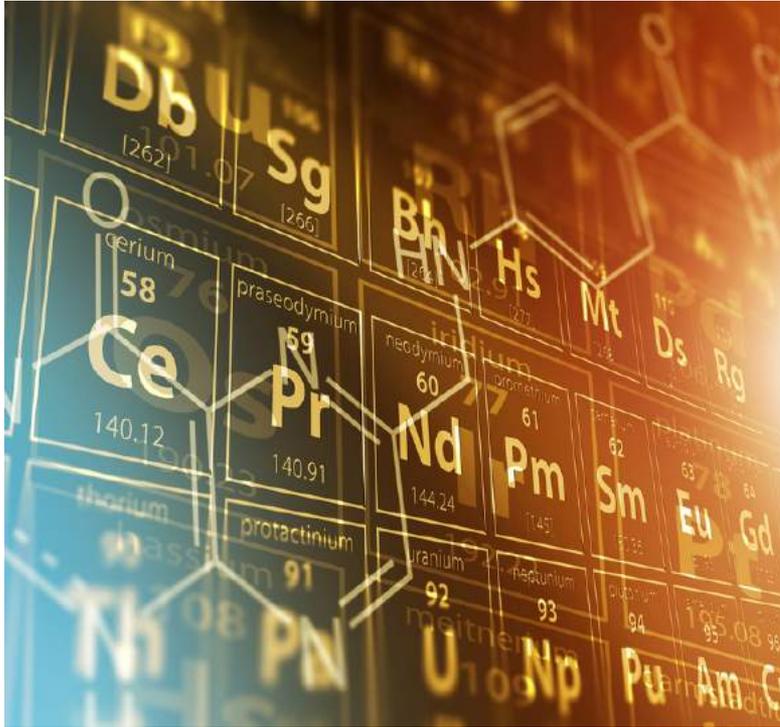


The initiative of the International Year of the Periodic Table of Chemical Elements is supported by the International Union of Pure and Applied Chemistry (IUPAC), International Union of Pure and Applied Physics (IUPAP), European Association for Chemical and Molecular Sciences (EuCheMS), The International Council for Science (ICSU), International Astronomical Union (IAU), The International Union of History and Philosophy of Science and Technology (IUHPS).



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Nel 2019 ricorre il 150° anniversario della scoperta della Tavola Periodica avvenuta nel 1869



La Tavola Periodica degli Elementi Chimici

Un documento che permette agli scienziati di capire e predire le proprietà della materia sulla Terra e nell'Universo

Uno dei più importanti risultati della scienza in grado di "catturare" l'essenza non solo della chimica e delle altre discipline scientifiche, ma della Natura stessa

La Tavola Periodica è il linguaggio della Natura

L'importanza di una scoperta scientifica può essere valutata in base alle diverse "platee" interessate: i ricercatori che lavorano nella disciplina scientifica specifica della scoperta; i ricercatori che lavorano in altre discipline scientifiche affini e il pubblico non direttamente coinvolto nella scienza

La Tavola Periodica può sicuramente essere considerata una scoperta scientifica molto importante

Chimica

La Tavola Periodica è un documento semplice ed elegante che raccoglie in maniera concisa gran parte delle conoscenze chimiche

Nessun'altra disciplina scientifica può vantare un documento simile considerato l'icona della chimica

The Periodic Table of the Elements

The callout box for Iron (Fe) provides the following data:

- atomic mass: 55.845
- atomic number: 26
- electron configuration: [Ar] 3d⁶ 4s²
- chemical symbol: Fe
- name: Iron
- 1st ionization energy: 762.5 kJ/mol
- electronegativity: 1.83
- oxidation states: +2, +3, +6

The legend identifies the following categories:

- alkali metals (orange)
- alkaline metals (yellow)
- other metals (light green)
- transition metals (green)
- lanthanoids (light blue)
- actinoids (dark blue)
- metalloids (light purple)
- nonmetals (purple)
- halogens (dark purple)
- noble gases (pink)
- unknown elements (grey)

Notes at the bottom of the table:

- * 132nd = 96.485 eV
- ** All elements are implied to have an oxidation state of zero.

Astronomia

The Origin of the Solar System Elements

1 H	big bang fusion 										cosmic ray fission 					2 He	
3 Li	4 Be	merging neutron stars? 					exploding massive stars 					5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg	dying low mass stars 					exploding white dwarfs 					13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
87 Fr	88 Ra																
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	Very radioactive isotopes; nothing left from stars									

Biologia

THE PERIODIC TABLE FOR BIOLOGISTS

I	II
1 H hydrogen	
2 Li lithium	4 Be beryllium
3 Na sodium	12 Mg magnesium
4 K potassium	20 Ca calcium
5 Rb rubidium	38 Sr strontium
6 Cs cesium	56 Ba barium
7 Fr francium	74 Ra radium

The most commonly occurring elements in living organisms are:

C ⁶ carbon	H ¹ hydrogen	O ⁸ oxygen	N ⁷ nitrogen
--------------------------	----------------------------	--------------------------	----------------------------

Other common elements are shaded in green.

relative atomic mass atomic number

1.01	1
H	hydrogen
	element name

transition-metals

21 Sc	22 Ti	23 V	24 Cr	25 Mn manganese	26 Fe iron	27 Co cobalt	28 Ni nickel	29 Cu copper	30 Zn zinc
39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd
72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	

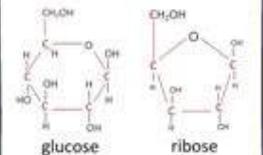
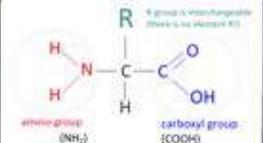
non-metals

5 B	6 C carbon	7 N nitrogen	8 O oxygen	9 F	10 Ne
13 Al	14 Si	15 P phosphorus	16 S sulphur	17 Cl chlorine	18 Ar
31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
49 In	50 Sn	51 Sb	52 Te	53 I iodine	54 Xe
81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn

Organic Compounds

contain **carbon** and are found in **living organisms**.

Some examples include:



Some exceptions are:



Some elements are used universally in nature—though their uses can be diverse.

N⁷
nitrogen

Amino group of amino acids (the monomers of proteins)

Also used in chlorophyll.

S¹⁶
sulphur

Source of energy for chemosynthetic bacteria in hydrothermal vents.

Found in the R-Group of cysteine, an amino acid, and can form disulfide bridges in protein folding.

Na¹¹
sodium

Generate resting and action potentials in neurons.

Used in maintaining osmosis. Sodium is the main cation (positive ion) in blood plasma, potassium in cytoplasm.

Sodium-potassium pump is an example of active transport.

K¹⁹
potassium

Fe²⁶
iron

Has a high affinity for oxygen.

Used in hemoglobin and myoglobin to carry oxygen in blood and muscles.

Used in ferredoxin in photosynthesis.

electron carrier in some bacteria.

P¹⁵
phosphorus

Phospholipids make up the plasma membrane.

Sugar-phosphate backbone of DNA structure.

Bonds between phosphate ions store energy in ATP.

phosphate ions

Ca²⁰
calcium

Extracellular component of bone matrix.

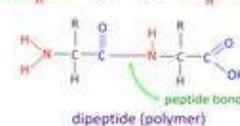
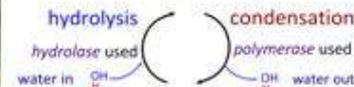
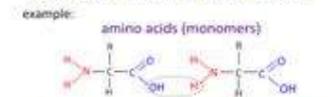
Forms exoskeletons.

Stimulates synaptic transmission between neurons.

Used in muscle contraction.

Condensation reactions create bonds between organic molecules, making **polymers**.

Hydrolysis reactions break bonds.



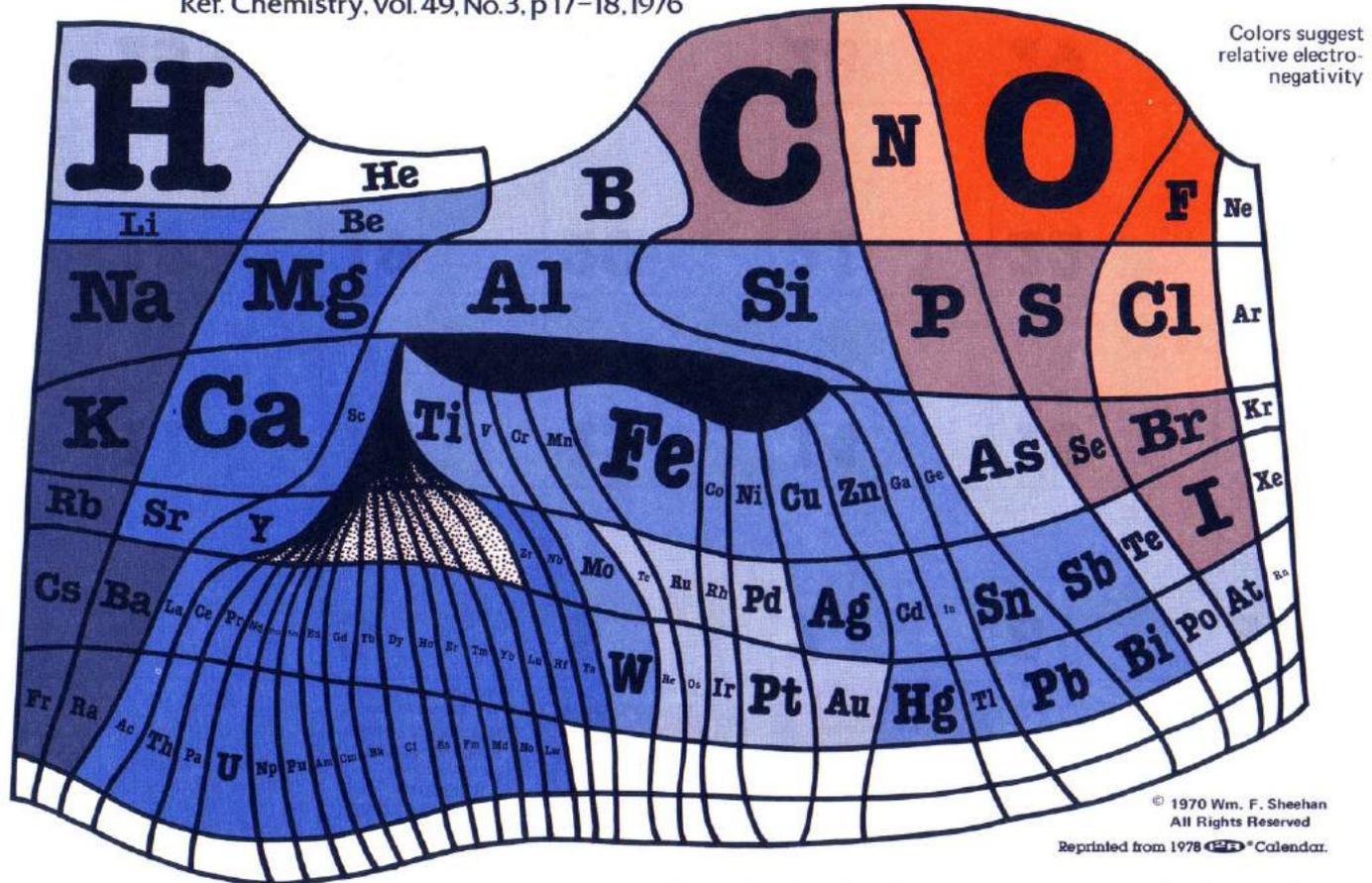
Resources used:

- Kent, M. *Advanced Biology*. Oxford University Press, 2000.
- Allott, A & Mindorf, D. *Biology Course Companion*. Oxford University Press, 2007.

Geologia

The Elements According to Relative Abundance

A Periodic Chart by Prof. Wm. F. Sheehan, University of Santa Clara, CA 95053
Ref. Chemistry, Vol. 49, No. 3, p 17-18, 1976



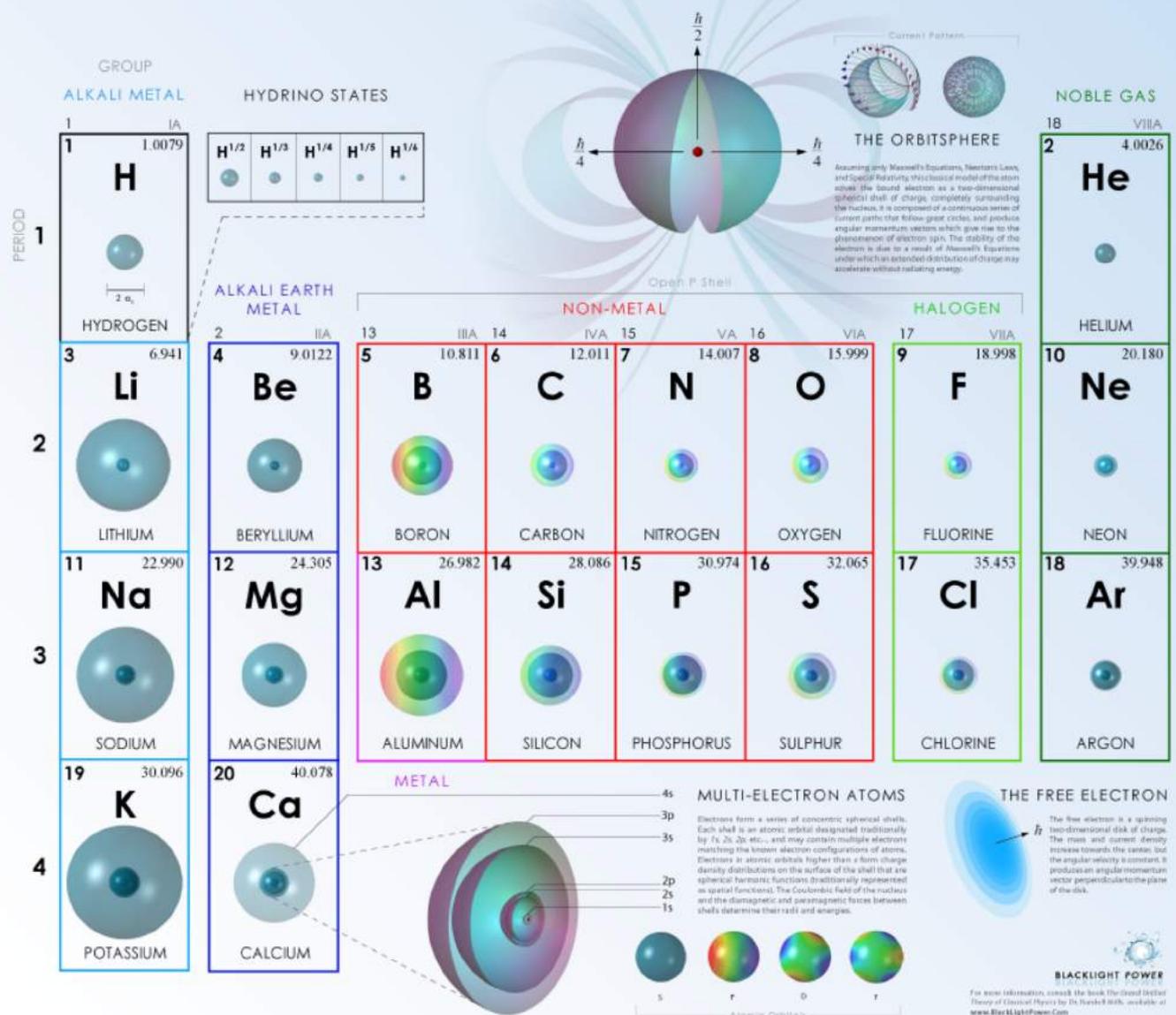
Roughly, the size of an element's own niche ("I almost wrote square") is proportioned to its abundance on Earth's surface, and in addition, certain chemical similarities (e.g., Be and Al, or B and Si) are sug-

gested by the positioning of neighbors. The chart emphasizes that in real life a chemist will probably meet O, Si, Al, . . . and that he better do something about it. Periodic tables based upon elemental abundance would, of course, vary from planet to planet. . . W.F.S.

NOTE: TO ACCOMMODATE ALL ELEMENTS SOME DISTORTIONS WERE NECESSARY, FOR EXAMPLE SOME ELEMENTS DO NOT OCCUR NATURALLY.

Fisica

PERIODIC TABLE OF ELEMENTS OF THE FIRST TWENTY-ELECTRON-ATOMS SOLVED WITH THE GRAND UNIFIED THEORY OF CLASSICAL PHYSICS



Matematica

Mathematical Expression of Mendeleev's Periodic Law

By Valery Tsimmerman

February 15, 2012

Mendeleev's dream of finding mathematical expression of his Periodic Law has finally come true. Here it is:

Periodic Law: $Z=A+g$

Where **A** represents atomic numbers of alkaline earth metals that can be expressed by following formula:

$$A = \left(\frac{p^3 + 3p^2 + 2p}{6} \right) \left| \cos \frac{p\pi}{2} \right| + \left(\frac{p^3 + 3p^2 + 5p + 3}{6} \right) \left| \sin \frac{p\pi}{2} \right|$$

and **g** is an integer representing groups of elements that has following boundaries: $(1 - L) \leq g \leq 0$

Term **L** represents period lengths and can be found from the following formula:

$$L = \left(\frac{p^2}{2} \right) \left| \cos \frac{p\pi}{2} \right| + \left(\frac{p^2 + 2p + 1}{2} \right) \left| \sin \frac{p\pi}{2} \right| \quad \text{representing period lengths.}$$

Term $p=1,2,3,4,\dots$ represents periods in all formulae.

Formula $Z=A+g$ assigns He(2) with Alkaline Earth metals. Helium could be treated as a special case and assigned with noble gases if lower boundary of term **g** was violated: $g=(-L)$ for $p=2$. Similarly, Mg could be placed next to Zn if $g=(-L)$ and $p=4$. Therefore, placing Helium in the same group with Ne, Ar, Kr, etc. is an example of a special case that can be regarded as Periodic Law violation.

Conclusion:

All groups and periods of the periodic system of chemical elements can be mathematically recreated by solving the above equations for $p=1,2,3,\dots$

Valery Tsimmerman

La Tavola Periodica non è solo scienza

La sua forma è usata per ordinare ogni tipo di "cose"

U.S. Presidents Periodic Table

2 A John Adams																	1 Gw George Washington					
10 Ty John Tyler	13 Fm Millard Fillmore													12 Ta Zachary Taylor	4 Ma James Madison	5 Mo James Monroe	8 Q John Quincy Adams	3 J Thomas Jefferson				
32 Fr Franklin D. Roosevelt	36 K John F. Kennedy	"Tecumseh's Curse" Elected in year ending in zero, died in office												Johnsons		Bushes		8 Ha William Henry Harrison	20 Ga James Garfield	25 Mk William McKinley	29 Hg Warren G. Harding	16 L Abraham Lincoln
7 Ja Andrew Jackson	22 Cv Grover Cleveland	24 Cv Grover Cleveland	28 Wi Woodrow Wilson	33 T Harry S. Truman	36 Jo Lyndon B. Johnson	42 C Bill Clinton	43 W George W. Bush	18 G Ulysses S. Grant	34 E Dwight D. Eisenhower	37 N Richard Nixon	30 Co Calvin Coolidge	40 R Ronald Reagan	26 Tr Theodore Roosevelt									
8 Vb Martin Van Buren	11 Pk James K. Polk	14 Pr Franklin Pierce	15 Bc James Buchanan	39 Ca Jimmy Carter	17 Jn Andrew Johnson	19 Hy Rutherford B. Hayes	41 Bh George H.W. Bush	21 Ar Chester A. Arthur	23 Hs Benjamin Harrison	27 Ta William Howard Taft	31 Hv Herbert Hoover	38 Fd Gerald Ford										
44 O Barack Obama																						

Color key:

Whig	Federalist
Democratic-Republican	
Democratic	Republican
Died in office	

- ◆ Dynastic president: related to another president
- \$ Presidents appearing on (currently circulated) paper U.S. currency
- i Impeached (but acquitted)
- x Resigned from office
- ↑ Ascended to presidency without being elected to presidency or vice presidency

La sua forma è usata per ordinare ogni tipo di "cose"

THE PERIODIC TABLE OF EDUCATION TECHNOLOGY

The community and editors of Daily Genius put together the following table of helpful edtech tools. They're current for the start of 2016. The table will be regularly updated and published on Daily Genius at <http://dailygenius.com/periodic-table>.
No products listed are advertised or sponsored.

Tw Twitter																Ip Apple iPad						
Fb Facebook	Li LinkedIn																Cv Camva	St StumbleUpon	Of Office 365	Sm ShowMe	Pm PicMonkey	Ch Chromecast
Em Edmodo	Sc Scoop.it																Pk Piktochart	Sl Slack	Qr QR Codes	Ik iKeepSafe	Dd Doodle	Mb MacBook
Sl Slideshare	Pi Pinterest	Qr Quora	Ka Khan Acad.	Kp Kerpoof	Cs Coursera	Wl Wordle	Ec eduCanon	Cd Code.org	Ws W3Schools	Do Doceri	eP ePals	Ib iBeacons	Cm Camtasia	Re Remind	Mc MasteryConnect	Sf Strify	Ad Android					
Gp Google+	Gr Grockit	Nn Ning	Am Animoto	Ss StudySync	Ex edX	Qz Quizlet	En Evernote	Hc Hour of Code	Ca Code Avengers	Ga Google Apps	On OneNote	Wp WordPress	Vn Videonotes	Cm Class Message	Ee Eyes Everywhere	Os Onmo	Io iOS					
Eb Edublogs	Sk Skype	Os OpenStudy	So Socrative	Ud Udacity	Sg Skills Genius	Yt YouTube	Pb Planboard	Sc Scratch	Rp Raspberry Pi	Gb Groupboard	Es edShelf	Pp Popplet	Lb Livefinders	Cd ClassDojo	Sk Sketch	Ir iRubric	Iw iWBs					
Wk Wikispaces	Di Digo	In Instagram	Kw Knewton	Uy Udemy	Pz Prezi	Td TED-Ed	Bs Bitstrips	Kd Kodable	Mn Minecraft	Sg Schoolology	Bc Book Creator	Ji Jing	Db Dropbox	Kb Kidblog	Im iMovie	Rs RobiStar	Tv Apple TV					

■ Social Networks
 ■ Online Learning
 ■ Multimedia
 ■ Coding
 ■ Classroom Tech
 ■ Hardware

Is ISTE	Ec Edcamp	Ws WISE Summit	Sw SXSWedu	Gv ASUGSV	In iNACOL	Ie IntegratEd	Ft FETC	Ei Excel in Ed	Lb Learning & Brain	Dm DML	Eu EdTech Europe	Md Miami Device	Ec Educon
Et EdTechFactor	As ASCD	Ge GESF	Bt BETT	Ei EdTech Summit	Cu CUE Conf.	Ns New Schools	St ST4T	Gc Global Ed Con	Ai AREA	En EdNET	Ll LearnLaunch	Ob OEB	Pw PBL World

■ Education Conferences

Produced by and for the Daily Genius community.
 Please feel free to share but attribute to <http://dailygenius.com/periodic-table>. Thanks!

