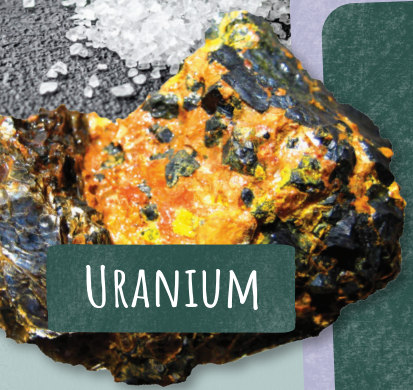


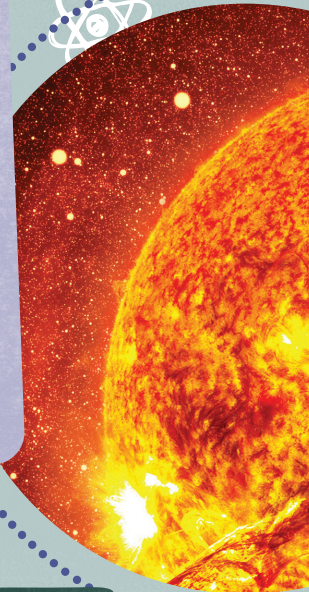


LITHIUM



URANIUM

# The BOOK of ELEMENTS



Erin Sprout and Isaac M. Hagenbuch, PhD



BISMUTH CRYSTAL

MERCURY



THE GOOD AND THE BEAUTIFUL LIBRARY



# WHEN DID HUMANS START STUDYING THE ELEMENTS?

The Lord created humans as curious creatures. We have always asked fundamental questions like “What is the earth made out of?” and “How do the heavens move?” This inquisitive nature is part of what makes humans different from all other life. In the ancient world, different groups of people had different ideas about the answers to these fundamental questions.

In the Far East, the Chinese asked questions about the earth and developed answers based on five elements: wood, fire, earth, metal, and water. They did not mean the same thing as modern people do by “elements,” but you will see the Chinese weren’t alone in the pursuit of the constituents of the material world.

At the same time as the Chinese, some ancient Greeks developed a system of four elements: fire, earth, air, and water. Aristotle added “æther” [EE-ther] to the list to explain how stars and planets move through the sky and how we can see their light.

But what do we call elements nowadays? Well, ancient man discovered at least nine of them, though they weren’t known as elements. These included gold, silver, copper, iron, lead, tin, mercury, sulfur, and carbon.



ALKALI METAL

ALKALINE EARTH METAL

TRANSITION METAL

POST-TRANSITION METAL

METALLOID

LANTHANIDE

ACTINIDE

NONMETAL

HALOGEN

NOBLE GAS

UNKNOWN CHEMICAL PROPERTIES

# PERIODIC TABLE OF THE ELEMENTS

State of matter  
(color of name)

**GAS**  
**LIQUID**  
**SOLID**  
**UNKNOWN**

1 IA <b>H</b> Hydrogen 1.008	2 IIA <b>He</b> Helium 4.002602											13 IIIA <b>B</b> Boron 10.81	14 IVA <b>C</b> Carbon 12.011	15 VA <b>N</b> Nitrogen 14.007	16 VIA <b>O</b> Oxygen 15.999	17 VIIA <b>F</b> Fluorine 18.998403163	18 VIIIA <b>Ne</b> Neon 20.1797
3 <b>Li</b> Lithium 6.94	4 <b>Be</b> Beryllium 9.0121831	Atomic Number → <b>1</b> ← Symbol										Name → <b>Hydrogen</b> ← Atomic Weight					
11 <b>Na</b> Sodium 22.98976928	12 <b>Mg</b> Magnesium 24.305	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 VIIIB	9 VIIIB	10 VIIIB	11 IB	12 IIB	13 IIIA <b>Al</b> Aluminium 26.9815385	14 IVA <b>Si</b> Silicon 28.085	15 VA <b>P</b> Phosphorus 30.973761998	16 VIA <b>S</b> Sulfur 32.06	17 VIIA <b>Cl</b> Chlorine 35.45	18 VIIIA <b>Ar</b> Argon 39.948
19 <b>K</b> Potassium 39.0983	20 <b>Ca</b> Calcium 40.078	21 <b>Sc</b> Scandium 44.955908	22 <b>Ti</b> Titanium 47.867	23 <b>V</b> Vanadium 50.9415	24 <b>Cr</b> Chromium 51.9961	25 <b>Mn</b> Manganese 54.938044	26 <b>Fe</b> Iron 55.845	27 <b>Co</b> Cobalt 58.933194	28 <b>Ni</b> Nickel 58.6934	29 <b>Cu</b> Copper 63.546	30 <b>Zn</b> Zinc 65.38	31 <b>Ga</b> Gallium 69.723	32 <b>Ge</b> Germanium 72.630	33 <b>As</b> Arsenic 74.921595	34 <b>Se</b> Selenium 78.971	35 <b>Br</b> Bromine 79.904	36 <b>Kr</b> Krypton 83.798
37 <b>Rb</b> Rubidium 85.4678	38 <b>Sr</b> Strontium 87.62	39 <b>Y</b> Yttrium 88.90584	40 <b>Zr</b> Zirconium 91.224	41 <b>Nb</b> Niobium 92.90637	42 <b>Mo</b> Molybdenum 95.95	43 <b>Tc</b> Technetium (98)	44 <b>Ru</b> Ruthenium 101.07	45 <b>Rh</b> Rhodium 102.90550	46 <b>Pd</b> Palladium 106.42	47 <b>Ag</b> Silver 107.8682	48 <b>Cd</b> Cadmium 112.414	49 <b>In</b> Indium 114.818	50 <b>Sn</b> Tin 118.710	51 <b>Sb</b> Antimony 121.760	52 <b>Te</b> Tellurium 127.60	53 <b>I</b> Iodine 126.90447	54 <b>Xe</b> Xenon 131.293
55 <b>Cs</b> Cesium 132.90545196	56 <b>Ba</b> Barium 137.327	57 - 71 Lanthanoids	72 <b>Hf</b> Hafnium 178.49	73 <b>Ta</b> Tantalum 180.94788	74 <b>W</b> Tungsten 183.84	75 <b>Re</b> Rhenium 186.207	76 <b>Os</