La sua forma è usata per ordinare ogni tipo di "cose"

The Periodic Table of Meat

Legend:

- Red Meat (Pink)
- Seafood (Blue)
- The Noble Meats (Purple)
- Cold Cuts (Green)
- Poultry (Yellow)
- Mixed (Cyan)
- Steaks (Orange)
- Gamey (Dark Blue)

1 B Bacon	2 H Hamburger																
3 P Pork chops	4 Bb Baby back ribs																
5 Bk Blackened fish	6 Gf Grilled fish	7 Bf Baked fish	8 Ff Fried fish	9 Mb Meatballs	10 Sg Sausage												
11 Pl Pork loin	12 Sr Spare ribs	13 Sh Sashimi	14 Im Shrimp	15 Sl Shellfish	16 Sq Squid	17 Ci Chai	18 Sj Sticky rice										
19 Cu Pork cutlet	20 Hh Hamhock	21 Ha Sliced ham	22 Ca Capicola	23 Cd Corned beef	24 Tp Tenderloin	25 Bs Beef sausage	26 R Beef ribs	27 Kb Kobe	28 Rt Rit roast	29 Cr Crab	30 Tu Tuna	31 Lb Lobster	32 Pg Chicken Parmigiana	33 Tm Chicken Teriyaki	34 Fg Chicken Fingers	35 Ng Chicken Nuggles	36 Fr Fried chicken
37 Ro Pork roast	38 Cz Chorizo	39 Ch Christmas ham	40 Mr Morhettia	41 Rb Roast beef	42 He Head cheese	43 Td T-bone steak	44 S Filet Mignon	45 Fm Fillet steak	46 Sf Steak au poivre	47 St Steak au jus	48 Cb Chicken Carbonnade	49 C Crispy chicken	50 Gt General Tso's chicken	51 Ty Teriyaki chicken	52 Jm Japanese steak	53 W Buffalo wings	54 Q BBQ chicken
55 Pp Pulled pork	56 Ap Ai pastor	57 Z Zungenwurst	58 Rs Prosciutto	59 Pm Pastami	60 Cw Cox tongue	61 Pr Pepper steak	62 Tt Steak Tartare	63 Si Strip steak	64 Md Mandarin beef	65 Bt Beef brisket	66 Cs Chicken Casserole	67 Re Roast beef	68 Tr Tandoori	69 K Kabobs	70 Gb Gumbo	71 Sp Spam	72 Pe Pepperoni
73 Gr Ground pork	74 Ct Carnitas	75 Fe Pig's feet	76 Pt Pancetta	77 Gy Gyoza	78 Fi Steak fingers	79 Sy Salisbury steak	80 Cf Chicken fried steak	81 Ry Ribeye	82 Sw Shawarma	83 J Beef jerky	84 D Duck	85 Th Thanksgiving turkey	86 T Sliced turkey	87 Sm Summer sausage	88 Bg Bologna	89 Lf Pimento loaf	90 Hd Hot dogs
91 Bn Bacon	92 Ek Eggs	93 L Lamb	94 Go Goat	95 Kl Kielbasa	96 Bh Bismark												
97 Dr Deer	98 Ra Rabbit	99 Wb Wild boar	100 O Ochsch	101 E Emu	102 G Gator												

Key Meat Facts:

- Bacon is the "meat of life." Without bacon, life on earth as we know it could not exist
- Noble Meats are named as such because they rate the highest on the Glanburg "Yumminess Scale." Lowest-ranking meats include Pig's feet, Spam and Roadkill
- Meats occur in two basic forms: boned and boneless
- Basic chemical formulas: H₂B = Bacon Double Cheeseburger; ThReD = Turducken; HaRbT = Cold Cut Trio; HdQH = A Barbeque, FrCIB = Heart attack

91 Bn Bacon	92 Ek Eggs	93 L Lamb	94 Go Goat	95 Kl Kielbasa	96 Bh Bismark
97 Dr Deer	98 Ra Rabbit	99 Wb Wild boar	100 O Ochsch	101 E Emu	102 G Gator

THE TABLE

74 W Tungsten, 53 I Iodine, 10 Ne Neon

KEY:

- 16 Cd Chardonnay
- 21 Sb Sauternes
- 22 Sv Sverre
- 23 Ms Moscato
- 24 Ma Malbec
- 25 Gr Grenache
- 26 Cg Cabernet
- 27 Ci Chianti
- 28 Cn Cynol
- 29 Cr Cabernet
- 30 Me Merlot
- 31 Na Nebbiolo
- 32 Ps Pinot Noir
- 33 Ri Riesling
- 34 Sg Syrah
- 35 Pt Pinot Noir
- 36 Ri Riesling
- 37 Sy Syrah
- 38 Te Tempranillo
- 39 Sz Szekes
- 40 Ta Tannin
- 41 Tn Tannin

WINE STYLES:

- Heavy, My White, Light-bodied Red
- Sweet White, Medium-bodied, Medium-Sweet
- Full-bodied, Full-Sweet
- Sparkling
- Neutral

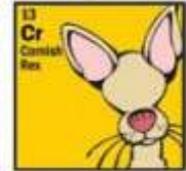
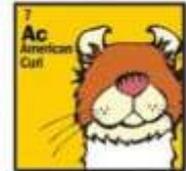
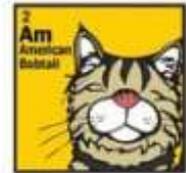
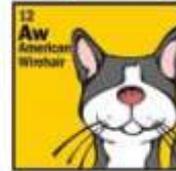
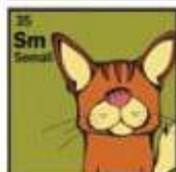
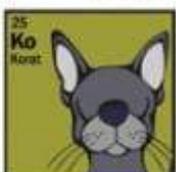
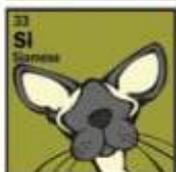
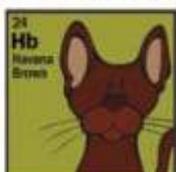
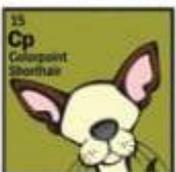
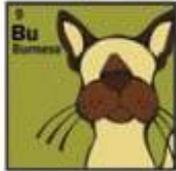
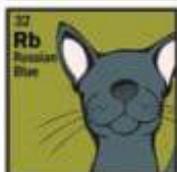
La sua forma è usata per ordinare ogni tipo di "cose"

THE CaT

T A B L E

OF THE FELIS CATUS

KEY:
■ SHORTHAIRED
■ LONGHAIRD & SEMI LONGHAIRD
■ MUTATIONS



La sua forma è usata per ordinare ogni tipo di "cose"

PERIODIC TABLE OF AIRLINES

Compiled from eDreams customers reviews since 2009

RANKING OF AIRLINE

OVERALL RATING

1 4,49

IATA CODE



1 4,49 SQ Singapore Airlines	2 4,40 F7 Darin Airline																
3 4,40 TG Thai Airways	4 4,36 HG NKO	5 4,35 EY Etihad Airways	6 4,32 A3 Aegean Airlines	7 4,30 EK Emirates	8 4,28 QR Qatar Airways	9 4,27 PG Bangkok Airways											
10 4,26 TK Turkish Airlines	11 4,24 NT Enter Canarias	12 4,21 LX Swire International	13 4,19 OS Austrian Airlines	14 4,18 AB Air Berlin	15 4,18 KM Air Malta	16 4,17 LG Luxair											
17 4,15 LH Lufthansa	18 4,13 OA Olympic Air	19 4,12 RJ Royal Jordanian	20 4,12 IF Island Airways	21 4,12 VN Vietnam Airlines	22 4,09 4U Germanwings	23 4,08 KU Kuwait Airways	24 4,08 I9 Air Italy	25 4,07 AY Finnair	26 4,06 S4 Sata International	27 4,05 V3 Capitair	28 4,05 B2 Belavia	29 4,04 RO Tarom	30 4,04 XK Air Corsica				
31 4,03 9U Air Moldova	32 4,03 9W Jet Airways	33 4,02 JP Adria Airways	34 4,02 OU Croatia Airlines	35 4,01 OK Czech Airlines	36 4,00 LO LOT	37 3,99 KLM KLM	38 3,99 TA Taca	39 3,97 AV Aviaco	40 3,97 FB Bulgaria Air	41 3,97 PS Ukraine International	42 3,97 MH Malaysian Airlines	43 3,96 TP TAP Portugal	44 3,96 BA British Airways				
45 3,95 BD British Midland	46 3,94 AF Air France	47 3,94 AZ Alitalia	48 3,93 JJ TAM Linhas Aereas	49 3,93 AP Air One	50 3,92 ZI Aigle Azur	51 3,90 AM Aeromexico	52 3,88 LY El Al Israel Airlines	53 3,87 MS Egyptair	54 3,87 LA LAN Airlines	55 3,84 SK Scandinavian Airlines	56 3,83 FI Icelandair	57 3,83 TX Air Caraibes	58 3,82 QS Smart Wings				
59 3,82 FV Rossiya Airlines	60 3,82 SN Brussels Airlines	61 3,82 AC Air Canada	62 3,82 S7 Siberia Airlines	63 3,80 EI Aer Lingus	64 3,78 SA South African Airways	65 3,77 JU JAT	66 3,77 ET Ethiopian Airlines	67 3,75 YM Montenegro Airlines	68 3,74 UX Air Europa	69 3,73 SS Coteair	70 3,72 HV Transavia	71 3,69 SU Aeroflot	72 3,67 ZB Monarch				
73 3,67 VS Virgin Atlantic	74 3,61 IG Meridiana	75 3,59 DL Delta	76 3,58 DE Condor Flugdienst	77 3,58 IB Iberia	78 3,56 TU Tunisair	79 3,54 VY Vueling	80 3,54 IV Wind Jet	81 3,54 UA United Airlines	82 3,54 CZ China Southern Airlines	83 3,54 TS Air Transat	84 3,52 GF Gulf Air	85 3,51 BE Flybe	86 3,46 PU Pluna Uruguay	87 3,45 MU China Eastern Airlines	88 3,45 VV Aerovot Airlines	89 3,41 AA American Airlines	90 3,40 BV Bu Express
91 3,40 US US Airways	92 3,38 BT Air Baltic	93 3,38 AR Aerolineas Argentinas	94 3,33 AT Royal Air Maroc	95 3,31 U2 Easyjet	96 3,27 CA Air China Limited	97 3,23 5L Aerocast	98 3,17 FR Ryanair	99 3,11 AH Air Algiers	100 2,74 S3 Sata Barbica Airlines								



Tavole Periodiche per ogni gusto

Periods	Alkali Metals Group 1	Alkali Earth Metals Group 2	Transition Metals										Boron Group 13	Carbon Group 14	Nitrogen Group 15	Oxygen Group 16	Halogens 17	Noble Gases 18
1	H Hydrogen Sun and Stars	He Helium Balloons											B Boron Sports Equipment	C Carbon Basis of Life's Molecules	N Nitrogen Protein	O Oxygen Air	F Fluorine Toothpaste	Ne Neon Advertising Signs
2	Li Lithium Batteries	Be Beryllium Emeralds											Al Aluminum Airlanes	Si Silicon Stone, Sand, and Soil	P Phosphorus Bones	S Sulfur Eggs	Cl Chlorine Swimming Pools	Ar Argon Light Bulbs
3	Na Sodium Salt	Mg Magnesium Chlorophyll											Ga Gallium Light-Emitting Diodes (LEDs)	Ge Germanium Semiconductor Electronics	As Arsenic Poison	Se Selenium Copiers	Br Bromine Photography Film	Kr Krypton Flashlights
4	K Potassium Fruits and Vegetables	Ca Calcium Shells and Bones	Sc Scandium Bicycles	Ti Titanium Aerospace	V Vanadium Springs	Cr Chromium Stainless Steel	Mn Manganese Earthmovers	Fe Iron Steel Structures	Co Cobalt Magnets	Ni Nickel Coins	Cu Copper Electric Wires	Zn Zinc Brass Instruments	Ga Gallium Light-Emitting Diodes (LEDs)	Ge Germanium Semiconductor Electronics	As Arsenic Poison	Se Selenium Copiers	Br Bromine Photography Film	Kr Krypton Flashlights
5	Rb Rubidium Global Navigation	Sr Strontium Fireworks	Y Yttrium Lasers	Zr Zirconium Chemical Pipelines	Nb Niobium Mag Lev Trains	Mo Molybdenum Cutting Tools	Tc Technetium Radioactive Diagnosis	Ru Ruthenium Electric Switches	Rh Rhodium Searchlight Reflectors	Pd Palladium Pollution Control	Ag Silver Jewelry	Cd Cadmium Paint	In Indium Liquid Crystal Displays (LCDs)	Sn Tin Plated Food Cans	Sb Antimony Car Batteries	Te Tellurium Thermoelectric Coolers	I Iodine Disinfectant	Xe Xenon High-Intensity Lamps
6	Cs Cesium Atomic Clocks	Ba Barium X-Ray Diagnosis	57 - 71 Rare Earth Metals	Hf Hafnium Nuclear Submarines	Ta Tantalum Mobile Phones	W Tungsten Lamp Filaments	Re Rhenium Rocket Engines	Os Osmium Pen Points	Ir Iridium Spark Plugs	Pt Platinum Labware	Au Gold Jewelry	Hg Mercury Thermometers	Tl Thallium Low-Temperature Thermometers	Pb Lead Weights	Bi Bismuth Fire Sprinklers	Po Polonium Anti-Static Brushes	At Astatine Radioactive Medicine	Rn Radon Surgical Implants
7	Fr Francium Laser Atom Traps	Ra Radium Luminous Watches	89 - 103 Actinide Metals	Rf Rutherfordium	Db Dubnium	105 Sg Seaborgium	106 Bh Bohrium	107 Hs Hassium	108 Mt Meitnerium	109 Ds Darmstadtium	110 Rg Roentgenium	111 Cn Copernicium	112 Nh Nihonium	113 Fl Flerovium	114 Mc Moscovium	115 Lv Livermorium	116 Ts Tennessine	117 Og Oganesson
8	<p>Superheavy Elements radioactive, never found in nature, no uses except atomic research</p>																	
	Rare Earth Metals		La Lanthanum Telescope Lenses	Ce Cerium Lighter Flints	Pr Praseodymium Torchworkers' Eyeglasses	Nd Neodymium Electric Motor Magnets	Pm Promethium Luminous Dials	Sm Samarium Electric Motor Magnets	Eu Europium Color Televisions	Gd Gadolinium MRI Diagnosis	Tb Terbium Fluorescent Lamps	Dy Dysprosium Smart Material Actuators	Ho Holmium Laser Surgery	Er Erbium Optical Fiber Communications	Tm Thulium Laser Surgery	Yb Ytterbium Scientific Fiber Lasers	Lu Lutetium Photodynamic Medicine	
	Actinide Metals		Ac Actinium Radioactive Medicine	Th Thorium Gas Lamp Mantles	Pa Protactinium Radioactive Waste	U Uranium Nuclear Power	Np Neptunium Radioactive Waste	Pu Plutonium Nuclear Weapons	Am Americium Smoke Detectors	Cm Curium Mineral Analyzers	Bk Berkelium Radioactive Waste	Cf Californium Mineral Analyzers	radioactive, never found in nature, no uses except atomic research					

The Periodic Table in pictures

Tavole Periodiche per ogni gusto

The Alchemical Table of Symbols

quintessence															essence						
universal seed	stone															borax	carbon	nitre	oxygen	anagarn	spirit
sodium	magnesium															alum	arsenical	phosphorus	sulfur	salt	sal ammoniac
potassium	calc	lime	sand	glass	clay	rust	iron	cobalt	nickel	copper	zinc	burnt alum	brass	arsenic	arsenic sulfur	scalls	rock salt				
vinegar	distilled vinegar	quicklime	caustic lime	wood	fumes	embers	steel	mercurial	verdigris	silver	cinnabar	spirit tin	tin	antimony	sulfuric acid	aqua fortis	aqua regia				
oil	oil of vitriol	vitriol	egg shell	corpse	wick	tallow	soap	scapstone	platinum	gold	mercury	spirit mercury	lead	blensuth	realgar	aqua vitae	water bath				
retort	crucible	pinch	pin	scruple	dram	ounce	pound	hour	day	night	week	month	year	spring	summer	autumn	winter				

Elements

fire	water
air	earth

**Zodiac Signs
and Processes**

**Other
Processes**

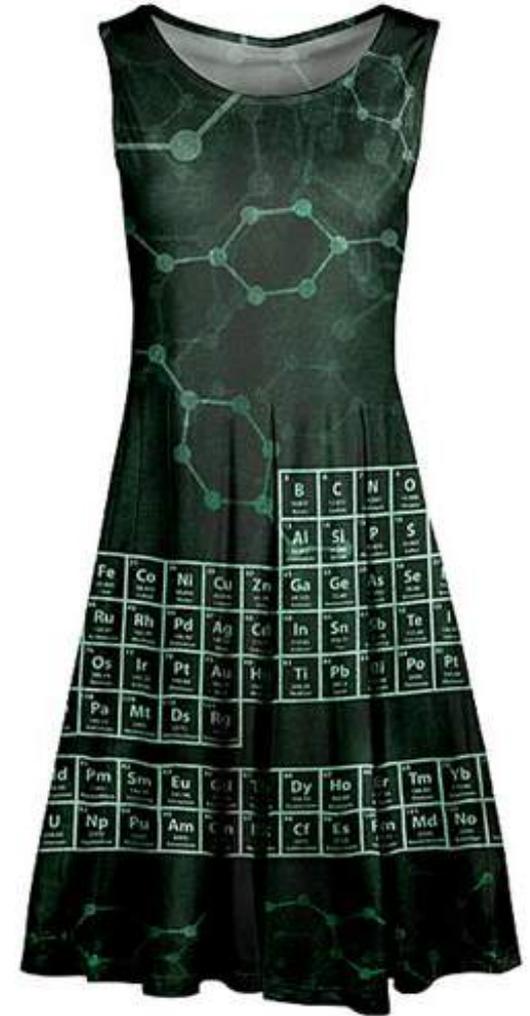
aries	taurus	gemini	cancer	leo	virgo	libra	scorpio	sagittarius	capricorn	aquarius	pisces
calcination	congelation	fixation	solution	digestion	distillation	sublimation	separation	ceration	fermentation	multiplication	projection
compos	rot	boil	solve	amalgamation	sake	purify	distill	filter	precipitate	sublimate	pulverize

Tavole Periodiche per ogni gusto

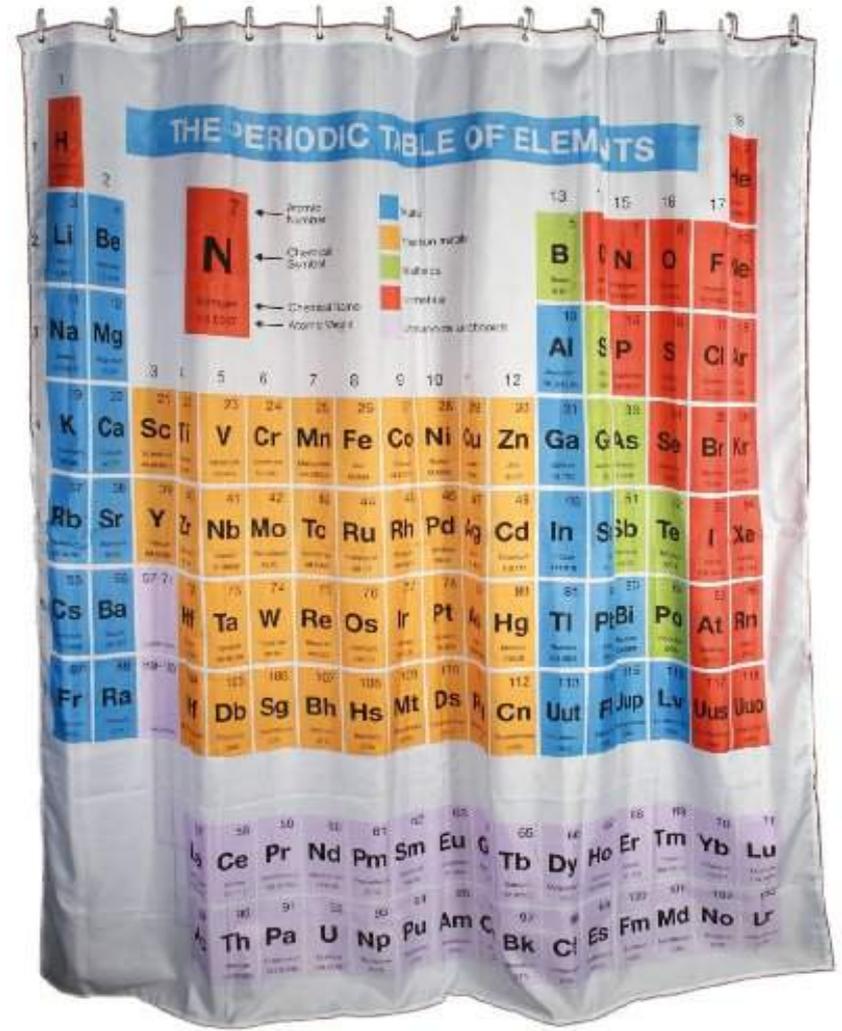
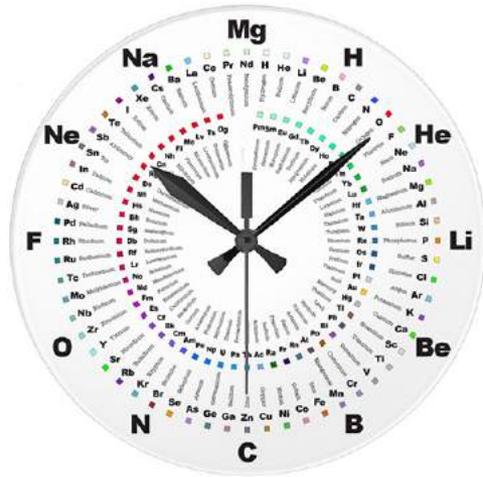
The Periodic Table by Inserting 90 Global Issues created by Kaanchi Chopra: each symbol abbreviates a relevant social problem affecting the world today

1 H Honour Killing																	2 He Health Hazards				
3 Li Lies	4 Be Beggary															5 B Bullying	6 C Climate Change	7 N Nuclear Weapons	8 O Over-population	9 F Female Foeticide	10 Ne Net Neutrality
11 Na Natural Disasters	12 Mg Micro-aggressions															13 Al Alzheimer's	14 Si Sati	15 P Paedophilia	16 S Suicides	17 Cl Child Labour	18 Ar Air Pollution
19 K Killing of girl child	20 Ca Crony Capitalism	21 Sc Skin Colour Discrimination	22 Ti Terrorism	23 V Violence	24 Cr Corruption	25 Mn Malnutrition	26 Fe Famine	27 Co Cloud Hacking	28 Ni Nepotism	29 Cu Child Abuse	30 Zn Zinc Toxicity	31 Ga Global Warming	32 Ge Gender Inequality	33 As AIDS	34 Se Slavery	35 Br Bulimia Nervosa	36 Kr Kidnapping and Ransom				
37 Rb Robbery	38 Sr Sex Ratio	39 Y Youth Unrest	40 Zr Zero Rated services	41 Nb Non-Binary Gender	42 Mo Molestation	43 Tc Tobacco-related health issues	44 Ru Reproductive Rights	45 Rh Racial Disparities in Healthcare	46 Pd Pay Discrimination	47 Ag Age-based Stereotypes	48 Cd Child Marriage	49 In Infectious Diseases	50 Sn Status of Sanitation	51 Sb Substance Abuse	52 Te Texting while driving	53 I Illiteracy	54 Xe Xenophobia				
55 Cs Caste System	56 Ba Body Shaming	71 Lu Legal understaffing	72 Hf Hungry Families	73 Ta Teen Pregnancy	74 W Water Crisis	75 Re Religious Zealotry	76 Os Orthodox Beliefs	77 Ir Intolerance	78 Pt Prostitution of children	79 Au Animal Abuse	80 Hg Human Trafficking	81 Tl Traffic Fatalities	82 Pb Police Brutality	83 Bi Binge Drinking	84 Po Poverty	85 At Airport Security	86 Rn Airborne Diseases				
87 Fr Fraud	88 Ra Rape	103 Lr LGBT Rights	104 Rf Regional Conflicts	105 Db Debt Bondage	106 Sg Same-sex Marriages	107 Bh Biological Hazards	108 Hs Hate Speech	109 Mt Mental Health	110 Ds Dowry System	111 Rg Religious Conflicts	112 Cn Chemical Weapons	113 Uut Un-touchability	114 Fl Forced Labour	115 Uup Un-employment	116 Lv Lack of universal design	117 Uus Under Utilization of Technology	118 Uuo Union Busting				

Oggetti che riproducono la Tavola Periodica

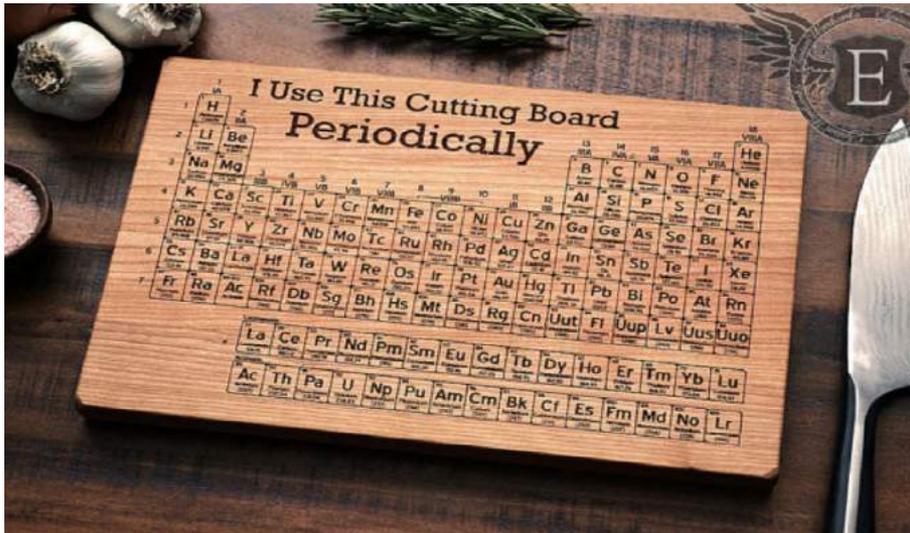


Oggetti che riproducono la Tavola Periodica

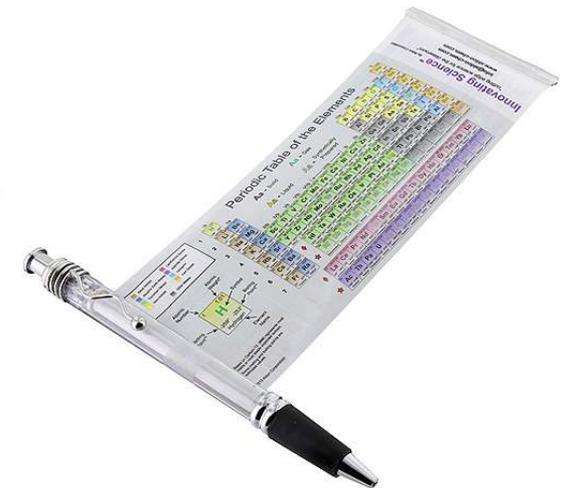
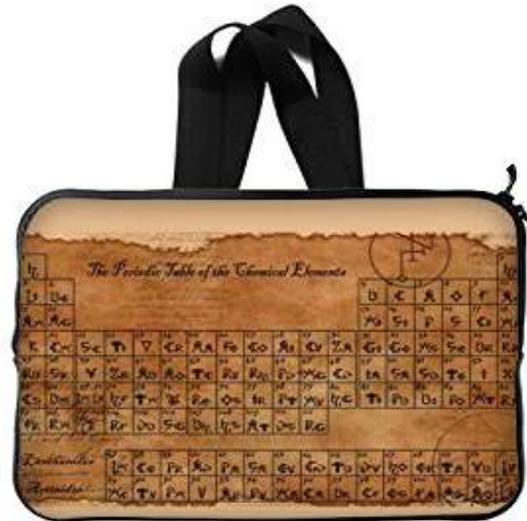
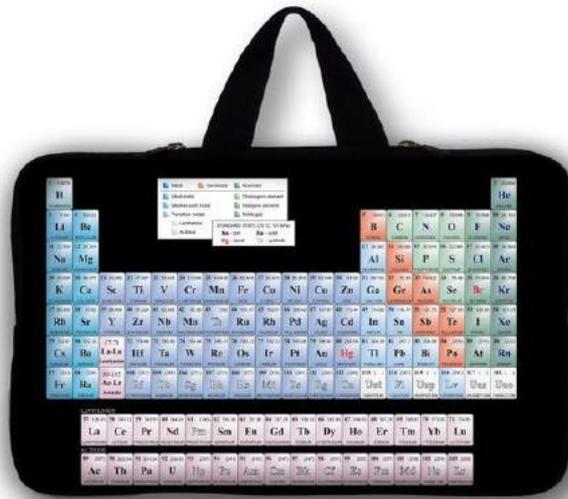
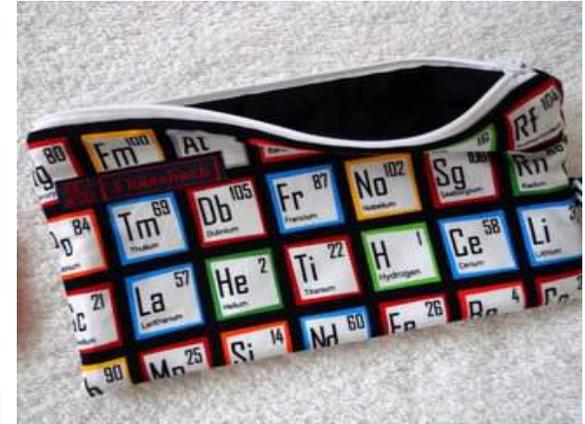
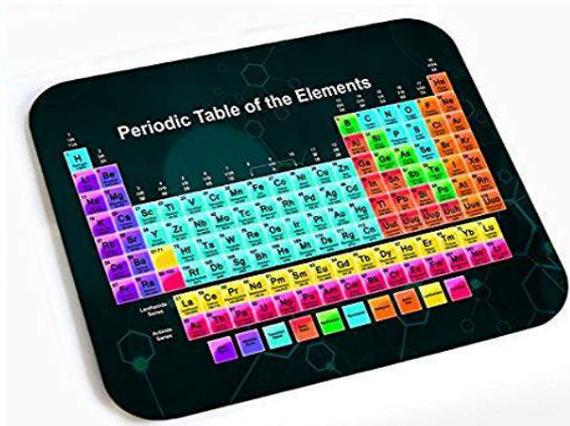
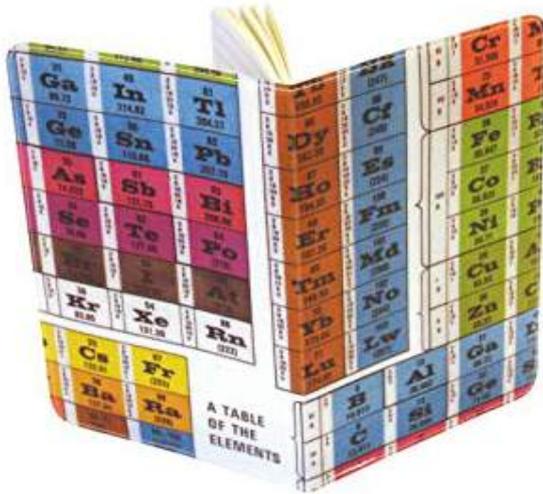


Shower curtain

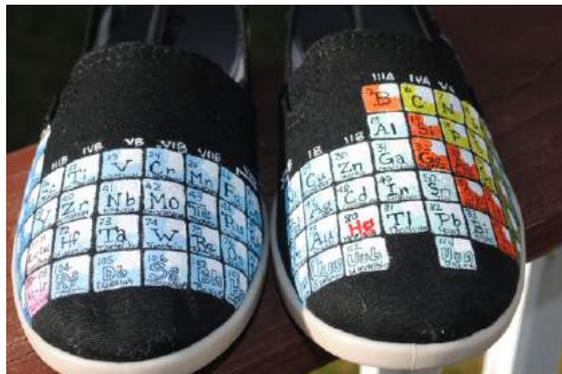
Oggetti che riproducono la Tavola Periodica



Oggetti che riproducono la Tavola Periodica



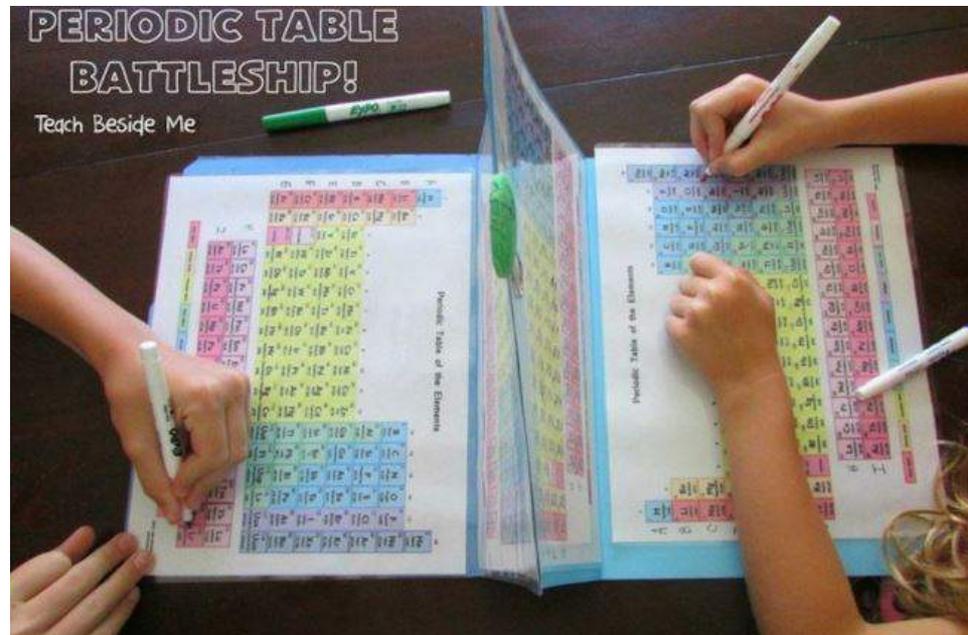
Oggetti che riproducono la Tavola Periodica



Oggetti che riproducono la Tavola Periodica



Playing cards

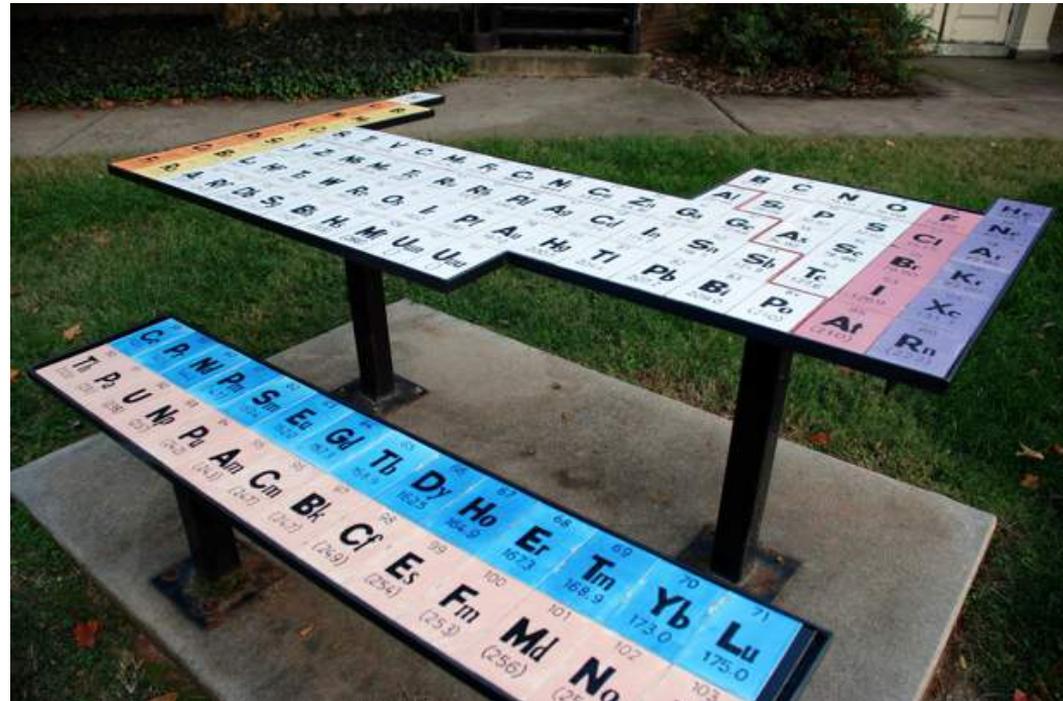


Oggetti che riproducono la Tavola Periodica



Una "dolce" Tavola Periodica da mangiare

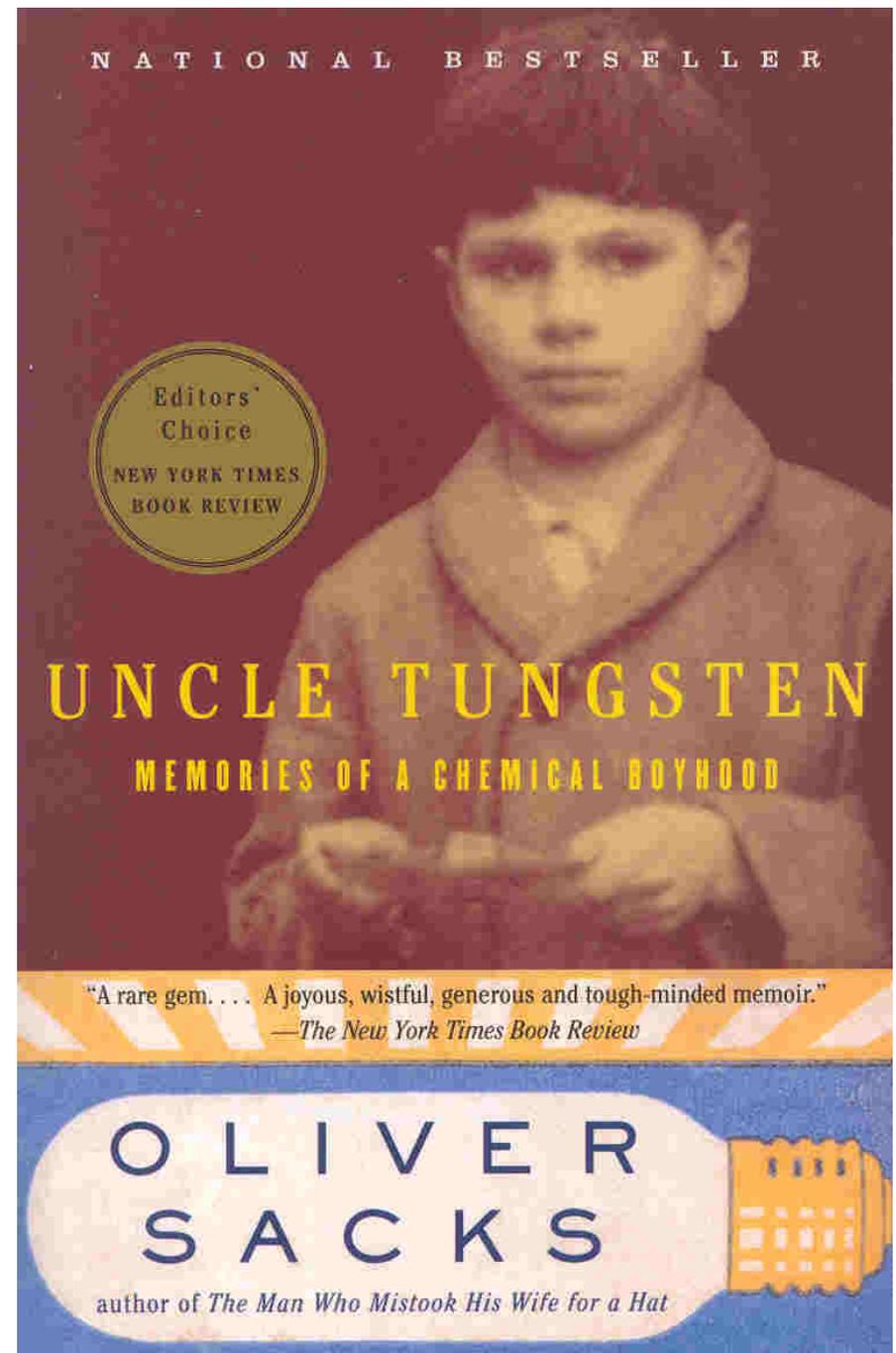
Una Tavola Periodica su cui mangiare

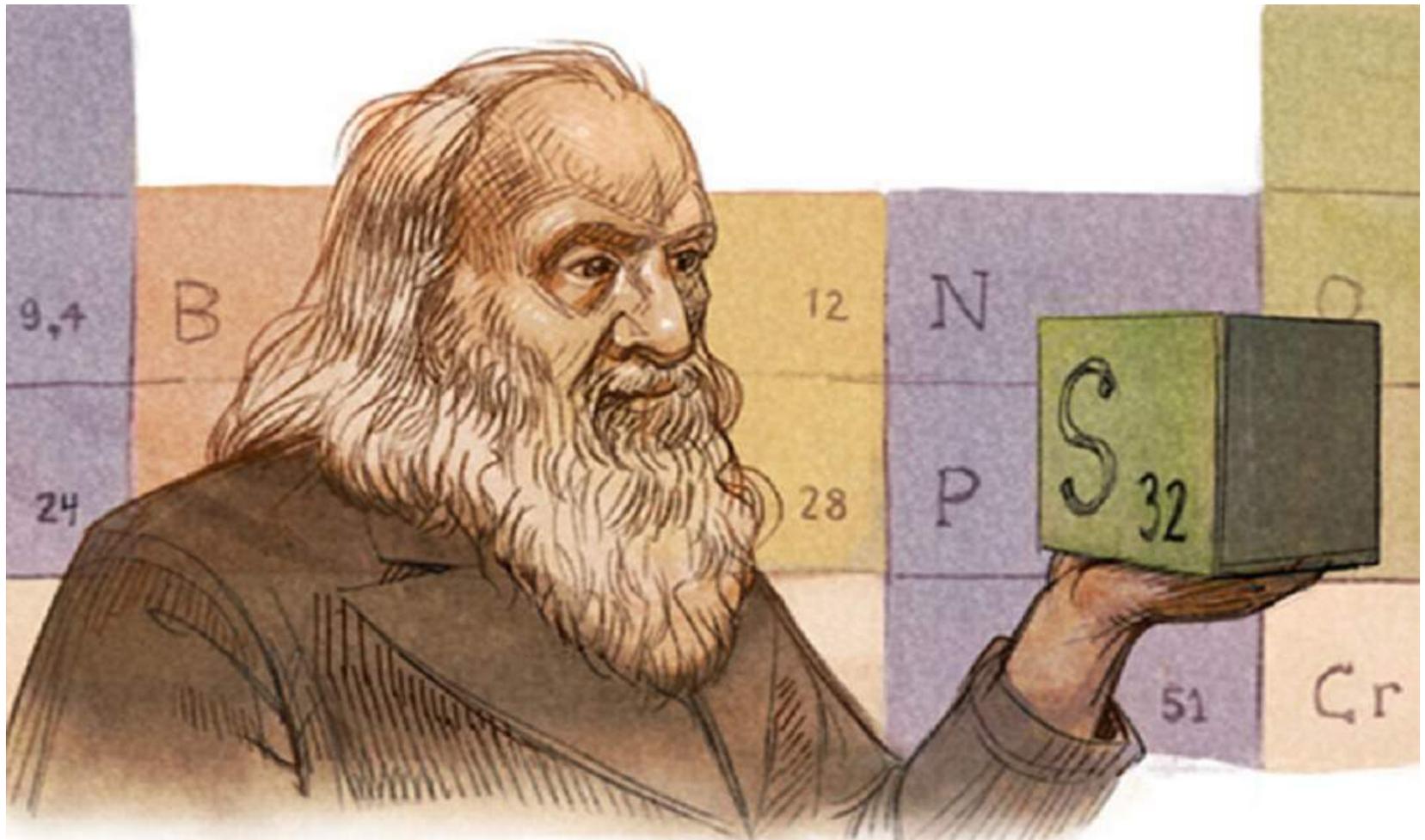


Oliver Sacks ha detto

*"La Tavola Periodica
è la scoperta più
importante nella
storia della Scienza:
ogni cosa al suo
posto*

New York Times, April 18, 1999





Dmitry Mendeleev è considerato il padre della Tavola Periodica (che lui chiamò Sistema Periodico)

Dmitry Mendeleev

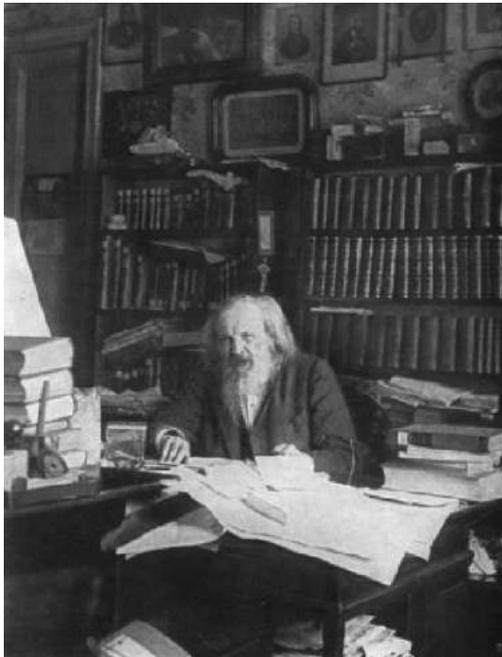
- Nasce l'8 febbraio 1834 a Verkhnie Aremzyani, in Siberia, ultimo di 17 figli
- Nel 1856 si laurea in Chimica all'Università di San Pietroburgo
- Dal 1859 al 1860 passa periodi di studio all'Università di Heidelberg in Germania, dove ha la fortuna di lavorare con Robert Bunsen
- Nel 1864 diventa professore di Tecnica Chimica all'Università di San Pietroburgo
- Nel 1865 prende il dottorato di ricerca in Chimica
- Nel 1867 diventa professore di Chimica Generale all'Università di San Pietroburgo
- Muore a San Pietroburgo il 2 febbraio 1907, forse per influenza

Ai funerali di Mendeleev partecipò un gran folla di cittadini e di studenti (con in mano una copia della Tavola Periodica in segno di tributo)



Dmitry Mendeleev è stato un chimico geniale, un fisico di primo ordine, un prolifico ricercatore in molti campi, esperto di tecnologia chimica, di chimica industriale e un economista con idee molto originali per il suo tempo

Lev Aleksandrovich Chugaen, un chimico russo



Mendeleev nella sua casa-ufficio

È stato un grande divulgatore della scienza convinto che la cultura dei cittadini dovesse essere migliorata

Si è anche interessato al sistema scolastico nazionale proponendo un rinnovamento della scuola superiore e l'istituzione nel 1871 della prima scuola per donne (dove insegnò)

Nel 1887 a Mosca per osservare un'eclissi solare salì su una mongolfiera che lo portò ad un'altezza di 3500 m (al di sopra delle nubi della città): prima di allora non aveva mai visto una mongolfiera e non sapeva come funzionasse



Si interessò alla produzione della vodka, stabilendo che una vodka di qualità doveva contenere il 40% in volume di alcol

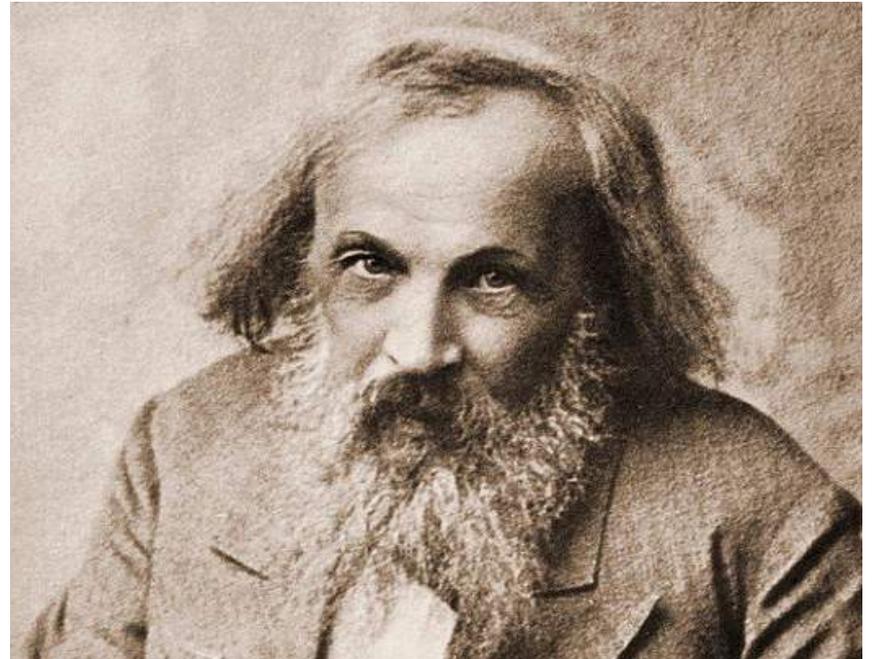


Fu a capo della Commissione per lo studio dei fenomeni spiritici: Mendeleev fu intransigente nel voler verificare sperimentalmente questi fenomeni (si fece costruire un tavolino speciale per le sedute spiritiche) arrivando alla conclusione che non esistevano le basi sperimentali per accettare lo spiritismo. Tutto però finì con un nulla di fatto!

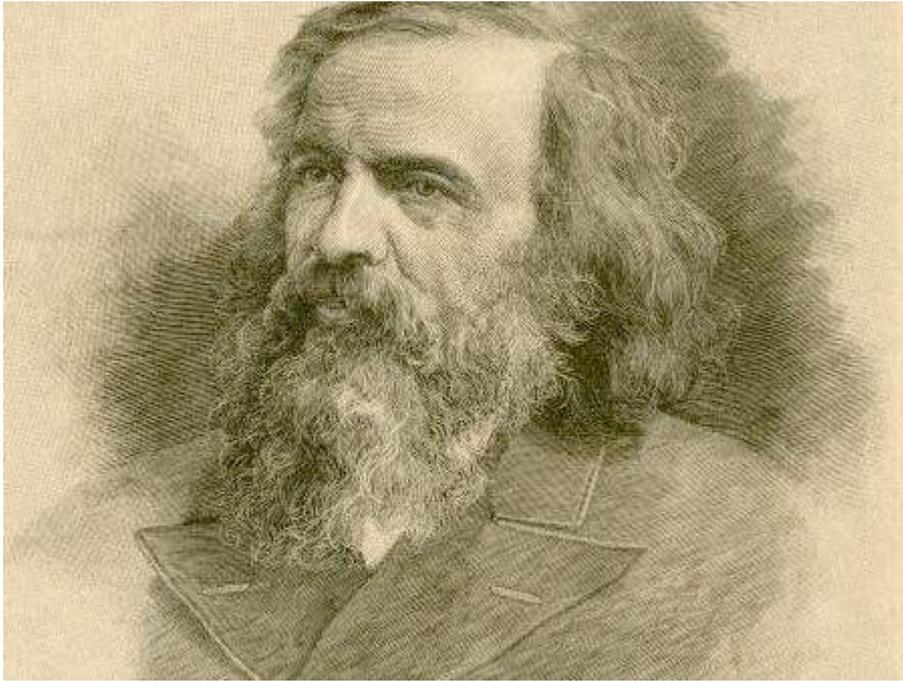


**Mendeleev disse:
*Quando uno vuole
credere, non c'è
prova scientifica che
tenga***

È stato un uomo di grande cultura, amante dell'Italia (visitò Roma, Napoli, Capri), persona senza peli sulla lingua, appassionato democratico, bigamo dichiarato, e sicuramente molto eccentrica



Pare che si facesse tagliare barba e capelli una volta all'anno da un tosapecore siberiano



Dmitry Mendeleev è considerato il padre della Tavola Periodica

Historical and Public Figures Collection
New York Public Library Archives

La costruzione della Tavola Periodica ha richiesto molto tempo e il coinvolgimento di molti scienziati



1789: Antoine Lavoisier ordinò i 33 elementi noti a quel tempo dividendoli fra gas, metalli e non metalli

In realtà ha ordinato solo 31 elementi perché ha aggiunto luce e calore che non sono elementi

192 DES SUBSTANCES SIMPLES.
TABLEAU DES SUBSTANCES SIMPLES.

	Noms nouveaux.	Noms anciens correspondans.
	Lumière.....	Lumière. Chaleur. Principe de la chaleur.
	Calorique.....	Fluide igné. Feu.
<i>Substances simples qui appartiennent aux trois règnes & qu'on peut regarder comme les élémens des corps.</i>	Oxygène.....	Matière du feu & de la chaleur. Air déphlogistiqué. Air empiréal. Air vital. Base de l'air vital. Gaz phlogistiqué.
	Azote.....	Mofete. Base de la mofete.
	Hydrogène.....	Gaz inflammable. Base du gaz inflammable.
	Soufre.....	Soufre.
	Phosphore.....	Phosphore.
	Carbone.....	Charbon pur.
<i>Substances simples non métalliques oxidables & acidifiables.</i>	Radical muriatique.	Inconnu.
	Radical fluorique..	Inconnu.
	Radical boracique..	Inconnu.
	Antimoine.....	Antimoine.
	Argent.....	Argent.
	Arsenic.....	Arsenic.
	Bismuth.....	Bismuth.
	Cobalt.....	Cobalt.
	Cuivre.....	Cuivre.
	Etain.....	Etain.
<i>Substances simples métalliques oxidables & acidifiables.</i>	Fer.....	Fer.
	Manganèse.....	Manganèse.
	Mercure.....	Mercure.
	Molybdène.....	Molybdène.
	Nickel.....	Nickel.
	Or.....	Or.
	Platine.....	Platine.
	Plomb.....	Plomb.
	Tungstène.....	Tungstène.
	Zinc.....	Zinc.
	Chaux.....	Terre calcaire, chaux.
	Magnésie.....	Magnésie, base du sel d'Épsum.
	Baryte.....	Barote, terre pesante.
<i>Substances simples salifiables terreuses.</i>	Alumine.....	Argile, terre de l'alun, base de l'alun.
	Silice.....	Terre siliceuse, terre vitrifiable.

1829: le Triadi di Dobereiner

Johann Dobereiner individuò delle "triadi" di elementi, cioè sequenze di tre elementi in cui quello centrale aveva un peso atomico medio fra quello del primo e del terzo elemento

Atomic Mass (1850)

Li	7	}	$\frac{7 + 39}{2} = 23$
Na	23		
K	39		
Ca	40	}	$\frac{40 + 137}{2} = 88.5$
Sr	87		
Ba	137		
P	31	}	$\frac{31 + 122}{2} = 76.5$
As	75		
Sb	122		
S	32	}	$\frac{32 + 128}{2} = 80$
Se	78		
Te	128		
Cl	35.5	}	$\frac{35.5 + 127}{2} = 81.25$
Br	80		
I	127		

Atomic Number

Li	3	}	$\frac{3 + 19}{2} = 11$
Na	11		
K	19		
Ca	20	}	$\frac{20 + 56}{2} = 38$
Sr	38		
Ba	56		
P	15	}	$\frac{15 + 51}{2} = 33$
As	33		
Sb	51		
S	16	}	$\frac{16 + 52}{2} = 34$
Se	34		
Te	52		
Cl	17	}	$\frac{17 + 53}{2} = 35$
Br	35		
I	53		



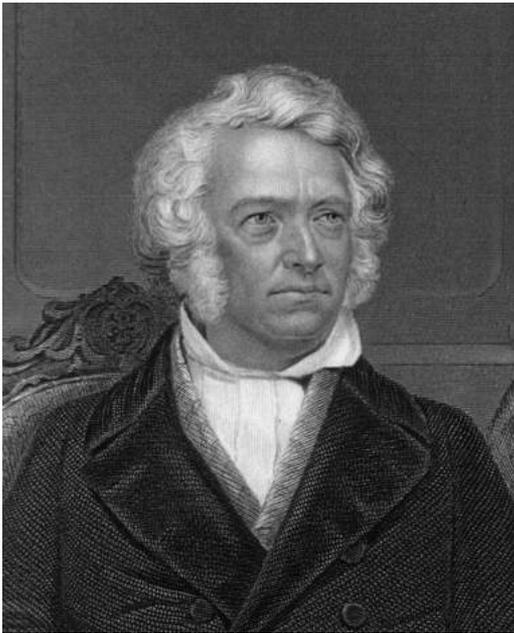
H						He	
Li	Be	B	C	N	O	F	Ne
Na	Mg	Al	Si	P	S	Cl	Ar
K	Ca	Ga	Ge	As	Se	Br	Kr
Rb	Sr	In	Sn	Sb	Te	I	Xe
Cs	Ba	Tl	Pb	Bi	Po	At	Rn



1836: Jöns Jacob Berzelius
(chimico svedese molto influente
nella prima metà del 1800 a cui si
deve l'introduzione dei simboli
chimici) ordinò gli elementi in una
tavola in base all'elettronegatività

Electrochemische Theorie.

Sauerstoff,	Palladium,
Schwefel,	Quecksilber,
Stickstoff,	Silber,
Fluor,	Kupfer,
Chlor,	Uran,
Brom,	Wismuth,
Jod,	Zinn,
Selen,	Blei,
Phosphor,	Cadmium,
Arsenik,	Kobalt,
Chrom,	Nickel,
Vanadium,	Eisen,
Molybdän,	Zink,
Wolfram,	Mangan,
Bor,	Cerium,
Kohlenstoff,	Thorium,
Antimon,	Zirconium,
Tellur,	Aluminium,
Tantal,	Yttrium,
Titan,	Beryllium,
Kiesel,	Magnesium,
Wasserstoff.	Calcium,
—	Strontium,
Gold,	Barium,
Osmium,	Lithium,
Iridium,	Natrium,
Platin,	Kalium.
Rhodium,	

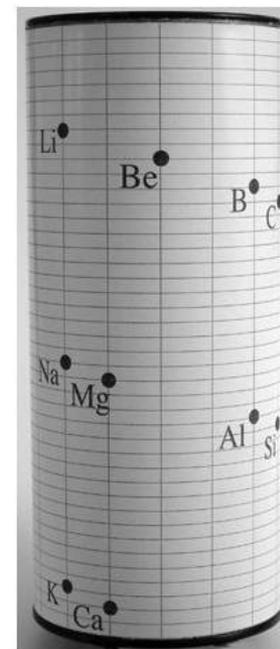
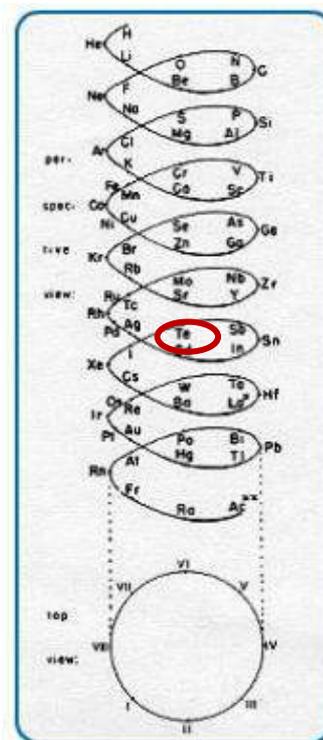
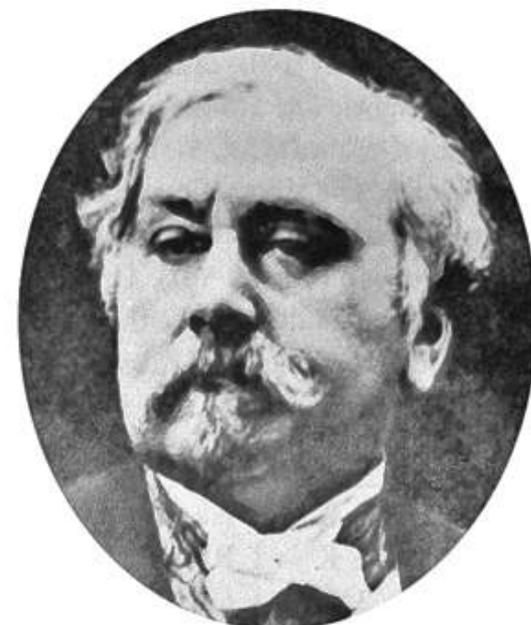


1843: il sistema di Leopold Gmelin

		O		N		H			
F	Cl	Br	I			Li	Na	K	
	S	Se	Te			Mg	Ca	Sr	Ba
	P	As	Sb			Be	Ce	La	
	C	B	Bi			Zr	Th	Al	
		Ti	Ta	W		Sn	Cd	Zn	
		Mo	V	Cr	U	Mn	Ni	Fe	
			Bi	Pb	Ag	Hg	Cu		
		Os	Ir	Rh	Pt	Pd	Au		

1862: Alexandre-Émile Béguyer de Chancourtois

Si tratta del primo tentativo di trovare un ordine in base al peso atomico: gli elementi sono posti a spirale su un cilindro metallico diviso in 16 parti. Poichè l'elemento tellurio è posto al centro, questo sistema prende il nome di *elica tellurica*



1862: Lothar Meyer

Lothar Meyer propose una tavola di soli 28 elementi ordinati secondo il peso atomico crescente: gli elementi erano raggruppati in righe verticali secondo la loro valenza

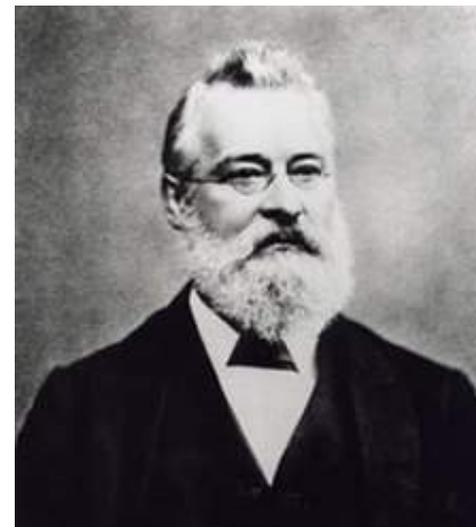
Eric Scerri: The Periodic Table: A Very Short Introduction



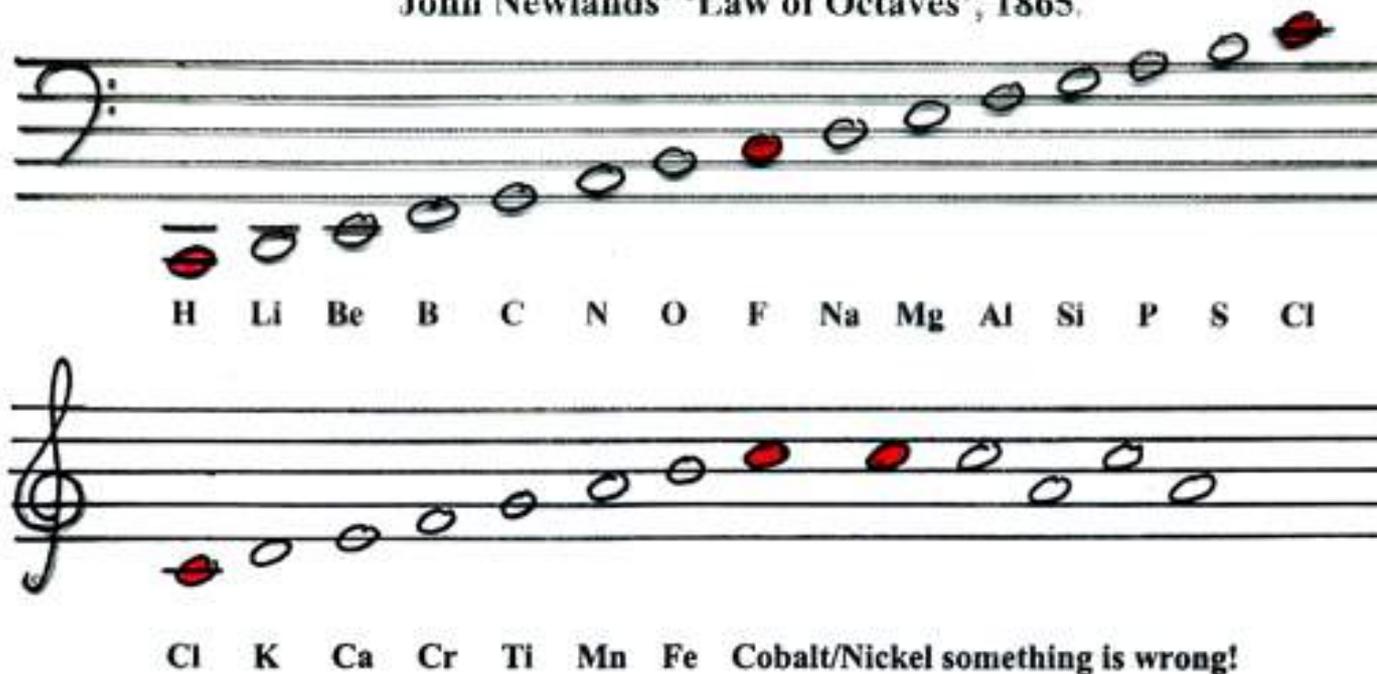
	4 werthig	3 werthig	2 werthig	1 werthig	1 werthig	2 werthig
	---	---	---	---	Li = 7.03	(Be = 9.3?)
Differenz =	---	---	---	---	16.02	(14.7)
	C = 12.0	N = 14.04	O = 16.00	Fl = 19.0	Na = 23.05	Mg = 24.0
Differenz =	16.5	16.96	16.07	16.46	16.08	16.0
	Si = 28.5	P = 31.0	S = 32.07	Cl = 35.46	K = 39.13	Ca = 40.0
Differenz =	$\frac{89.1}{2} = 44.55$	44.0	46.7	44.51	46.3	47.6
	---	As = 75.0	Se = 78.8	Br = 79.97	Rb = 85.4	Sr = 87.6
Differenz =	$\frac{89.1}{2} = 44.55$	45.6	49.5	46.8	47.6	49.5
	Sn = 117.6	Sb = 120.6	Te = 128.3	I = 126.8	Cs = 133.0	Ba = 137.1
Differenz =	89.4 = 2 x 44.7	87.4 = 2 x 43.7	---	---	(71 = 2 x 35.5)	---
	Pb = 207.0	Bi = 208.0	---	---	(Tl = 204?)	---

1865: le Ottave di John Newlands

Newlands ordinò gli elementi all'aumentare del peso atomico in gruppi di sette, cominciando una nuova riga con l'ottavo elemento: il primo elemento di ciascuna riga aveva proprietà chimiche simili



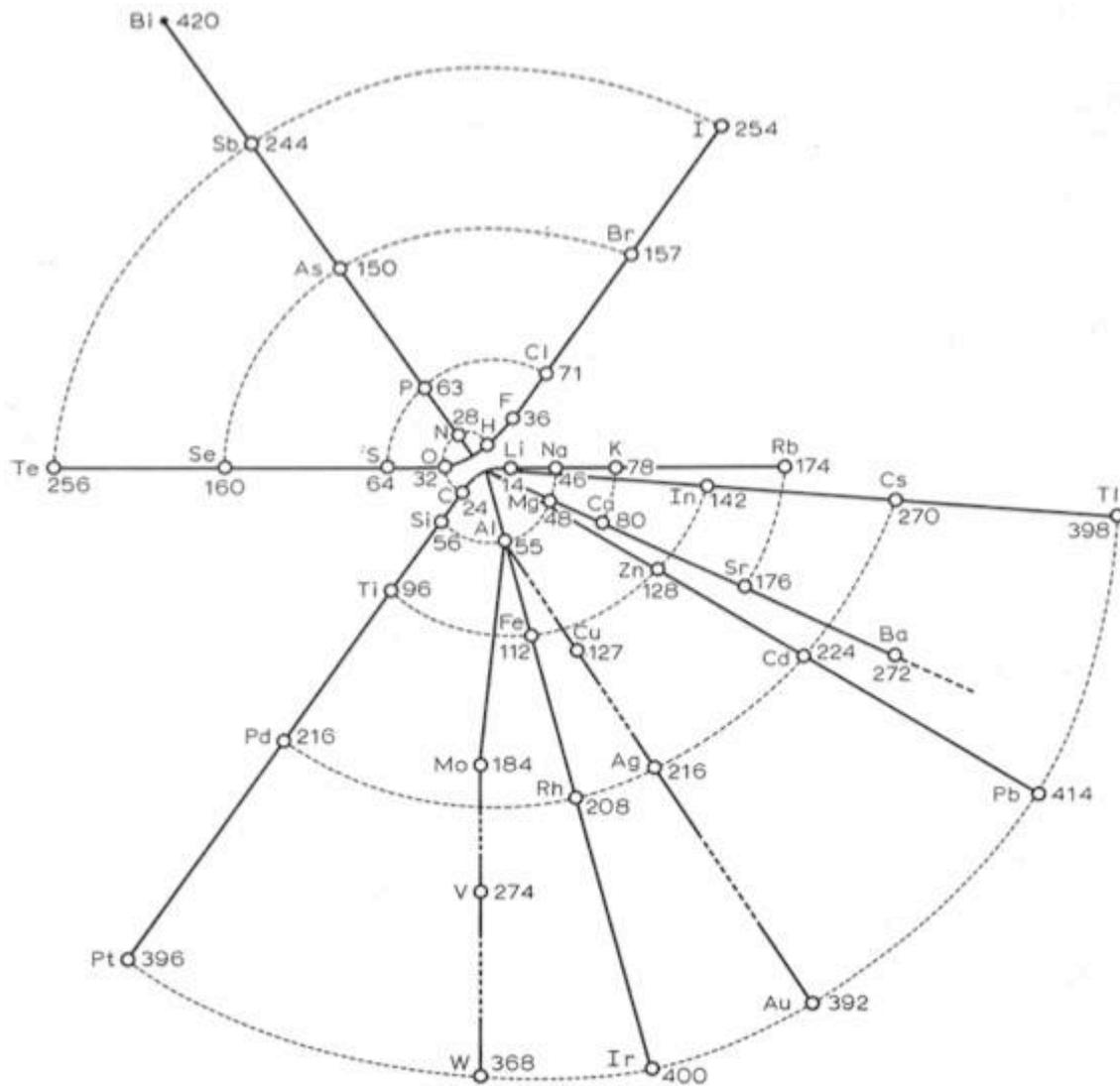
John Newlands' 'Law of Octaves', 1865.



H Li Be B C N O F Na Mg Al Si P S Cl

Cl K Ca Cr Ti Mn Fe Cobalt/Nickel something is wrong!

1867: la spirale di Gustavus Hinrichs



1868: la tavola "persa" di Lothar Meyer

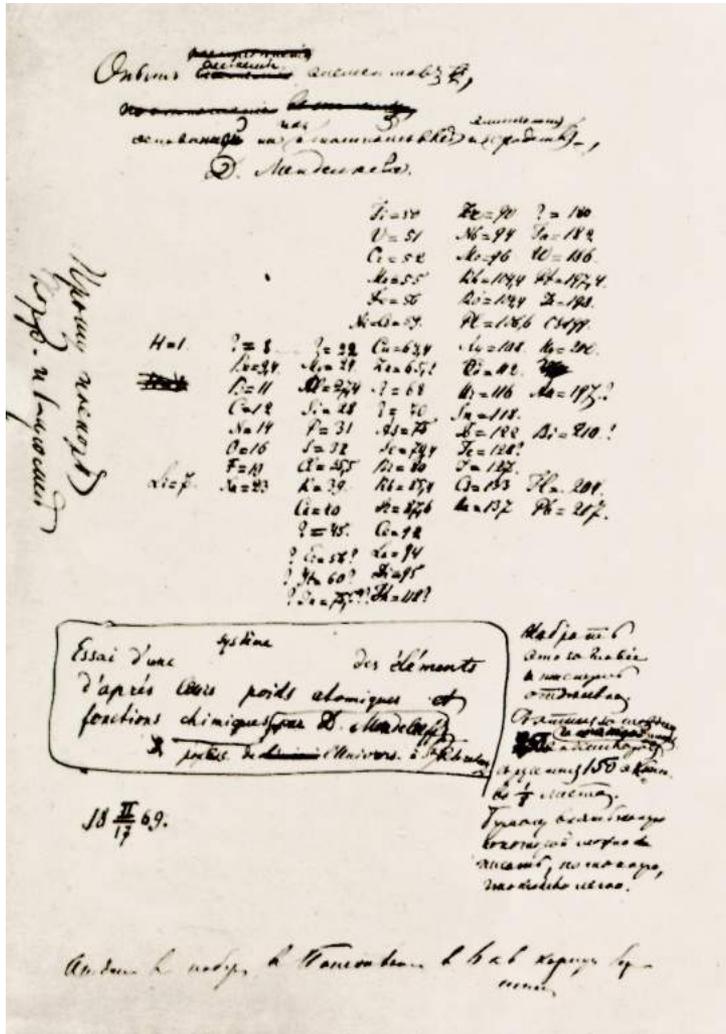
Lothar Meyer preparò una tavola contenente 53 elementi ordinati in base al peso atomico da pubblicare in un suo libro del 1868: purtroppo l'editore perse la tavola che fu resa pubblica solo dopo la morte di Meyer avvenuta nel 1895

Eric Scerri: The Periodic Table: A Very Short Introduction

1 Cr=52.6	2 Mn=55.1 49.2 Ru=104.3 92.8=2.46.4 Pt=197.1	3 Al=27.3 2 $\frac{1}{2}$ Al=14.8 Fe=56.0 48.9 Rh=103.4 92.8=2.46.4 Ir=197.1	4 Al.=27.3 Co=58.7 47.8 Pd=106.0 93=2.465 Os=199.	5 Ni=58.7	6 Cu=63.5 44.4 Ag=107.9 88.8=2.44.4 Au=196.7	7 Zn=65.0 46.9 Cd=111.9 88.3=2.44.5 Hg=200.2	8 C=12.00 16.5 Si=28.5 2 $\frac{1}{2}$ Si=44.5 2 $\frac{1}{2}$ Si=44.5 Sn=117.6 89.4=2.41.7 Pb=207.0
9 N=14.4 16.96 P=31.0 44.0 As=75.0 45.6 Sb=120.6 87.4=2.43.7 Bi=208.0	10 O=16.00 16.07 S=32.07 46.7 Se=78.8 49.5 Te=128.3	11 F=19.0 16.46 Cl=35.46 44.5 Br=79.9 46.8 I=126.8	12 Li=7.03 16.02 Na=23.05 16.08 K=39.13 46.3 Rb=85.4 47.6 Cs=133.0 71=2.35.5 Te=204.0	13 Be=9.3 14.7 Mg=24.0 16.0 Ca=40.0 47.6 Sr=87.6 49.5 Ba=137.1	14 Ti=48 42.0 Zr=90.0 47.6 Ta=137.6	15 Mo.=92.0 45.0 Vd=137.0 47.0 W=184.0	

1869: la prima Tavola Periodica di Mendeleev

(gli elementi sono ordinati in funzione del peso atomico crescente da sinistra a destra e dall'alto verso il basso)



ОПЫТЪ СИСТЕМЫ ЭЛЕМЕНТОВЪ, ОСНОВАННОЙ НА ИХЪ АТОМНОМЪ ВѢСѢ И ХИМИЧЕСКОМЪ СХОДСТВѢ.

	Ti=50	Zr=90	?=180.		
	V=51	Nb=94	Ta=182.		
	Cr=52	Mo=96	W=186.		
	Mn=55	Rh=104,4	Pt=197,1.		
	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=27,3	?=68	U=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	I=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?			

Д. Менделѣевъ

1870: la Tavola Periodica di Lothar Meyer

Table from *Annalen der Chemie, Supplementband 7*, 354 (1870).

Periodic table according to Lothar Meyer, 1870

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
	B=11,0	Al=27,3		--		?In=113,4	Tl=202,7	
	C=11,97	Si=28	--		--		--	Pb=206,4
	N=14,01	P=30,9	Ti=48		As=74,9	Zr=89,7	--	Bi=207,5
	O=15,96	31,98	V=51,2		Nb=93,7		Ta=182,2	
			Cr=52,4		Se=78	Te=128?	--	
--	F=19,1	Cl=35,38			Mo=95,6		W=183,5	
			Mn=54,8		Br=79,75	J=126,5	--	
			Fe=55,9			Ru=103,5	Os=198,6 ?	
			Co=Ni=58,6			Rh=104,1	Ir=196,7	
Li=7,01	Na=22,99	K=39,04				Pd=106,2	Pt=196,7	
					Rb=85,2		Cs=132,7	--
			Cu=63,3			Ag=107,66	Au=196,2	
?Be=9,3	Mg=23,9	Ca=39,9			Sr=87,0		Ba=136,8	--
			Zn=64,9			Cd=111,6	Hg=199,8	

1871: l'ultima versione della Tavola Periodica di Mendeleev

Reihen	Gruppe I. — R ¹ 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	—=44	Ti=48	V=51	Cr=52	Mn=55	Fe=56, Co=59, Ni=59, Cu=63.
5	(Cu=63)	Zn=65	—=68	—=72	As=75	Se=78	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	?Di=138	?Ce=140	—	—	—	— — — —
9	(—)	—	—	—	—	—	—	
10	—	—	?Er=178	?La=180	Ta=182	W=184	—	Os=195, Ir=197, Pt=198, Au=199.
11	(Au=199)	Hg=200	Tl=204	Pb=207	Bi=208	—	—	
12	—	—	—	Th=231	—	U=240	—	— — — —

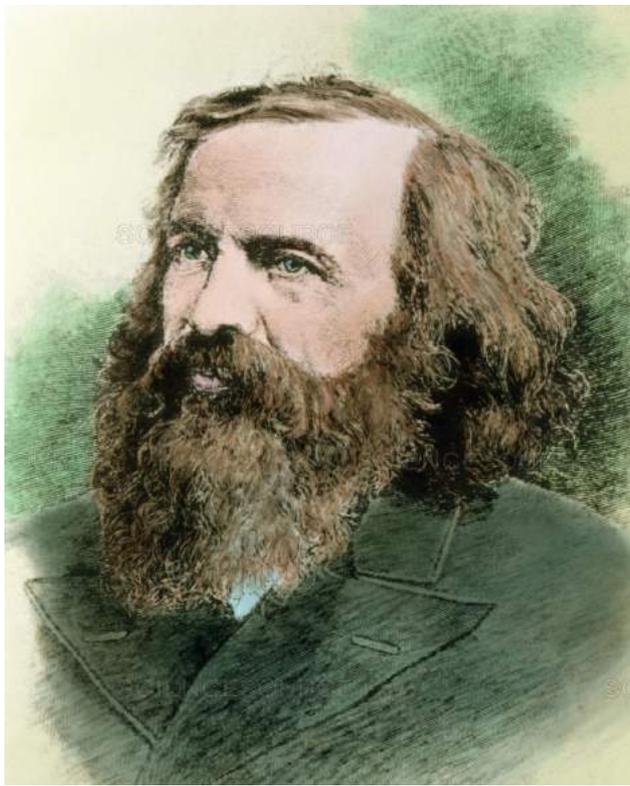
Le righe orizzontali sono interrotte in modo tale che gli elementi di ciascuna colonna presentano stessa valenza ed hanno proprietà chimiche simili

1871: l'ultima versione della Tavola Periodica di Mendeleev

ЕСТЕСТВЕННАЯ СИСТЕМА ЭЛЕМЕНТОВЪ Д. МЕНДЕЛѢЕВА.

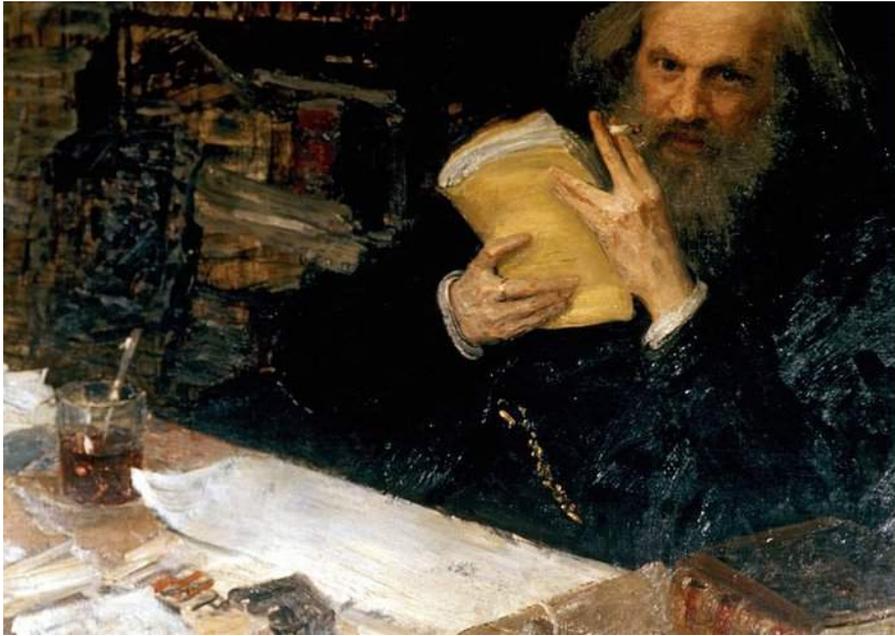
		Группа I.	Группа II.	Группа III.	Группа IV.	Группа V.	Группа VI.	Группа VII.	Группа VIII. (септетиъ изъ I)	II=I IX			
Всѣмъ означенъ образующій составъ:		R'O	R'O или RO	R'O ²	R'O ² или RO ²	R'O ²	R'O ² или RO ²	R'O ²	R'O ² или RO ²				
Точнѣе:		H=1 H ² O, NH ₃ Cl, H ² N, H ² C, BOH.			RH ¹	RH ²	RH ²	RH					
Периодъ I-й. Периодъ 2-й. Периодъ 3-й. Периодъ 4-й. Периодъ 5-й. Периодъ 6-й. Периодъ 7-й. Периодъ 8-й.	Рядъ 1.	Li=7 LiCl, LiOH, Li ₂ O, LiX, Li ₂ CO ₃	Be=9, ¹ BeCl ₂ BeO, Be ² Al ³ Si ⁴ O ₁₂	B=11 BCl, B ² O, BN, B ² Na ³ O, BF ₃	C=12 CH ₄ C ² H ² ... CO, CO ₂ CO ² M ²	N=14 NH ₃ N ² Cl, N ² O, NO, NO ² NO ² NM ²	O=16 OH ² O ² C, O ² HO, OM ² O ² R, HOH	F=19 FH, BF, SF ₂ , CaF ₂ KF, KF ²	* Это твердое, халкогенное изъ соед. * Это газообразное или жидкое. M=K, Ag... M ² =Ca, Pb... X=Cl, NO, OH, OM... X ² =SO ₂ CO ² , O ₂ ...				
	Рядъ 2.	Na=23 NaCl, NaHO, Na ² O, Na ² SO ₄ Na ² CO ²	Mg=24 MgCl ₂ MgO, MgCO ₂ MgSO ₄ Mg ² H ² PO ₄	Al=27, ³ Al ³ Cl ₃ Al ³ O ₂ KAIS ³ O ² Al ³ H ² O.	Si=28 SH ₄ SiCl ₄ Si ² F ² KABS ² O ₂ SiO ₂	P=31 PH ₃ PCl ₃ PH ₃ P ² O ² H ² O ² , Ca ² P ² O ₇	S=32 SH ₂ (SM ² S ² M ²) SO ₂ (SO ² X)(Ba ² SO ₄)	Cl=35, ⁵ ClH, ClM, ClCl, ClOH, ClO ² H, AgCl	Fe=56 Fe ² O ² :Fe ² Si Fe ² O ² :Fe ² O ² FeK ² Oy ²	Co=59 CoX ₂ CoX ² CoX ² 5NH ² CoK ² Oy ²	Ni=59 NiX ₂ NO, NiSO ² NH ² O NiK ² Oy ²	Cu=63 CuX, CuX ₂ Cu ₂ H, Cu ² O, CuO, CuKCy ²	
	Рядъ 3.	K=39 KCl, KOH, K ² O, KNO ₃ K ² CO ₃ K ² SO ₄	Ca=40 CaSO ₄ CaO ₂ SiO ₂ CaCl ₂ CaO, CaCO ₂	Zn=65 ZnCl ₂ ZnO, ZnCO ₂ ZnSO ₄ ZnEt ₂	Ti=48(50 ¹) TiCl ₂ TiO ₂ Ti ² O ₃ FeTiO ₂ TiSO ₄ ²	V=51 VOCl ₂ V ² O ₃ VO ₂ Pb ² V ² O ₃ VO ₂	Cr=52 CrCl ₂ CrCl ₃ Cr ² O ₃ CrO ₂ K ² CrO ₄ Cr ² O ₇ Cl ₂	Mn=55 MnK ² O ² MnO ² MnCl ₂ MnO, MnO ₂	Br=80 BrH, BrM, BrO ² M, BrAg ₂	Ru=104 RuO ₂ RuCl ₂ RuO ₂ RuCl ₂ RuK ² Oy ²	Rh=104 Rh ² O ₂ RhCl ₂ RhK ² Oy ²	Pd=106 PdH ₂ h ₂ O, PdCl ₂ PdCl ₂ PdK ² Oy ²	Ag=108 AgX, AgCl ₂ AgNO ₃ AgX AgCl, Ag ² O, AgKCy ²
	Рядъ 4.	Rb=85 RbCl, RbOH, Rb ² PtCl ₂	Sr=87 SrCl ₂ SrO, SrH ² O ² SrSO ₄ SrCO ₂	In=113 InCl ₂ In ² O ₂	Sb=122 SbCl ₂ Sb ² O ₃ Sb ² F ² Sb ² O ₃ Sb ² S ² SiO ₂	Te=125(128 ¹) TeH ₂ TeCl ₂ TeO ₂ TeO ² M ² TeM ₂	I=127 IH, IAg, IHO, IHO ₂ IHgI ₂ IKI						
	Рядъ 5.	Cs=133 CsCl, CsOH, Cs ² PtCl ₂	Ba=137 BaCl ₂ BaH ² O ² BaO BaSO ₄ BaSiF ₆	Ce=140(132 ²) CeCl ₂ Ce ² O ₂ CeO ₂ CeX ₂ CeX ₂ (CeK ² X ²)									
	Рядъ 6.												
	Рядъ 7.												
	Рядъ 8.												
Рядъ 9.													
Рядъ 10.													

Prima stampa dell'ultima versione della Tavola Periodica conservata nella Casa-Museo di Mendeleev a San Pietroburgo



Dmitry Mendeleev è considerato il padre della Tavola Periodica

Ha usato la sua tavola per predire l'esistenza e le proprietà di elementi a quel tempo sconosciuti lasciando delle caselle vuote in opportune posizioni

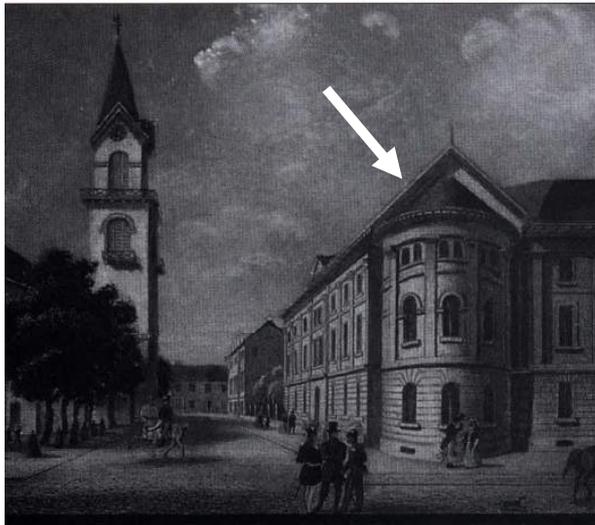


Dmitry Mendeleev è considerato il padre della Tavola Periodica

Nel "pensare" la sua Tavola Periodica Mendeleev non ha seguito pedissequamente l'ordine predetto dal peso atomico, invertendo la posizione di alcuni elementi

Primo Congresso Internazionale di Chimica settembre 1860, Karlsruhe (Germania)

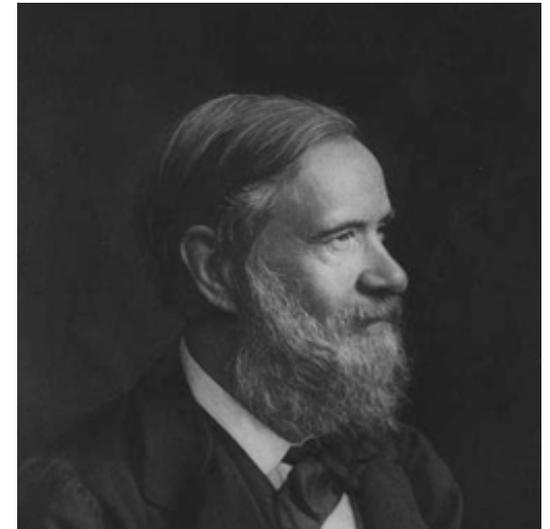
La partecipazione di Mendeleev a questo congresso, dove incontrò Cannizzaro, è stata decisiva per lo sviluppo del suo pensiero sulla legge periodica



Ständehaus (destra) dove si è tenuto il Congresso del 1860



La sala dove si è tenuto il Congresso del 1860

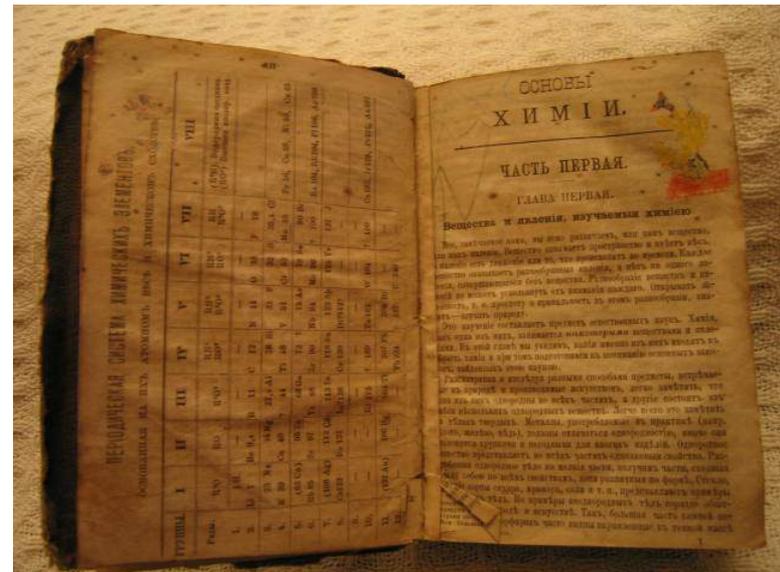


Stanislo Cannizzaro,
chimico palermitano
(1826 - 1910)

La Tavola Periodica è nata anche per esigenze didattiche

Mendeleev era convinto che la difficoltà nel capire la chimica derivasse dalla mancanza di una chiara classificazione degli elementi:

“noi offriamo agli studenti solo dettagli sui componenti della materia, senza dare una visione d'insieme che permette di capire le relazioni fra le varie sostanze”



Alcuni libri di Chimica scritti da Mendeleev

Mendeleev era solito dire di essere stato ispirato per la costruzione della Tavola Periodica dal gioco di carte chiamato solitario e aver avuto tanta pazienza



Lo studio di Mendeleev nel Collegio dei Dodici all'Università di San Pietroburgo

Mendeleev ha detto anche:

Ho visto in un sogno una tavola dove tutti gli elementi trovavano il loro posto. Una volta sveglio, ho scritto immediatamente questa tavola su un pezzo di carta

La Tavola Periodica è un documento "vivo" che continua a crescere: nuovi elementi vengono scoperti

Series	Zero Group	Group I	Group II	Group III	Group IV	Group V	Group VI	Group VII	Group VIII			
0	x											
1	y	Hydrogen H=1.008										
2	Helium He=4.0	Lithium Li=7.03	Beryllium Be=9.1	Boron B=11.0	Carbon C=12.0	Nitrogen N=14.04	Oxygen O=16.00	Fluorine F=19.0				
3	Neon Ne=19.9	Sodium Na=23.05	Magnesium Mg=24.1	Aluminium Al=27.0	Silicon Si=28.4	Phosphorus P=31.0	Sulphur S=32.06	Chlorine Cl=35.45				
4	Argon Ar=38	Potassium K=39.1	Calcium Ca=40.1	Scandium Sc=44.1	Titanium Ti=48.1	Vanadium V=51.4	Chromium Cr=52.1	Manganese Mn=55.0	Iron Fe=55.9	Cobalt Co=59	Nickel Ni=59	(Cu)
5		Copper Cu=63.6	Zinc Zn=65.4	Gallium Ga=70.0	Germanium Ge=72.3	Arsenic As=75.0	Selenium Se=79	Bromine Br=79.85				
6	Krypton Kr=81.8	Rubidium Rb=85.4	Strontium Sr=87.6	Yttrium Y=89.0	Zirconium Zr=90.6	Niobium Nb=94.0	Molybdenum Mo=96.0		Ruthenium Ru=101.7	Rhodium Rh=103.0	Palladium Pd=106.5	(Ag)
7		Silver Ag=107.9	Cadmium Cd=112.4	Indium In=114.0	Tin Sn=119.0	Antimony Sb=120.0	Tellurium Te=127	Iodine I=127				
8	Xenon Xe=128	Cesium Cs=132.9	Barium Ba=137.4	Lanthanum La=139	Cerium Ce=140				--	--	--	(-)
9												
10				Ytterbium Yb=173		Tantalum Ta=183	Tungsten W=184		Osmium Os=191	Iridium Ir=193	Platinum Pt=194.9	(Au)
11		Gold Au=197.2	Mercury Hg=200.0	Thallium Tl=204.1	Lead Pb=206.9	Bismuth Bi=208						
12			Radium Ra=224		Thorium Th=232		Uranium U=239					

Nel 1904 Mendeleev inserisce i gas nobili nella sua tavola

La "Tavola Periodica" ha cominciato a "popolarsi" a partire dal 1718, anno in cui furono scoperti i primi elementi: è una storia che copre 300 anni

Un video che dura 99 secondi:
<https://youtu.be/7kCCWWtCrpA>

300 years of element discovery

1718

			6 C Ancient	
			15 P 1669	16 S Ancient
			33 As 1250	
			80 Sn 2100 BCE	81 Sb 1600 BCE
			82 Pb Ancient	83 Bi 1500
	26 Fe 3500 BCE			
		29 Cu Ancient		
		47 Ag 3000 BCE		
		79 Au 3000 BCE	80 Hg 1500	

Transition metals

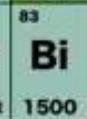
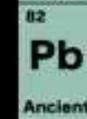
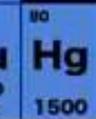
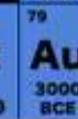
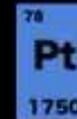
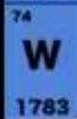
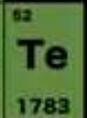
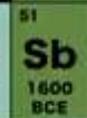
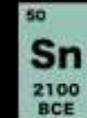
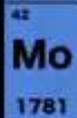
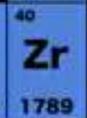
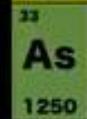
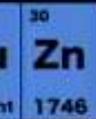
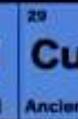
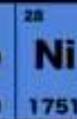
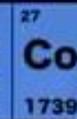
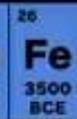
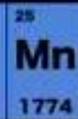
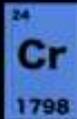
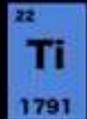
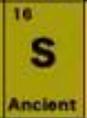
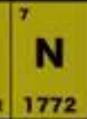
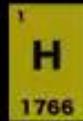
Post-transition metals

Metalloids

Other non-metals

300 years of element discovery

1800



Alkaline earth metals

Lanthanides

Transition metals

Post-transition metals

Metalloids

Other non-metals

Halogens

300 years of element discovery

1910

1 H 1766																	2 He 1895				
3 Li 1817	4 Be 1797															5 B 1808	6 C Ancient	7 N 1772	8 O 1774	9 F 1886	10 Ne 1898
11 Na 1807	12 Mg 1775															13 Al 1825	14 Si 1824	15 P 1669	16 S Ancient	17 Cl 1774	18 Ar 1894
19 K 1807	20 Ca 1808	21 Sc 1879	22 Ti 1791	23 V 1801	24 Cr 1798	25 Mn 1774	26 Fe 3500 BCE	27 Co 1739	28 Ni 1751	29 Cu Ancient	30 Zn 1746	31 Ga 1875	32 Ge 1886	33 As 1250	34 Se 1817	35 Br 1826	36 Kr 1898				
37 Rb 1861	38 Sr 1790	39 Y 1794	40 Zr 1789	41 Nb 1801	42 Mo 1781			44 Ru 1844	45 Rh 1803	46 Pd 1803	47 Ag 3000 BCE	48 Cd 1817	49 In 1863	50 Sn 2100 BCE	51 Sb 1600 BCE	52 Te 1783	53 I 1811	54 Xe 1898			
55 Cs 1860	56 Ba 1808			73 Ta 1802	74 W 1783			76 Os 1803	77 Ir 1803	78 Pt 1750	79 Au 3000 BCE	80 Hg 1500	81 Tl 1861	82 Pb Ancient	83 Bi 1500	84 Po 1898			86 Rn 1900		
88 Ra 1898																					

57 La 1839	58 Ce 1803	59 Pr 1885	60 Nd 1885
89 Ac 1899	90 Th 1829		
		92 U 1789	

62 Sm 1879	63 Eu 1901	64 Gd 1880	65 Tb 1843	66 Dy 1886	67 Ho 1878	68 Er 1843	69 Tm 1879	70 Yb 1878	71 Rb 1907
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Alkali metals	Alkaline earth metals	Lanthanides	Actinides	Transition metals
Post-transition metals	Metalloids	Other non-metals	Halogens	Noble gases

300 years of element discovery

1937

1 H 1766																	2 He 1895						
3 Li 1817	4 Be 1797																	5 B 1808	6 C Ancient	7 N 1772	8 O 1774	9 F 1886	10 Ne 1898
11 Na 1807	12 Mg 1775																	13 Al 1825	14 Si 1824	15 P 1669	16 S Ancient	17 Cl 1774	18 Ar 1894
19 K 1807	20 Ca 1808	21 Sc 1879	22 Ti 1791	23 V 1801	24 Cr 1798	25 Mn 1774	26 Fe 3500 BCE	27 Co 1739	28 Ni 1751	29 Cu Ancient	30 Zn 1746	31 Ga 1875	32 Ge 1886	33 As 1250	34 Se 1817	35 Br 1826	36 Kr 1898						
37 Rb 1861	38 Sr 1790	39 Y 1794	40 Zr 1789	41 Nb 1801	42 Mo 1781	43 Tc 1937	44 Ru 1844	45 Rh 1803	46 Pd 1803	47 Ag 3000 BCE	48 Cd 1817	49 In 1863	50 Sn 2100 BCE	51 Sb 1600 BCE	52 Te 1783	53 I 1811	54 Xe 1898						
55 Cs 1860	56 Ba 1808			72 Hf 1923	73 Ta 1802	74 W 1783	75 Re 1825	76 Os 1803	77 Ir 1803	78 Pt 1750	79 Au 3000 BCE	80 Hg 1500	81 Tl 1861	82 Pb Ancient	83 Bi 1500	84 Po 1898	86 Rn 1900						
88 Ra 1898																							

57 La 1839	58 Ce 1803	59 Pr 1885	60 Nd 1885
89 Ac 1899	90 Th 1829	91 Pa 1913	92 U 1789

62 Sm 1879	63 Eu 1901	64 Gd 1880	65 Tb 1843	66 Dy 1886	67 Ho 1878	68 Er 1843	69 Tm 1879	70 Yb 1878	71 Rb 1907
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Alkali metals	Alkaline earth metals	Lanthanides	Actinides	Transition metals
Post-transition metals	Metalloids	Other non-metals	Halogens	Noble gases

300 years of element discovery

2018

1 H 1766																	2 He 1895						
3 Li 1817	4 Be 1797																	5 B 1808	6 C Ancient	7 N 1772	8 O 1774	9 F 1886	10 Ne 1898
11 Na 1807	12 Mg 1775																	13 Al 1825	14 Si 1824	15 P 1669	16 S Ancient	17 Cl 1774	18 Ar 1894
19 K 1807	20 Ca 1808	21 Sc 1879	22 Ti 1791	23 V 1801	24 Cr 1798	25 Mn 1774	26 Fe 3500 BCE	27 Co 1739	28 Ni 1751	29 Cu Ancient	30 Zn 1746	31 Ga 1875	32 Ge 1886	33 As 1250	34 Se 1817	35 Br 1826	36 Kr 1898						
37 Rb 1861	38 Sr 1790	39 Y 1794	40 Zr 1789	41 Nb 1801	42 Mo 1781	43 Tc 1937	44 Ru 1844	45 Rh 1803	46 Pd 1803	47 Ag 3000 BCE	48 Cd 1817	49 In 1863	50 Sn 2100 BCE	51 Sb 1600 BCE	52 Te 1783	53 I 1811	54 Xe 1898						
55 Cs 1860	56 Ba 1808		72 Hf 1923	73 Ta 1802	74 W 1783	75 Re 1825	76 Os 1803	77 Ir 1803	78 Pt 1750	79 Au 3000 BCE	80 Hg 1500	81 Tl 1861	82 Pb Ancient	83 Bi 1500	84 Po 1898	85 At 1940	86 Rn 1900						
87 Fr 1939	88 Ra 1898		104 Rf 1964	105 Db 1968	106 Sg 1974	107 Bh 1981	108 Hs 1984	109 Mt 1982	110 Ds 1994	111 Rg 1994	112 Cn 1996	113 Nh 2004	114 Fl 1999	115 Mc 2010	116 Lv 2000	117 Ts 2010	118 Og 2006						

57 La 1839	58 Ce 1803	59 Pr 1885	60 Nd 1885	61 Pm 1945	62 Sm 1879	63 Eu 1901	64 Gd 1880	65 Tb 1843	66 Dy 1886	67 Ho 1878	68 Er 1843	69 Tm 1879	70 Yb 1878	71 Rb 1907
89 Ac 1899	90 Th 1829	91 Pa 1913	92 U 1789	93 Np 1940	94 Pu 1940	95 Am 1944	96 Cm 1944	97 Bk 1949	98 Cf 1950	99 Es 1952	100 Fm 1952	101 Md 1955	102 No 1963	103 Lr 1965

1955

Alkali metals	Alkaline earth metals	Lanthanides	Actinides	Transition metals
Post-transition metals	Metalloids	Other non-metals	Halogens	Noble gases

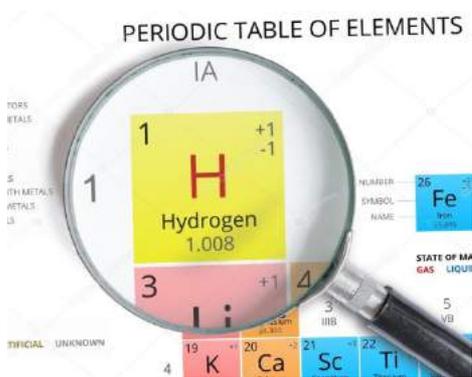
Chi ha contribuito a far crescere la Tavola Periodica?

1766

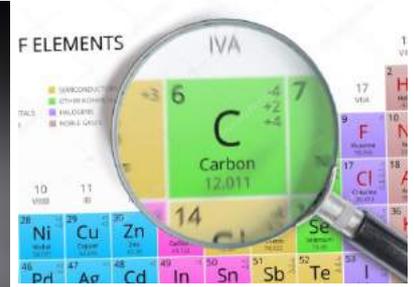
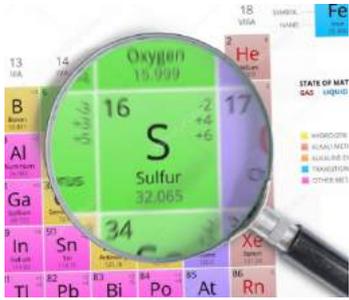
Henry Cavendish (1731 - 1810), un inglese, milionario eccentrico e geniale, che identificò l'idrogeno come elemento, decompose e sintetizzò l'acqua



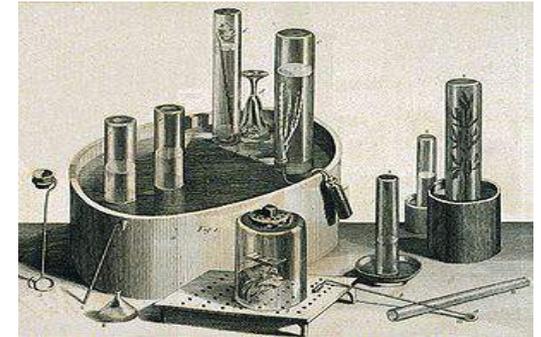
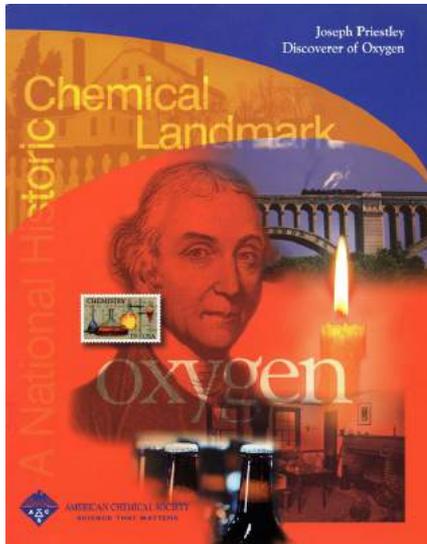
H. Cavendish



Antoine Lavoisier (1743 - 1794) ha identificato come elementi lo zolfo e il carbonio e ha dato il nome ad altri elementi



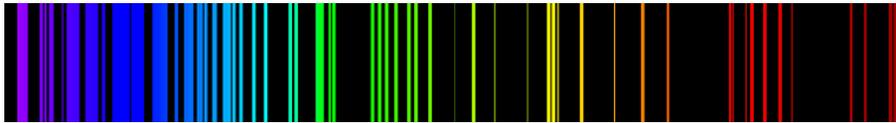
Joseph Priestley (1733 - 1804) ha identificato l'elemento ossigeno



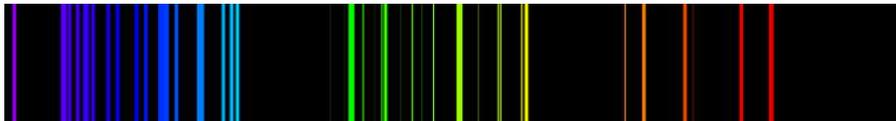
Equipments used by Joseph Priestley in his experiments on oxygen and other gases

Robert Wilhelm Bunsen (1811 - 1899), chimico e fisico, e Gustav Robert Kirchhoff (1824 - 1887), fisico e matematico, entrambi tedeschi

1860



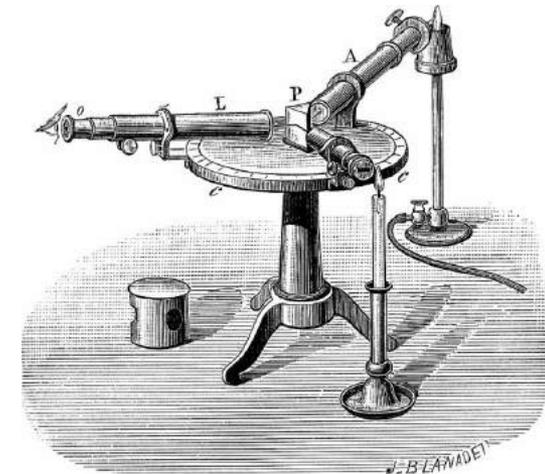
Spettro di emissione del cesio



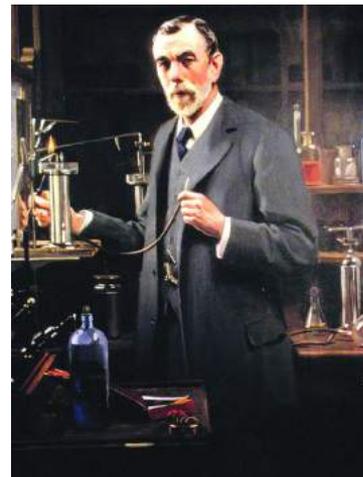
Spettro di emissione del rubidio



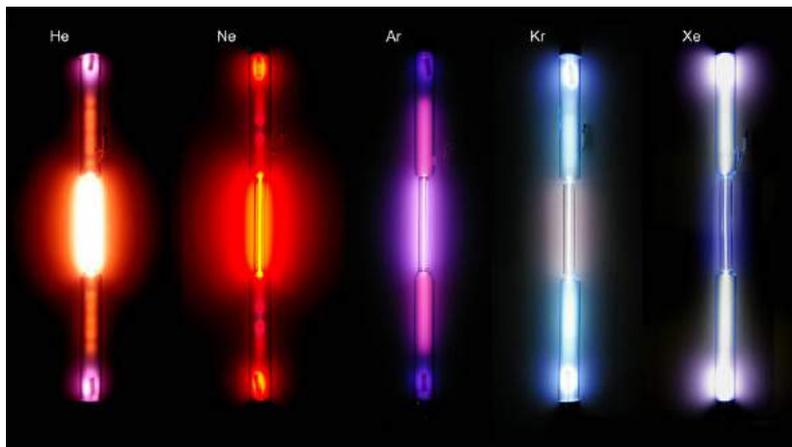
**Gustav Kirchhoff (a sinistra)
Robert Bunsen (a destra)**



Sir William Ramsay (1852 - 1916) chimico scozzese

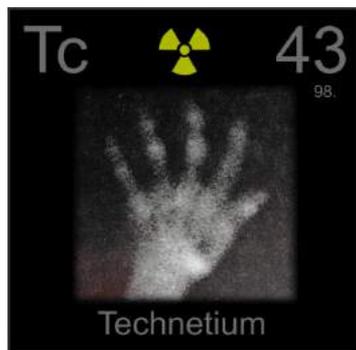


2	4
He	
Helium	
10	20.1
Ne	
Neon	
18	39.9
Ar	
Argon	
36	83.8
Kr	
Krypton	
54	131.3
Xe	
Xenon	
86	222
Rn	
Radon	



1894 - 1898

Emilio Gino Segrè (1905 - 1989) fisico italiano



1937

Allievo di Enrico Fermi e uno dei
membri dei *Ragazzi di Via
Panisperna*; fece parte del
Progetto Manhattan



Solo uomini hanno contribuito a far crescere la Tavola Periodica?



(William Röntgen). During this period, there were spectacular advances in all areas of science. In this context, the development of the periodic system by Julius Lothar Meyer and Dmitri Mendeleev was one of the most important steps. Nevertheless, the concept of the atom continued to be debated. Indeed, the debate began to intensify towards the end of the 19th century. A great supporter of atomism such as Ludwig Boltzmann (1844-1906) met with fierce resistance from, among others, Ernst Mach (1838-1916). For epistemological reasons, he insisted on hypothetical sciences. As long as atoms could not be directly proved, their existence was to be doubted.

It was exactly this position that was the guiding principle for the status of researchers presented. This is already clear with the example of William Röntgen (1845-1923): first Nobel Prize for physics (1901). Röntgen made no direct contribution to

the atomic model, however, his discovery of the X-rays provided a tool that allowed a glimpse into the atomic shell. That allowed his "plum-pudding model" was soon found to be incorrect, this in no way diminished the significance of this versatile and successful researcher.

Max Planck (1858-1947) Nobel Prize for physics (1918) at first did not have the atom in his sights. He was more interested in thermodynamics, and especially in the laws of radiation. In 1900 he accepted the Physical Society of Berlin — and like the whole world — with an experimentalist's best realization that changed the world view: he found to time and space, energy is quantized. He does not rest from a continuum, but is "externally granular". The smallest unit is the Planck constant, a fundamental natural constant.

Sir Joseph Thomson (1856-1940): Nobel Prize for physics (1906) discovered the first electron in 1897 and researched its properties. In the basis

of the available knowledge, he developed a first concrete atomic model in which the electrons were embedded in a positively charged mass. Although his "plum-pudding model" was soon found to be incorrect, this in no way diminished the significance of this versatile and successful researcher.

The finest Rutherford (1871-1937) Nobel Prize for chemistry 1908, which as a physicist he pursued over) was a brilliant experimentalist endowed with an equal genius of being able to interpret the results. He recognized three types of radiation (alpha, beta, and gamma). He used scattering experiments with alpha radiation, which consists of helium nuclei, to prove that the atom is almost empty. The diameter of the atomic nucleus is about 10,000 times smaller than the atom itself. Furthermore, he proved that atoms are not indivisible and that, in addition to protons, there must also be neutrons present in their nucleus. With Niels Bohr he developed the core-shell model of the atom.

Niels Bohr (1879-1962): Nobel Prize for physics (1922) became famous for his equally elegant, but nevertheless incorrect, atom model. In 1913 all facts seemed to indicate that the electrons did not buzz like bees around the nucleus.



Predictably spectra and quantum theory seemed to indicate an order. A planetary model, almost suggested itself, but according to classical physics, the moving electrons should emit energy and consequently collapse into the nucleus. The 28-year-old Niels Bohr ignored this principle and postulated that the electrons in these orbits were "out of law". This clearly meant that classical physics could not describe or explain the properties of the atoms. The framework of physical theory came crashing down. Fundamentally new models had to be developed!

1. Ideologically, the shell model has attracted little favour owing to its character. Seven shells can be recognized (K, L, M, N, O, P, Q). Each of these has a certain number of shells (1, 2, 3, 4, 5, 6, 7). The s orbital can accommodate two electrons, the p orbitals six, the d orbitals 10, and the f orbitals 14. The transition metals and the lanthanides and actinides have filled inner shells, which explains their chemical differences as well as their similarities. The subdivision into eight main groups and five secondary groups was abandoned. According to international consensus, the Periodic Table today consists of 18 groups.



F 9
Fluorine
Atomic weight: 19.00

1866 Henri Moissan (1852-1907): Nobel Prize for chemistry (1906). Prepared by electrolysis of potassium fluoride in aqueous hydrofluoric acid (HF).

1871 Carl Wilhelm Sönder (1742-1798) identified a uric acid (U) in fluorine.

4. Fluorine-containing polymers such as Teflon are everywhere and pervade our everyday existence. Their surfaces are water and oil repellent, making them ideal materials in many areas of home and industry.

Name: from *fluere* (Latin = flowing)

Properties: Gerry Agricola (1495-1555) named fluorine "fluor mineral" (1529). The most aggressive and most reactive element with the highest atomic number, heavier an electron, and violently so that, from the outer shell, negatively, heaves an electron, and violently so that, from the outer shell, heaves an electron, and violently so that, from the outer shell, heaves an electron.

4. Also zinc has been used for many centuries. The amount of zinc improves the immune system, improves the immune system, improves the immune system, improves the immune system.

Ne 10
Neon
Atomic weight: 20.18

1898 Sir William Ramsay (1852-1916) and Morris William Travers (1872-1916). Predicted from the Periodic Table. Isolated by fractional distillation of air and identified by spectral analysis.

6. Neon lamps are being increasingly encountered in everyday life. Together with the neon, they have revolutionized lighting and signage.

Na 11
Sodium
Atomic weight: 22.99

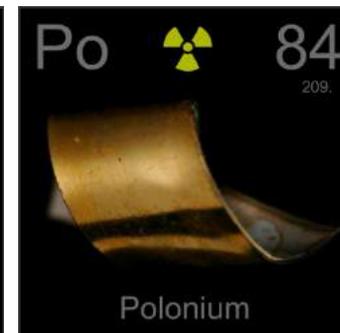
1807 Sir Humphry Davy (1778-1829) isolated the element by electrolysis of molten sodium chloride (NaOH).

6. So far water today contains about 20 µg of NaCl per litre. In contrast, the physiological sodium solution only has 136 µg/l. When 10g was formed, the sea was not yet 100.

Marie Curie



Maria Salomea Skłodowska, nota come Marie Curie (1867 - 1934), chimica e fisica polacca naturalizzata francese, con il marito Pierre Curie ha scoperto il radio e il polonio (così chiamato in onore alla sua nazione)



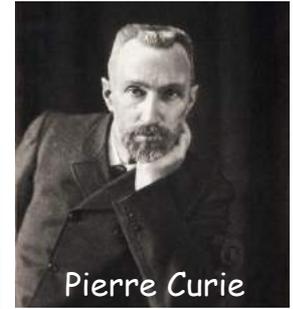
1898

Marie Curie è stata la prima donna ad avere il premio Nobel e l'unica persona ad aver ricevuto due premi Nobel in due diversi ambiti scientifici

✓ 1905: Nobel per la Fisica con Pierre Curie e Antoine Henri Becquerel

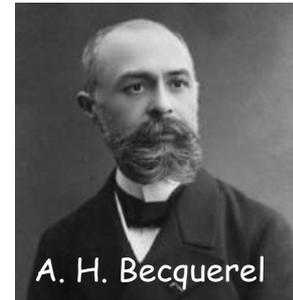


Marie Curie



Pierre Curie

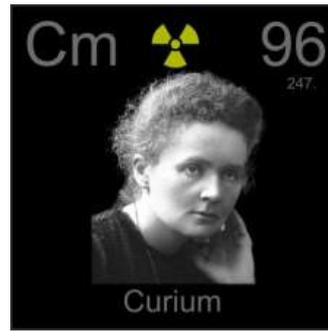
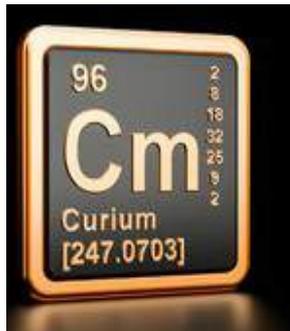
✓ 1911: Premio Nobel per la Chimica



A. H. Becquerel



1944



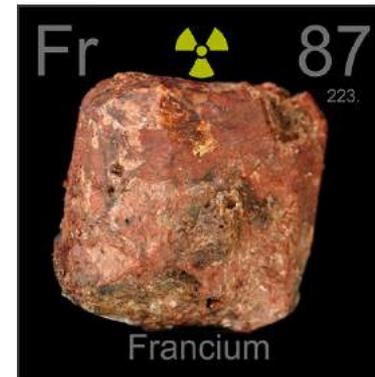
in onore dei coniugi Curie

Marguerite Perey



Marguerite Catherine Perey (1909 -1975) è stata una chimica francese, nota soprattutto per aver scoperto un nuovo elemento che, in omaggio alla sua nazionalità, chiamò francio

È stata candidata al Nobel più volte: il Comitato Nobel decise che i suoi studi sul francio, benché importanti, non meritavano il Nobel



1939

Il contributo nascosto delle donne alla Tavola Periodica



**Harriet Brooks
(radon)**



**Berta Karlik
(astato)**



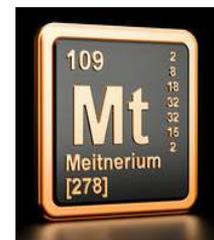
**Lise Meitner
(protoattinio)**



**Ida Noddack
(renio)**



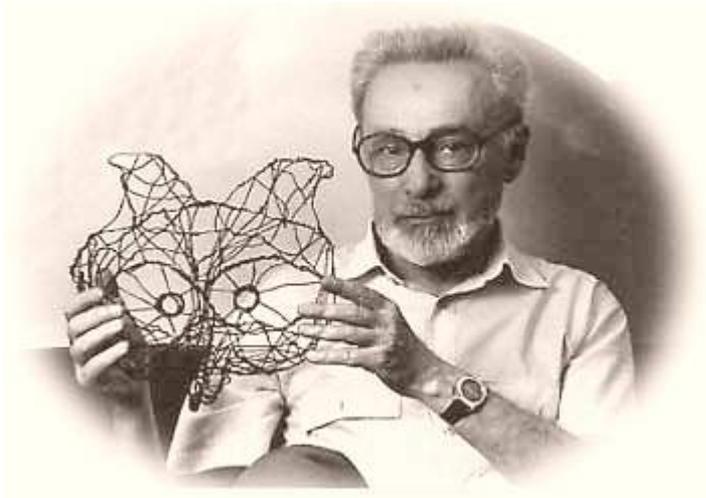
**Stephanie Horowitz
(concetto di isotopo)**



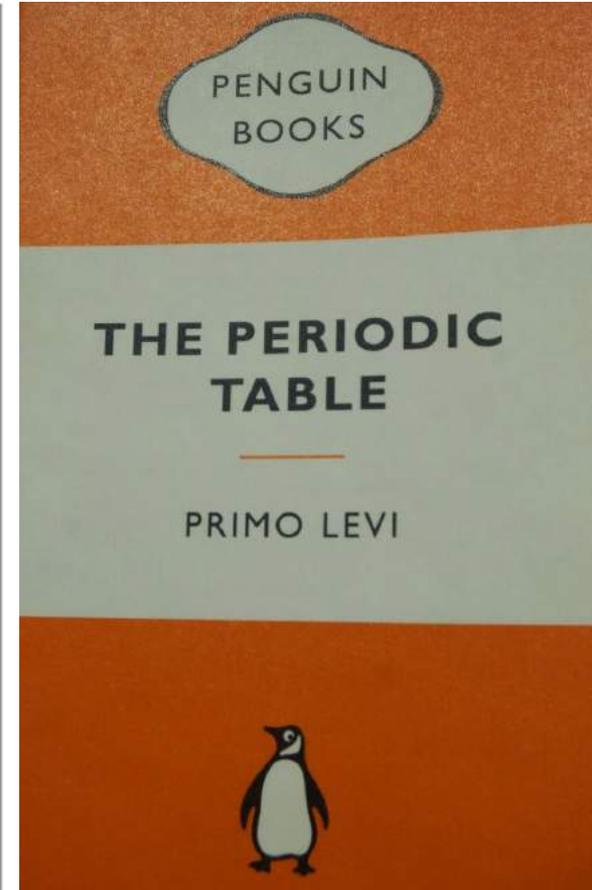
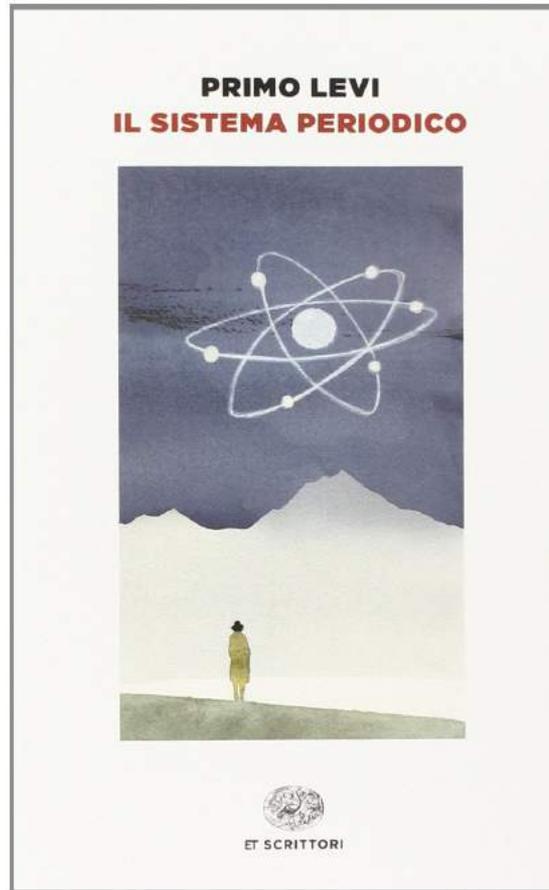
in onore di Lisa Meitner

1997

1975



Primo Levi (1919 - 1987)



Nel 2019 ricorre anche il 100° anniversario della nascita di Primo Levi

The Periodic Table of the Elements

										18																																								
period 1																		2																																
1	1.00794 1.00811 H Hydrogen [1s] ¹																4.002602 2.01818 He Helium [1s] ²																																	
2	3														4		10																																	
Li	Be														B		C		N		O		F		Ne																									
3	11														13		14		15		16		17		18																									
Na	Mg														Al		Si		P		S		Cl		Ar																									
4	19		20														21		22		23		24		25		26		27		28		29		30		31		32		33		34		35		36			
K	Ca		Sc		Ti		V		Cr		Mn		Fe		Co		Ni		Cu		Zn		Ga		Ge		As		Se		Br		Kr																	
5	37		38														39		40		41		42		(98)		43		44		45		46		47		48		49		50		51		52		53		54	
Rb	Sr		Y		Zr		Nb		Mo		Tc		Ru		Rh		Pd		Ag		Cd		In		Sn		Sb		Te		I		Xe																	
6	55		56														57		58		59		60		61		62		63		64		65		66		67		68		69		70							
Cs	Ba		La		Hf		Ta		W		Re		Os		Ir		Pt		Au		Hg		Tl		Pb		Bi		Po		At		Rn																	
7	87		88														89		90		91		92		(287)		93		94		95		96		97		98		99		100		101		102					
Fr	Ra		Lr		Rf		Db		Sg		Bh		Hs		Mt		Ds		Rg		Cn		Nh		Fl		Mc		Lv		Ts		Og																	

atomic mass
or most stable mass number

1st ionization energy in kJ/mol

chemical symbol

name

electron configuration

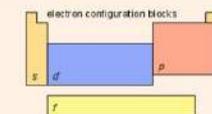
55.845
762.5 1.83
26
Fe
Iron
[Ar] 3d⁶ 4s²

atomic number

electronegativity

oxidation states
most common are bold

- alkali metals
- alkaline metals
- other metals
- transition metals
- lanthanoids
- actinoids
- metalloids
- nonmetals
- halogens
- noble gases
- unknown elements
- radioactive elements have masses in parentheses



notes

* 1.02 MeV = 99.485 eV

* all elements are implied to have an oxidation state of zero.

138.9054 57 La Lanthanum [Xe] 5f ¹ 6s ²	140.116 58 Ce Cerium [Xe] 4f ¹ 5d ¹ 6s ²	140.9076 59 Pr Praseodymium [Xe] 4f ³ 6s ²	144.242 60 Nd Neodymium [Xe] 4f ⁴ 6s ²	(145) 61 Pm Promethium [Xe] 4f ⁵ 6s ²	150.36 62 Sm Samarium [Xe] 4f ⁶ 6s ²	151.964 63 Eu Europium [Xe] 4f ⁷ 6s ²	157.25 64 Gd Gadolinium [Xe] 4f ⁷ 5d ¹ 6s ²	158.9253 65 Tb Terbium [Xe] 4f ⁹ 6s ²	162.500 66 Dy Dysprosium [Xe] 4f ¹⁰ 6s ²	164.9303 67 Ho Holmium [Xe] 4f ¹¹ 6s ²	167.259 68 Er Erbium [Xe] 4f ¹² 6s ²	168.9342 69 Tm Thulium [Xe] 4f ¹³ 6s ²	173.054 70 Yb Ytterbium [Xe] 4f ¹⁴ 6s ²
(227) 89 Ac Actinium [Rn] 5f ¹ 7s ²	232.0377 90 Th Thorium [Rn] 6d ² 7s ²	231.0368 91 Pa Protactinium [Rn] 5f ² 6d ¹ 7s ²	238.0289 92 U Uranium [Rn] 5f ³ 6d ¹ 7s ²	(237) 93 Np Neptunium [Rn] 5f ⁴ 6d ¹ 7s ²	(244) 94 Pu Plutonium [Rn] 5f ⁶ 7s ²	(247) 95 Am Americium [Rn] 5f ⁷ 7s ²	(247) 96 Cm Curium [Rn] 5f ⁷ 6d ¹ 7s ²	(247) 97 Bk Berkelium [Rn] 5f ⁹ 7s ²	(251) 98 Cf Californium [Rn] 5f ¹⁰ 6d ¹ 7s ²	(252) 99 Es Einsteinium [Rn] 5f ¹¹ 6d ¹ 7s ²	(257) 100 Fm Fermium [Rn] 5f ¹² 7s ²	(258) 101 Md Mendelevium [Rn] 5f ¹³ 7s ²	(259) 102 No Nobelium [Rn] 5f ¹⁴ 7s ²

Nella Tavola Periodica gli elementi sono ordinati in funzione del numero atomico (numero dei protoni) crescente; in realtà è la configurazione elettronica il vero principio ordinatore

The Periodic Table of the Elements

group 1																	18																																	
period 1	1 H Hydrogen 1.00794 1.008 1.008																	2 He Helium 4.002602 4.003 4.003																																
2	3 Li Lithium 6.941 6.94 6.94	4 Be Beryllium 9.012182 9.012 9.012																	9 F Fluorine 18.998403 18.998 18.998	10 Ne Neon 20.1797 20.18 20.18																														
3	11 Na Sodium 22.98976 22.99 22.99	12 Mg Magnesium 24.3050 24.31 24.31																	17 Cl Chlorine 35.453 35.45 35.45	18 Ar Argon 39.948 39.95 39.95																														
4	19 K Potassium 39.0983 39.1 39.1	20 Ca Calcium 40.078 40.08 40.08	21 Sc Scandium 44.95591 44.96 44.96	22 Ti Titanium 47.867 47.87 47.87	23 V Vanadium 50.9415 50.94 50.94	24 Cr Chromium 51.9961 52.00 52.00	25 Mn Manganese 54.93804 54.94 54.94	26 Fe Iron 55.845 55.85 55.85	27 Co Cobalt 58.93319 58.93 58.93	28 Ni Nickel 58.6934 58.7 58.7	29 Cu Copper 63.546 63.55 63.55	30 Zn Zinc 65.38 65.38 65.38	31 Ga Gallium 69.723 69.72 69.72	32 Ge Germanium 72.64 72.64 72.64	33 As Arsenic 74.92160 74.92 74.92	34 Se Selenium 78.96 79.0 79.0	35 Br Bromine 79.904 79.9 79.9	36 Kr Krypton 83.798 83.8 83.8																																
5	37 Rb Rubidium 85.4678 85.47 85.47	38 Sr Strontium 87.62 87.62 87.62	39 Y Yttrium 88.90585 88.91 88.91	40 Zr Zirconium 91.224 91.22 91.22	41 Nb Niobium 92.90638 92.91 92.91	42 Mo Molybdenum 95.96 96.0 96.0	43 Tc Technetium 98.9062 98.91 98.91	44 Ru Ruthenium 101.07 101.07 101.07	45 Rh Rhodium 102.9055 102.91 102.91	46 Pd Palladium 106.42 106.42 106.42	47 Ag Silver 107.8682 107.87 107.87	48 Cd Cadmium 112.411 112.41 112.41	49 In Indium 114.818 114.82 114.82	50 Sn Tin 118.710 118.71 118.71	51 Sb Antimony 121.760 121.76 121.76	52 Te Tellurium 127.00 127.0 127.0	53 I Iodine 126.9044 126.90 126.90	54 Xe Xenon 131.293 131.3 131.3																																
6	55 Cs Cesium 132.9054 132.91 132.91	56 Ba Barium 137.327 137.33 137.33	57 Lu Lutetium 174.9668 174.97 174.97	58 Hf Hafnium 178.49 178.5 178.5	59 Ta Tantalum 180.9478 180.95 180.95	60 W Tungsten 183.84 183.84 183.84	61 Re Rhenium 186.207 186.21 186.21	62 Os Osmium 190.23 190.23 190.23	63 Ir Iridium 192.221 192.22 192.22	64 Pt Platinum 195.084 195.08 195.08	65 Au Gold 196.9665 196.97 196.97	66 Hg Mercury 200.59 200.6 200.6	67 Tl Thallium 204.3893 204.39 204.39	68 Pb Lead 207.2 207.2 207.2	69 Bi Bismuth 208.9804 208.98 208.98	70 Po Polonium (209) (209) (209)	71 At Astatine (210) (210) (210)	72 Rn Radon (222) (222) (222)	73 Fr Francium (223) (223) (223)	74 Ra Radium (226) (226) (226)	75 Ac Actinium (227) (227) (227)	76 Th Thorium (232) (232) (232)	77 Pa Protactinium (231) (231) (231)	78 U Uranium (238) (238) (238)	79 Np Neptunium (237) (237) (237)	80 Pu Plutonium (244) (244) (244)	81 Am Americium (243) (243) (243)	82 Cm Curium (247) (247) (247)	83 Bk Berkelium (247) (247) (247)	84 Cf Californium (251) (251) (251)	85 Es Einsteinium (252) (252) (252)	86 Fm Fermium (257) (257) (257)	87 Md Mendelevium (258) (258) (258)	88 No Nobelium (259) (259) (259)	89 Lr Lawrencium (260) (260) (260)	90 Rf Rutherfordium (261) (261) (261)	91 Db Dubnium (262) (262) (262)	92 Sg Seaborgium (266) (266) (266)	93 Bh Bohrium (264) (264) (264)	94 Hs Hassium (277) (277) (277)	95 Mt Meitnerium (268) (268) (268)	96 Ds Darmstadtium (271) (271) (271)	97 Rg Roentgenium (272) (272) (272)	98 Cn Copernicium (285) (285) (285)	99 Nh Nihonium (284) (284) (284)	100 Fl Flerovium (289) (289) (289)	101 Mc Moscovium (288) (288) (288)	102 Lv Livermorium (292) (292) (292)	103 Ts Tennessine (117) (117) (117)	104 Og Oganesson (118) (118) (118)

atomic mass
or most stable mass number

1st ionization energy
in kJ/mol

chemical symbol

name

electron configuration

atomic number

electronegativity

oxidation states
most common are bold

55.845 26

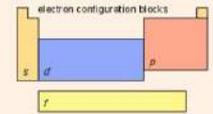
762.5 1.83

Fe

Iron

[Ar] 3d⁶ 4s²

- alkali metals
- alkaline metals
- other metals
- transition metals
- lanthanoids
- actinoids
- metalloids
- nonmetals
- halogens
- noble gases
- unknown elements
- radioactive elements have masses in parentheses



notes

- 1.31 eV = 36.485 eV
- all elements are implied to have an oxidation state of zero.

138.9054 138.91 138.91	140.116 140.12 140.12	140.9076 140.91 140.91	144.242 144.24 144.24	(145) 145.0 145.0	150.36 150.36 150.36	151.964 151.96 151.96	157.25 157.25 157.25	158.9253 158.93 158.93	162.500 162.50 162.50	164.9303 164.93 164.93	167.259 167.26 167.26	168.9342 168.93 168.93	173.054 173.05 173.05	
La Lanthanum ([Xe]5d ¹ 6s ²)	Ce Cerium ([Xe]4f ¹ 5d ¹ 6s ²)	Pr Praseodymium ([Xe]4f ³ 6s ²)	Nd Neodymium ([Xe]4f ⁴ 6s ²)	Pm Promethium ([Xe]4f ⁵ 6s ²)	Sm Samarium ([Xe]4f ⁶ 6s ²)	Eu Europium ([Xe]4f ⁷ 6s ²)	Gd Gadolinium ([Xe]4f ⁷ 5d ¹ 6s ²)	Tb Terbium ([Xe]4f ⁹ 6s ²)	Dy Dysprosium ([Xe]4f ¹⁰ 6s ²)	Ho Holmium ([Xe]4f ¹¹ 6s ²)	Er Erbium ([Xe]4f ¹² 6s ²)	Tm Thulium ([Xe]4f ¹³ 6s ²)	Yb Ytterbium ([Xe]4f ¹⁴ 6s ²)	
(227) 227.0 227.0	232.0380 232.04 232.04	231.0368 231.04 231.04	238.0289 238.03 238.03	(237) 237.0 237.0	(244) 244.0 244.0	(243) 243.0 243.0	(247) 247.0 247.0	(247) 247.0 247.0	(251) 251.0 251.0	(252) 252.0 252.0	(257) 257.0 257.0	(258) 258.0 258.0	(259) 259.0 259.0	(260) 260.0 260.0
Ac Actinium ([Rn]6s ² 7s ²)	Th Thorium ([Rn]6d ² 7s ²)	Pa Protactinium ([Rn]5f ² 6d ¹ 7s ²)	U Uranium ([Rn]5f ³ 6d ¹ 7s ²)	Np Neptunium ([Rn]5f ⁴ 6d ¹ 7s ²)	Pu Plutonium ([Rn]5f ⁶ 7s ²)	Am Americium ([Rn]5f ⁷ 7s ²)	Cm Curium ([Rn]5f ⁷ 6d ¹ 7s ²)	Bk Berkelium ([Rn]5f ⁹ 7s ²)	Cf Californium ([Rn]5f ¹⁰ 7s ²)	Es Einsteinium ([Rn]5f ¹¹ 7s ²)	Fm Fermium ([Rn]5f ¹² 7s ²)	Md Mendelevium ([Rn]5f ¹³ 7s ²)	No Nobelium ([Rn]5f ¹⁴ 7s ²)	

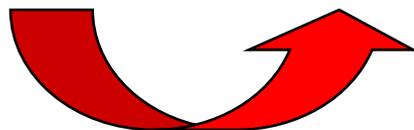
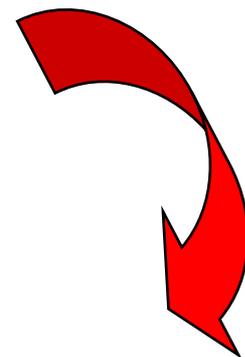
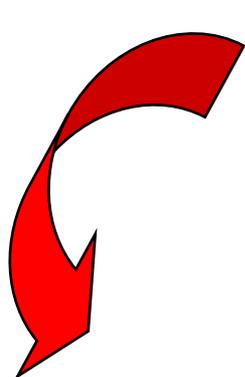
Nella Tavola Periodica coesistono i tre livelli che caratterizzano la Chimica: macroscopico, ultramicroscopico e simbolico

La chimica: una disciplina che lavora a tre livelli

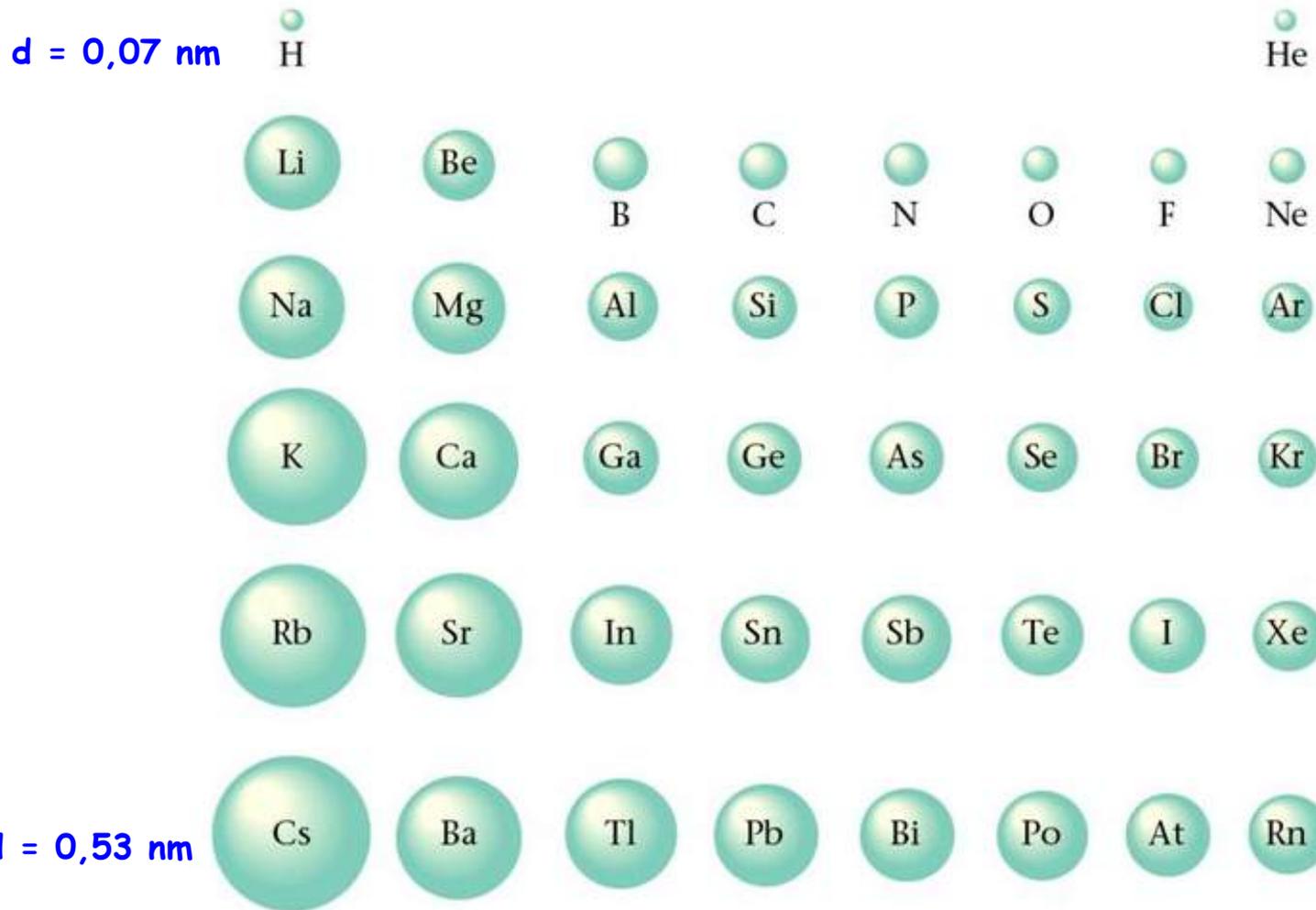
macroscopico
(i fatti tangibili)

ultramicroscopico
(atomi e molecole)

simbolico
(linguaggio chimico)



Gli atomi sono particelle a forma sferica di dimensioni variabili, ma sempre molto piccole: centesimi o decimi di nanometro (10^{-9} m)



Quanto sono piccoli gli atomi

La punta di una matita è fatta di grafite,
un solido formato da atomi di carbonio

Una riga lunga 3,5 cm e spessa
0,7 mm tracciata con la matita



lascia sul foglio 5 milioni di file allineate le une
vicine alle altre e ciascuna fila formata da
250 milioni di atomi

Un maxi-esercito formato da circa 1 milione
di miliardi di soldatini invisibili: quasi 150.000
volte l'attuale popolazione del mondo

IUPAC Periodic Table of the Elements

1 H hydrogen 1.008 [1.0078, 1.0082]																	2 He helium 4.0026
3 Li lithium 6.94 [6.938, 6.997]	4 Be beryllium 9.0122	Key: atomic number Symbol name conventional atomic weight standard atomic weight										13 B boron 10.81 [10.806, 10.821]	14 C carbon 12.011 [12.009, 12.012]	15 N nitrogen 14.007 [14.006, 14.008]	16 O oxygen 15.999 [15.999, 16.000]	17 F fluorine 18.998	18 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 28.086 [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 39.948
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 101.07(2)	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



INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

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

For notes and updates to this table, see www.iupac.org. This version is dated 28 November 2016.
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Oltre alla Tavola Periodica "ufficiale"
esistono altre versioni

La Tavola Periodica estesa

dove il blocco-f è messo nella sua giusta posizione

Legend for the extended periodic table:

- Alkali Metal
- Alkaline Earth
- Transition Metal
- Basic Metal
- Metalloid
- Nonmetal
- Halogens
- Noble Gas
- Lanthanide
- Actinide

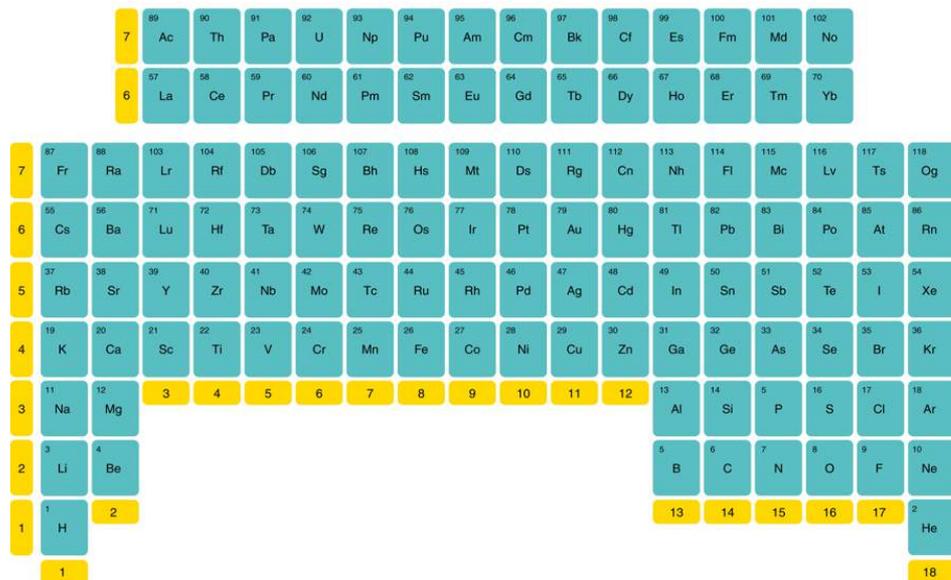
La Tavola Periodica Janet

che è basata sugli orbitali atomici e sul loro riempimento

Legend for the Janet periodic table:

- Alkali Metal
- Alkaline Earth
- Transition Metal
- Basic Metal
- Metalloid
- Nonmetal
- Halogens
- Noble Gas
- Lanthanide
- Actinide

Una Tavola Periodica "rovesciata"



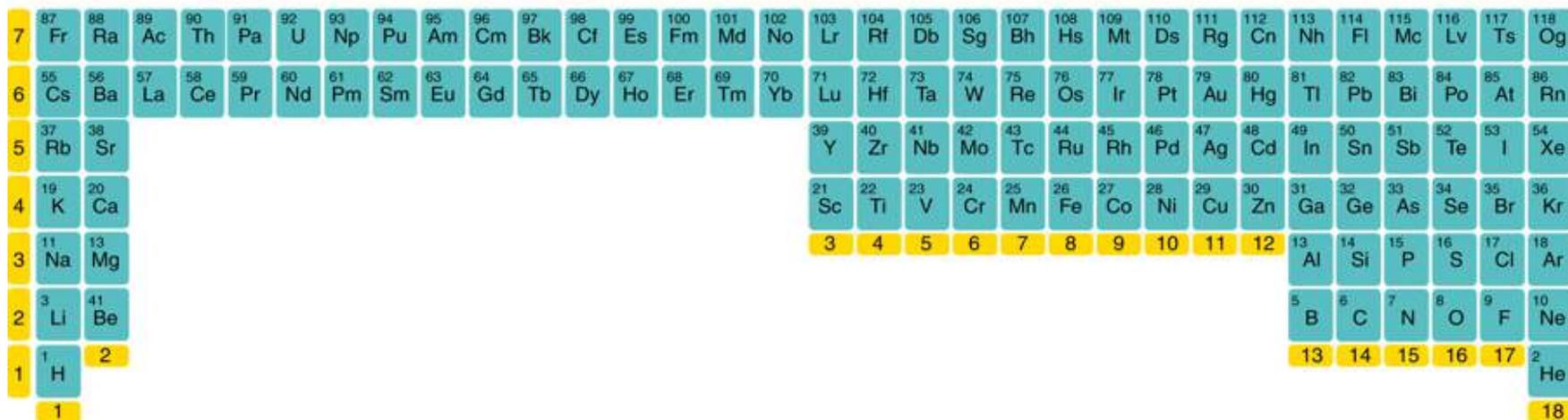
A periodic table oriented upside down. The top row (row 7) contains elements 89 (Ac), 90 (Th), 91 (Pa), 92 (U), 93 (Np), 94 (Pu), 95 (Am), 96 (Cm), 97 (Bk), 98 (Cf), 99 (Es), 100 (Fm), 101 (Md), and 102 (No). The second row (row 6) contains elements 87 (La), 88 (Ce), 89 (Pr), 90 (Nd), 91 (Pm), 92 (Sm), 93 (Eu), 94 (Gd), 95 (Tb), 96 (Dy), 97 (Ho), 98 (Er), 99 (Tm), and 100 (Yb). The main body of the table consists of 18 columns and 7 rows (rows 1-7). Row 1 (top of the main body) contains H (1) and He (2). Row 2 contains Li (3) and Be (4). Row 3 contains Na (11), Mg (12), Al (13), Si (14), P (15), S (16), Cl (17), and Ar (18). Row 4 contains K (19), Ca (20), Sc (21), Ti (22), V (23), Cr (24), Mn (25), Fe (26), Co (27), Ni (28), Cu (29), Zn (30), Ga (31), Ge (32), As (33), Se (34), Br (35), and Kr (36). Row 5 contains Rb (37), Sr (38), Y (39), Zr (40), Nb (41), Mo (42), Tc (43), Ru (44), Rh (45), Pd (46), Ag (47), Cd (48), In (49), Sn (50), Sb (51), Te (52), I (53), and Xe (54). Row 6 contains Cs (55), Ba (56), Lu (71), Hf (72), Ta (73), W (74), Re (75), Os (76), Ir (77), Pt (78), Au (79), Hg (80), Tl (81), Pb (82), Bi (83), Po (84), At (85), and Rn (86). Row 7 (bottom of the main body) contains Fr (87), Ra (88), Lr (103), Rf (104), Db (105), Sg (106), Bh (107), Hs (108), Mt (109), Ds (110), Rg (111), Cn (112), Nh (113), Fl (114), Mc (115), Lv (116), Ts (117), and Og (118). The atomic numbers 1 through 18 are highlighted in yellow.

Turning the periodic table upside down

The periodic table is immensely powerful for rationalizing many different properties of the chemical elements, but would turning it on its head make some important aspects easier to understand and give everyone a new perspective on chemistry?

Martyn Poliakoff, Alexis D. J. Makin, Samantha L. Y. Tang and Ellen Poliakof

Nature Chemistry, **11**, 391–393 (2019)



A standard periodic table oriented normally. The top row (row 7) contains elements 87 (Fr), 88 (Ra), 89 (Ac), 90 (Th), 91 (Pa), 92 (U), 93 (Np), 94 (Pu), 95 (Am), 96 (Cm), 97 (Bk), 98 (Cf), 99 (Es), 100 (Fm), 101 (Md), 102 (No), 103 (Lr), 104 (Rf), 105 (Db), 106 (Sg), 107 (Bh), 108 (Hs), 109 (Mt), 110 (Ds), 111 (Rg), 112 (Cn), 113 (Nh), 114 (Fl), 115 (Mc), 116 (Lv), 117 (Ts), and 118 (Og). The second row (row 6) contains elements 55 (Cs), 56 (Ba), 57 (La), 58 (Ce), 59 (Pr), 60 (Nd), 61 (Pm), 62 (Sm), 63 (Eu), 64 (Gd), 65 (Tb), 66 (Dy), 67 (Ho), 68 (Er), 69 (Tm), 70 (Yb), 71 (Lu), 72 (Hf), 73 (Ta), 74 (W), 75 (Re), 76 (Os), 77 (Ir), 78 (Pt), 79 (Au), 80 (Hg), 81 (Tl), 82 (Pb), 83 (Bi), 84 (Po), 85 (At), and 86 (Rn). The main body of the table consists of 18 columns and 7 rows (rows 1-7). Row 1 (top of the main body) contains H (1) and He (2). Row 2 contains Li (3) and Be (4). Row 3 contains Na (11), Mg (12), Al (13), Si (14), P (15), S (16), Cl (17), and Ar (18). Row 4 contains K (19), Ca (20), Sc (21), Ti (22), V (23), Cr (24), Mn (25), Fe (26), Co (27), Ni (28), Cu (29), Zn (30), Ga (31), Ge (32), As (33), Se (34), Br (35), and Kr (36). Row 5 contains Rb (37), Sr (38), Y (39), Zr (40), Nb (41), Mo (42), Tc (43), Ru (44), Rh (45), Pd (46), Ag (47), Cd (48), In (49), Sn (50), Sb (51), Te (52), I (53), and Xe (54). Row 6 contains Cs (55), Ba (56), Lu (71), Hf (72), Ta (73), W (74), Re (75), Os (76), Ir (77), Pt (78), Au (79), Hg (80), Tl (81), Pb (82), Bi (83), Po (84), At (85), and Rn (86). Row 7 (bottom of the main body) contains Fr (87), Ra (88), Lr (103), Rf (104), Db (105), Sg (106), Bh (107), Hs (108), Mt (109), Ds (110), Rg (111), Cn (112), Nh (113), Fl (114), Mc (115), Lv (116), Ts (117), and Og (118). The atomic numbers 1 through 18 are highlighted in yellow.

Il vantaggio: molte delle proprietà crescono dal basso verso l'alto e gli elettroni cominciano a riempire gli orbitali ad energia più bassa partendo dal basso, come "l'acqua che riempie un bicchiere"

Tavole Periodiche con forme "esotiche"

A circular periodic table with a central hole. The elements are arranged in concentric rings. The innermost ring contains Hydrogen (H), Helium (He), Lithium (Li), and Beryllium (Be). The next ring contains Boron (B), Carbon (C), Nitrogen (N), Oxygen (O), Fluorine (F), and Neon (Ne). The table continues with various groups of elements, including the transition metals, and ends with Oganesson (Og) at the top. Arrows of different colors (yellow, orange, red, blue) point from the center outwards, following the arrangement of the elements.

A 3D model of a periodic table rolled into a cylinder. The elements are arranged in a grid. The top row shows H, C, N, O. The second row shows Si, P, S. The third row shows Co, Ni, Cu, Zn, Ga, Ge, As, Se. The fourth row shows Rh, Pd, Ag, Cd, In, Sn, Sb, Te. The fifth row shows Ir, Pt, Au, Hg, Tl, Pb, Bi, Po. The sixth row shows Mt, Ds, Rg, Cn.

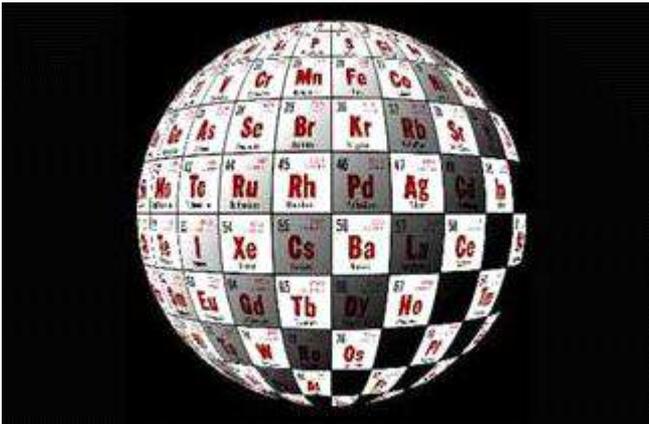
A 3D model of a periodic table rolled into a cylinder. The elements are arranged in a grid. The top row shows Hydrogen (H) and Helium (He). The second row shows Lithium (Li) and Beryllium (Be). The third row shows Boron (B), Carbon (C), Nitrogen (N), and Oxygen (O). The fourth row shows Fluorine (F) and Neon (Ne). The fifth row shows Sodium (Na), Magnesium (Mg), Aluminum (Al), Silicon (Si), Phosphorus (P), Sulfur (S), Chlorine (Cl), and Argon (Ar). The sixth row shows Potassium (K), Calcium (Ca), Scandium (Sc), Titanium (Ti), Vanadium (V), Chromium (Cr), Manganese (Mn), Iron (Fe), Cobalt (Co), Nickel (Ni), Copper (Cu), Zinc (Zn), Gallium (Ga), Germanium (Ge), Arsenic (As), Selenium (Se), Bromine (Br), and Krypton (Kr). The seventh row shows Rubidium (Rb), Strontium (Sr), Yttrium (Y), Zirconium (Zr), Niobium (Nb), Molybdenum (Mo), Technetium (Tc), Ruthenium (Ru), Rhodium (Rh), Palladium (Pd), Silver (Ag), Cadmium (Cd), Indium (In), Tin (Sn), Antimony (Sb), Tellurium (Te), Iodine (I), and Xenon (Xe). The eighth row shows Francium (Fr), Radium (Ra), Actinium (Ac), Thorium (Th), Protactinium (Pa), Uranium (U), Neptunium (Np), Plutonium (Pu), Americium (Am), Curium (Cm), Berkelium (Bk), Californium (Cf), Einsteinium (Es), Fermium (Fm), Mendelevium (Md), Nihonium (Nh), Tennessine (Ts), and Oganesson (Og). The bottom row shows the Lanthanoids and Actinoids.

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Tavole Periodiche con forme "esotiche"

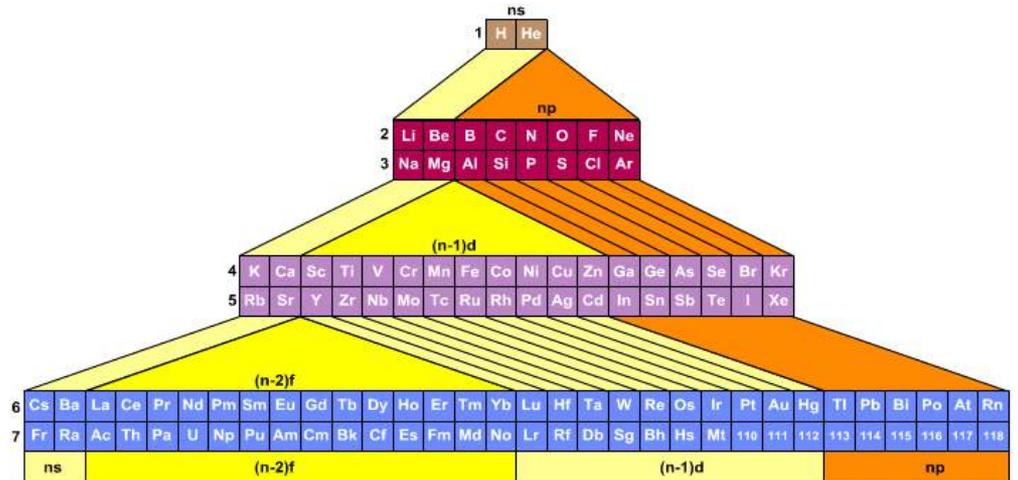
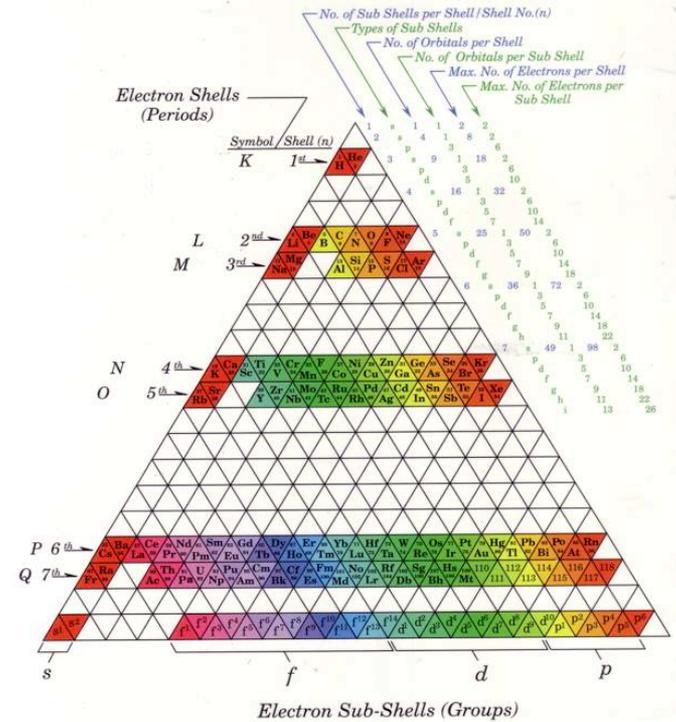
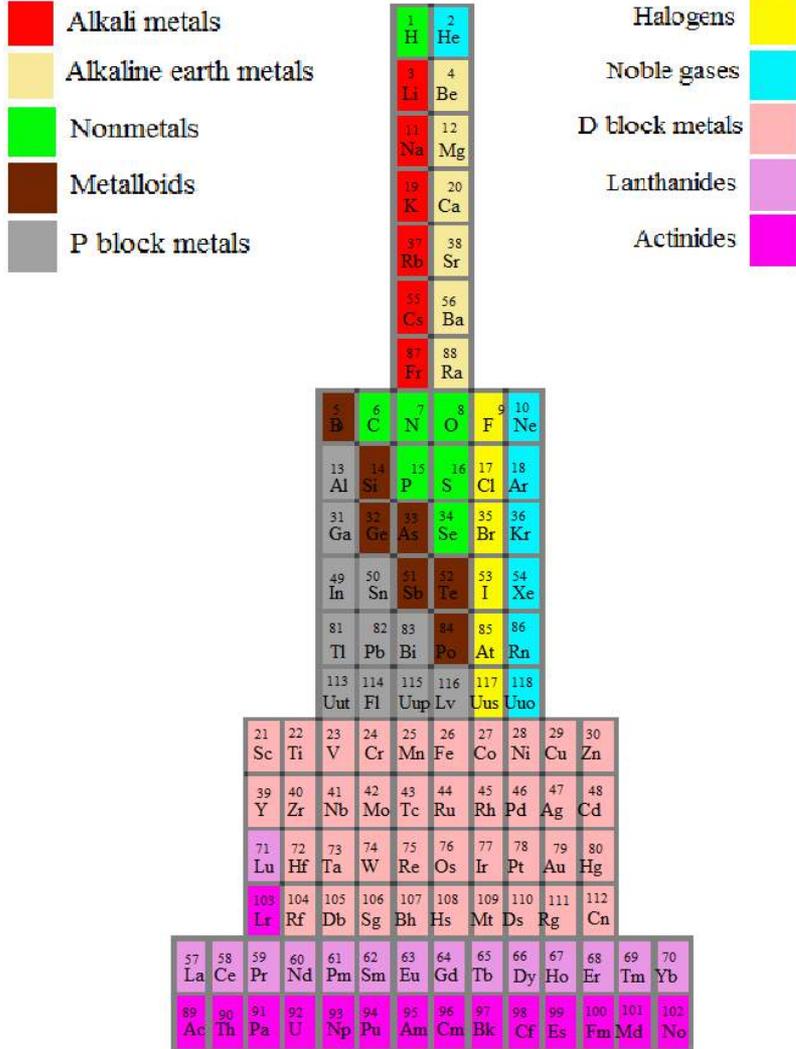
Una Tavola Periodica Sferica

Questa bella versione elaborata dalla Union Carbide nel 1960 purtroppo non "funziona": secondo gli autori è impossibile "arrotolare" la Tavola Periodica in una sfera



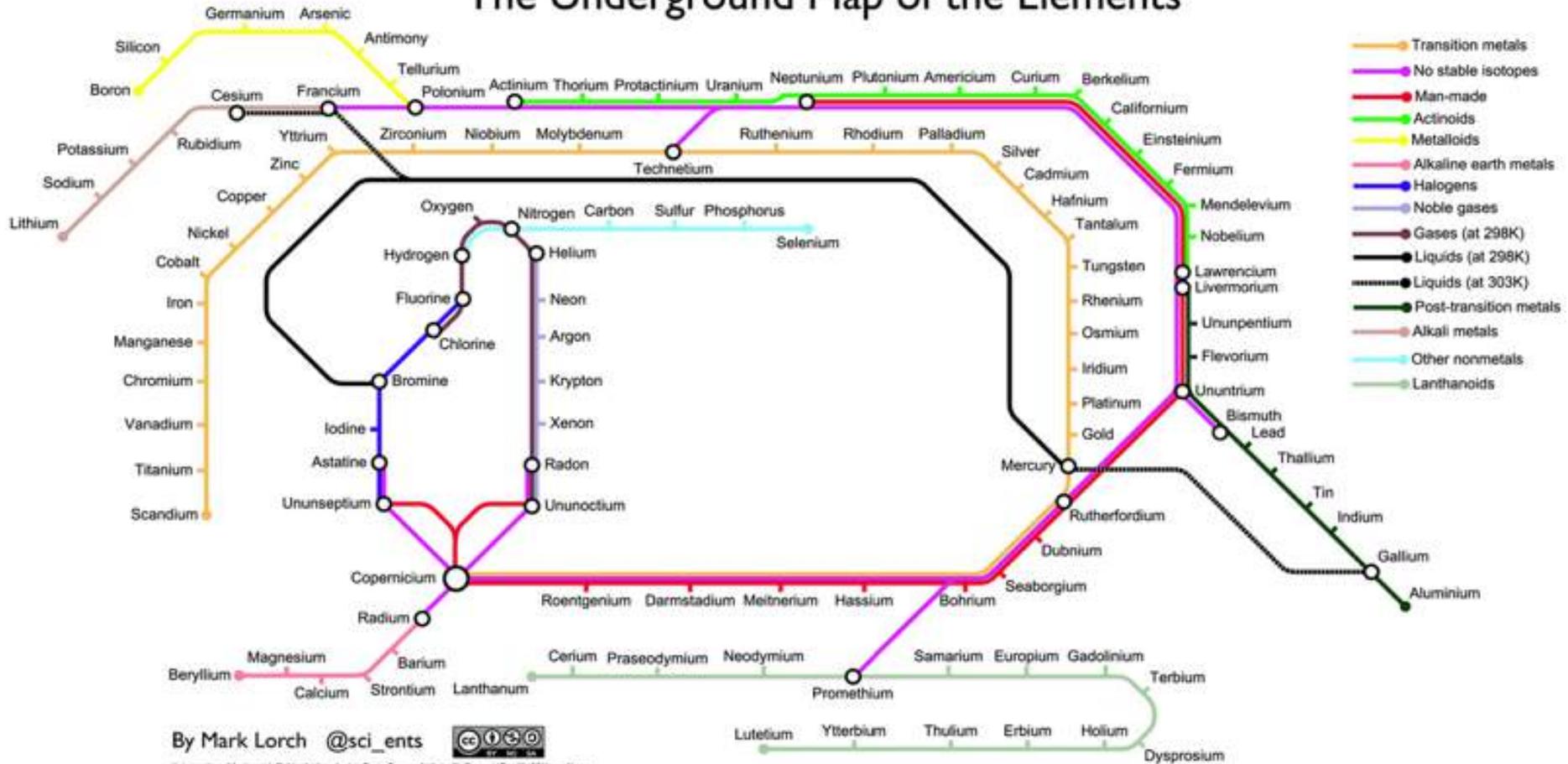
Tavole Periodiche con forme "esotiche"

Pyramidal periodic table



Tavole Periodiche con forme "esotiche"

The Underground Map of the Elements



Tavole Periodiche che mostrano gli elementi in diretta



University of Iowa (USA)

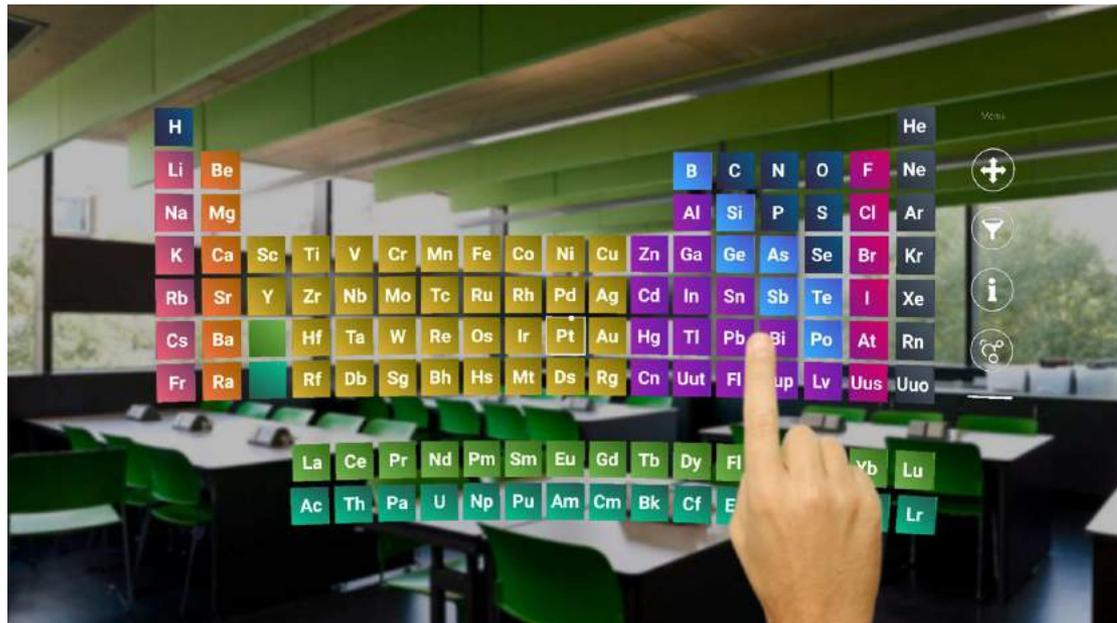
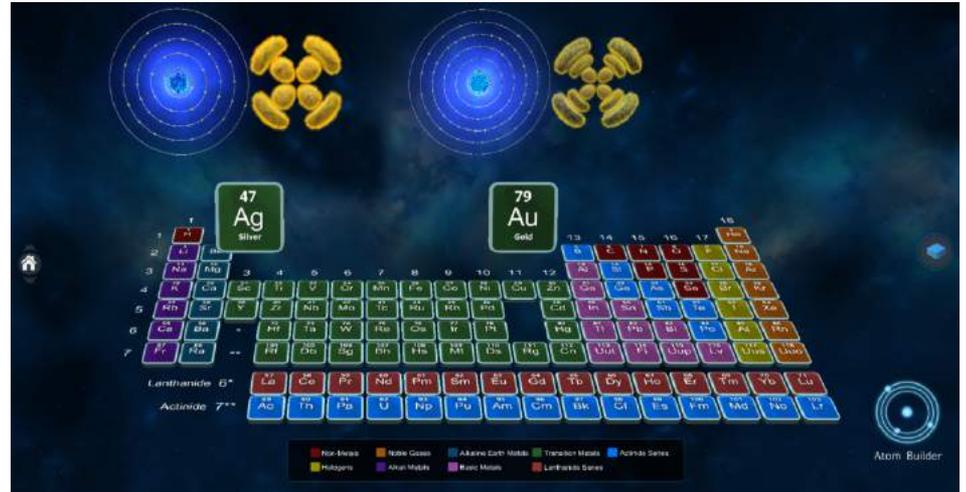
Tavole Periodiche che mostrano gli elementi in diretta



DePauw University, Indiana (USA)



Tavole Periodiche touch

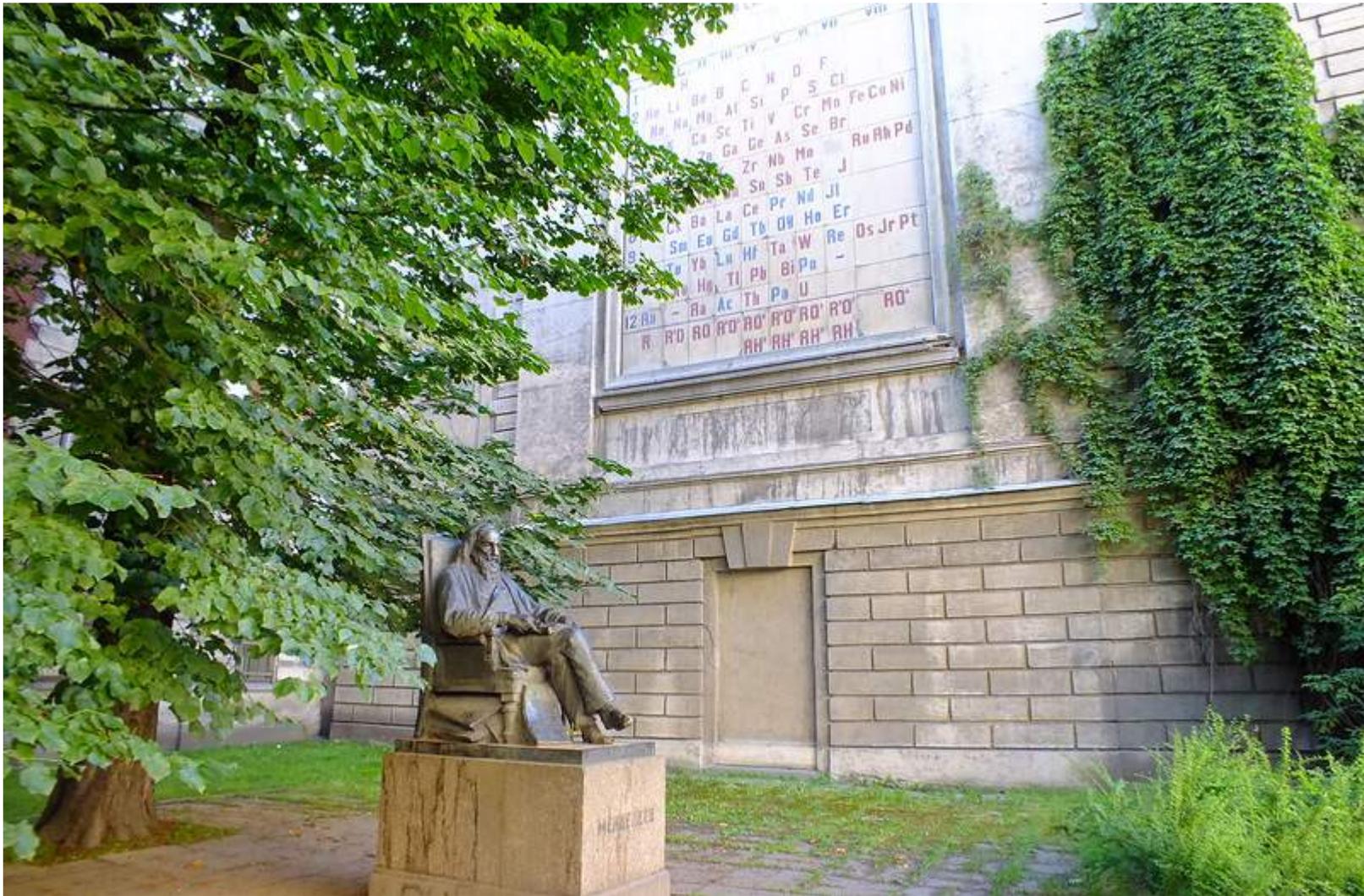


Tavole Periodiche "umane"



Lisbona (Portogallo)

Monumenti dedicati alla Tavola Periodica



San Pietroburgo

Monumenti dedicati alla Tavola Periodica



Bratislava, Slovacchia

Tavole Periodiche grandissime



Murcia (Spagna)

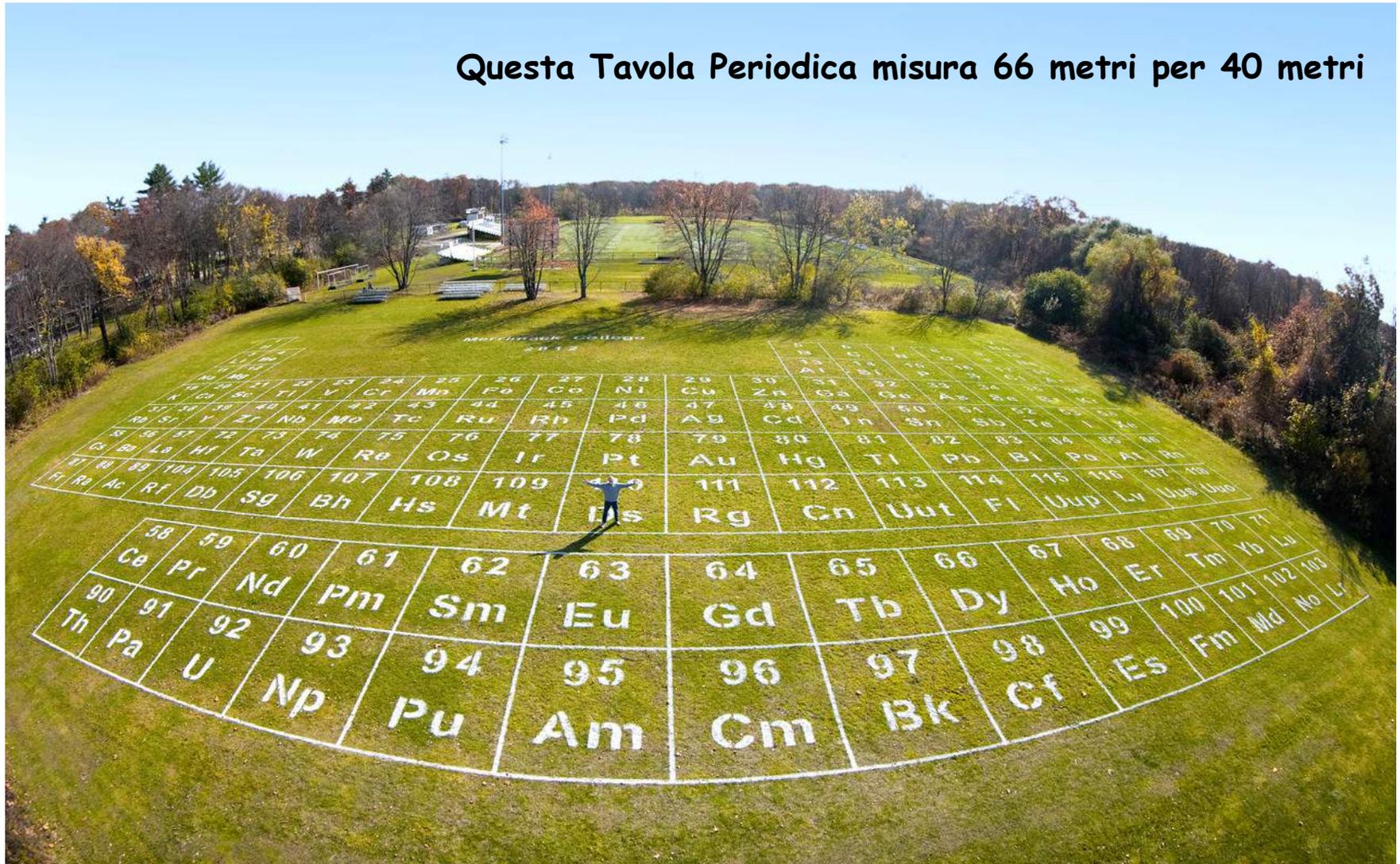
Tavole Periodiche grandissime



Daley Center, Chicago (USA)

Tavole Periodiche grandissime

Questa Tavola Periodica misura 66 metri per 40 metri



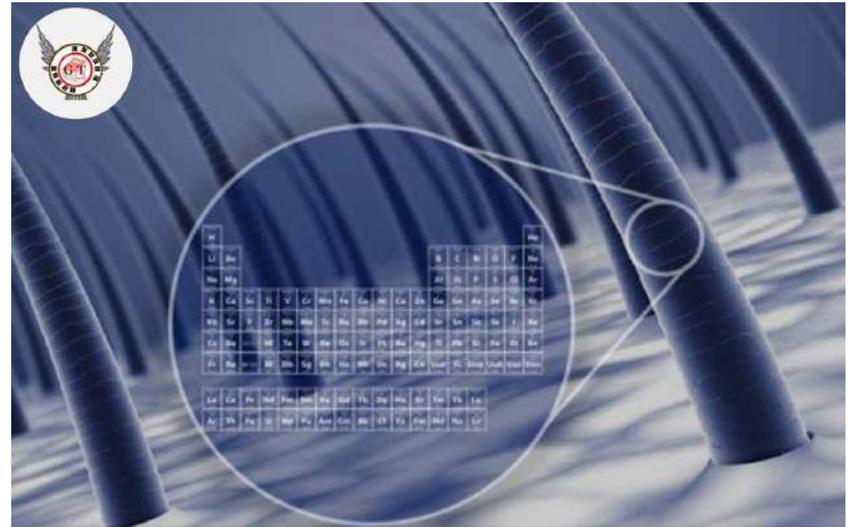
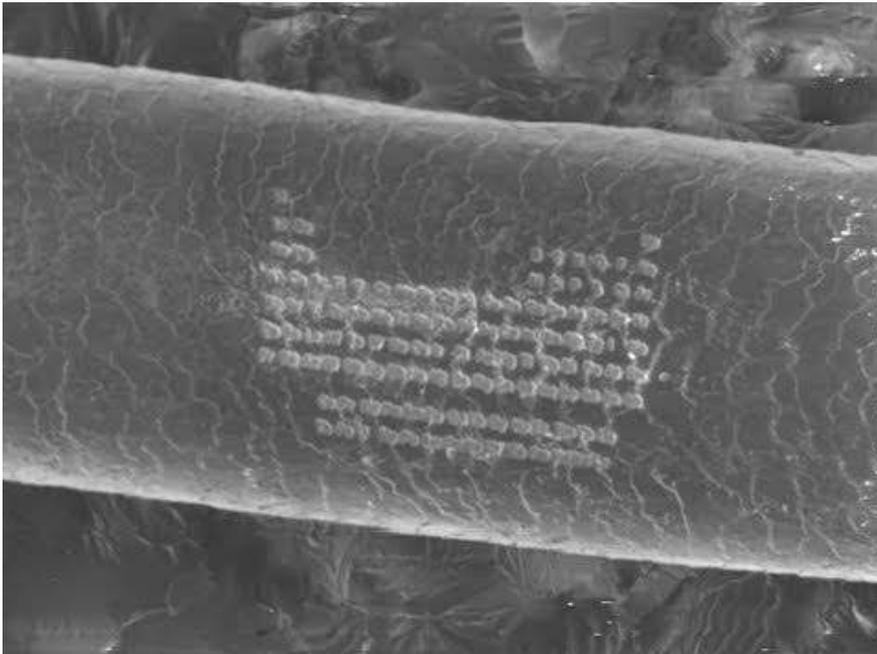
Merrimack College, North Andover, MA (USA)

Una Tavola Periodica molto piccola



La Tavola Periodica più piccola al mondo è stata realizzata nel dicembre 2010: un regalo per il compleanno del Prof. Martyn Poliakoff

La Tavola Periodica è stata incisa su un capello di Poliakoff usando un fascio di ioni e un microscopio ad elettroni: misura 89,67 micron in larghezza e 46,39 micron in altezza



World's smallest periodic table was created on a strand of hair at the University of Nottingham. In this periodic table, each symbol measures about 4 millionths of a meter across.

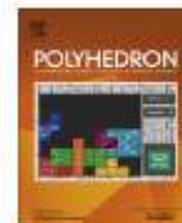
**Alcune considerazioni
conclusive**



Contents lists available at [ScienceDirect](#)

Polyhedron

journal homepage: www.elsevier.com/locate/poly



Review

Row 7 of the periodic table complete: Can we expect more new elements; and if so, when?

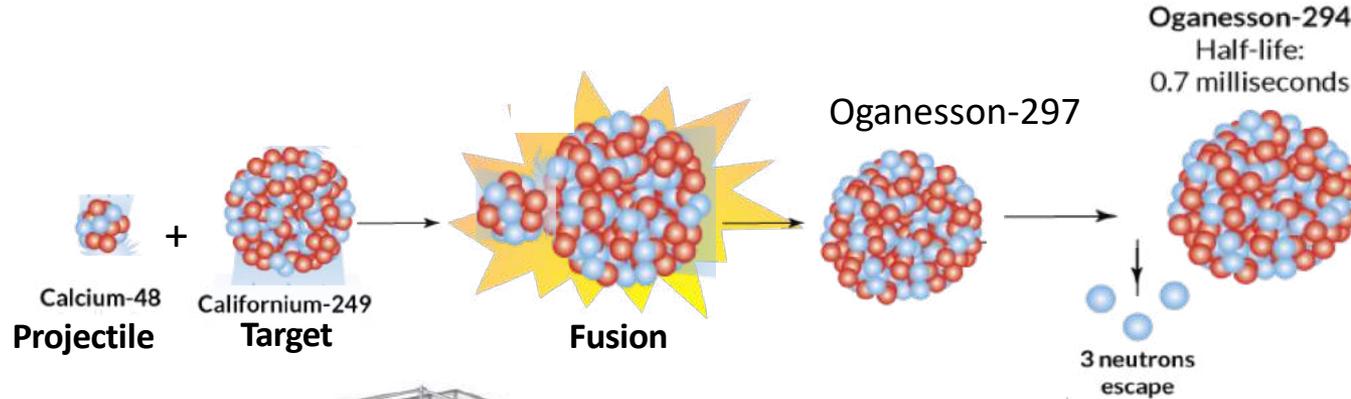


Jan Reedijk

Ora che il settimo periodo è stato completato gli scienziati si stanno ponendo alcune domande:

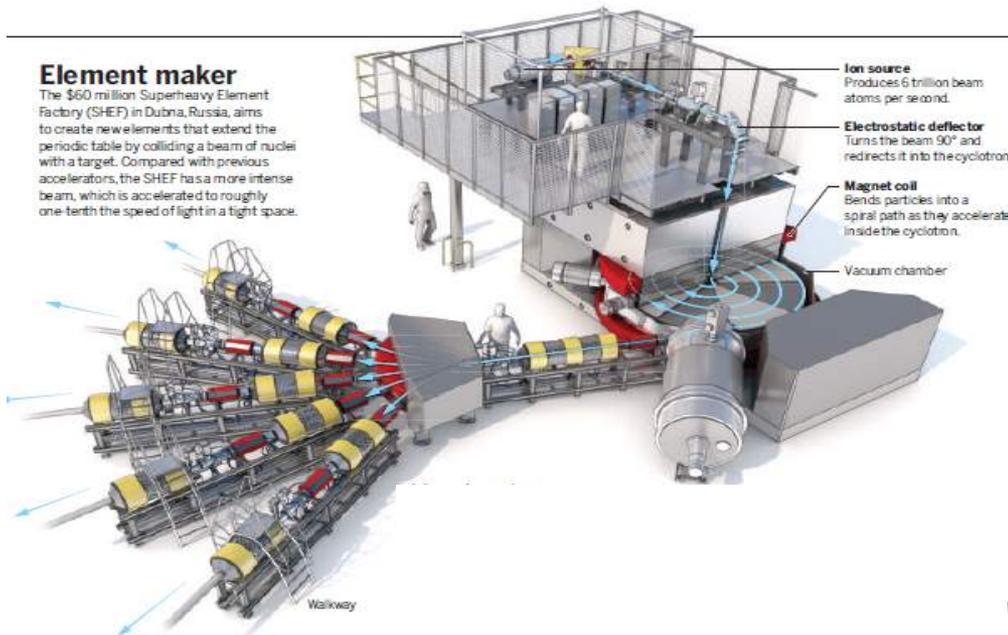
Quanti altri elementi possono essere aggiunti? La Tavola Periodica è veramente un documento "senza fine"?

Gli elementi superpesanti si ottengono con un processo simile alla nucleosintesi che avviene nelle stelle



Element maker

The \$60 million Superheavy Element Factory (SHEF) in Dubna, Russia, aims to create new elements that extend the periodic table by colliding a beam of nuclei with a target. Compared with previous accelerators, the SHEF has a more intense beam, which is accelerated to roughly one-tenth the speed of light in a tight space.



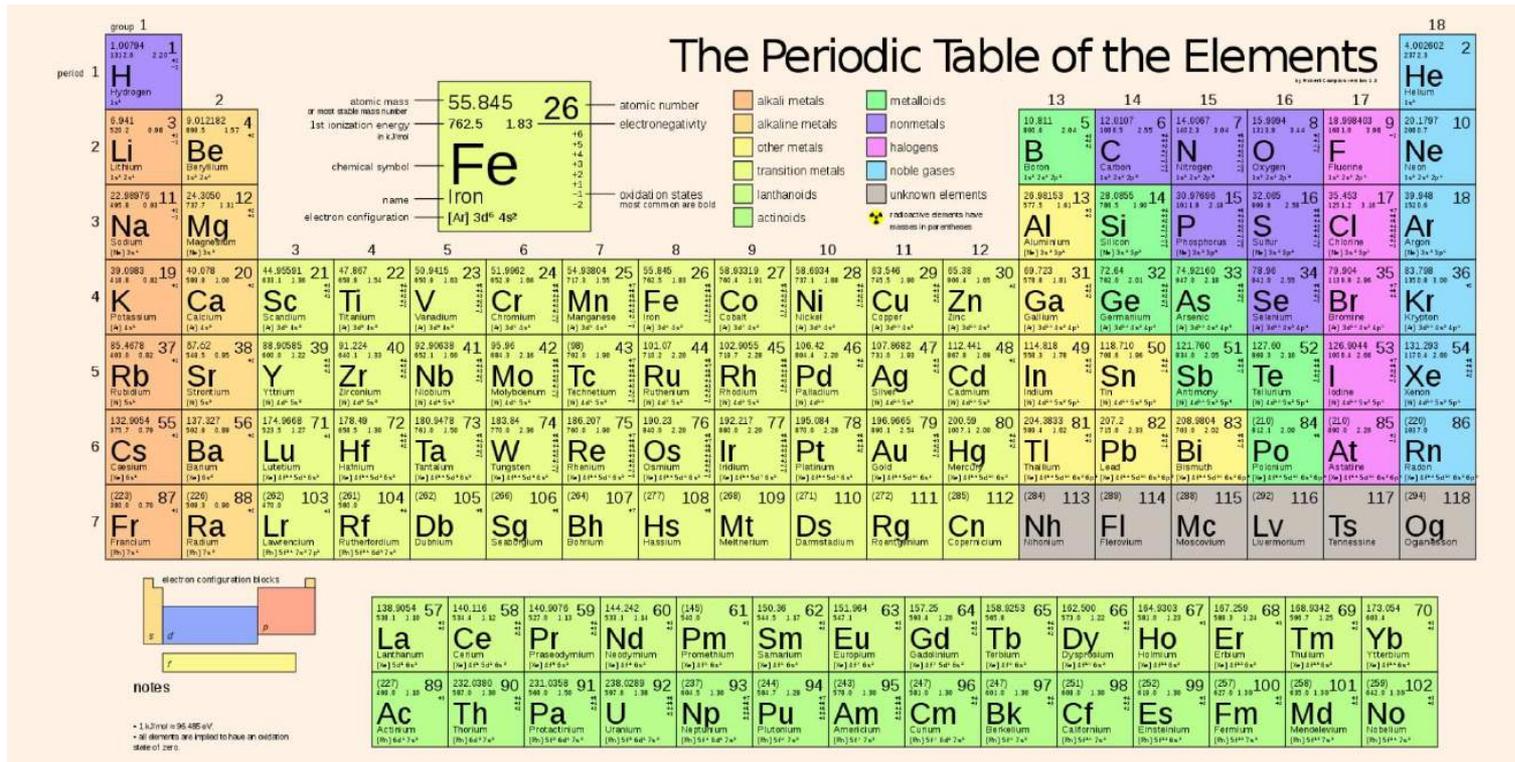
Creation, separation, and detection

The beam is split and redirected toward the target, separator, and detector in another room (right).



Nessun nuovo elemento prima di 5 anni

La domanda più "intrigante" per i chimici: poiché gli ultimi elementi creati hanno proprietà molto diverse da quelle degli elementi che li precedono nello stesso gruppo, ha senso mantenere l'attuale concetto di periodicità e di Tavola Periodica?



Mendeleev ha detto:

Negli elementi, che scopriamo ovunque attorno a noi e senza i quali neanche il cielo stellato esisterebbe, noi ritroviamo al tempo stesso le loro peculiarità individuali, la loro molteplicità infinita e la sottomissione alla generale armonia della Natura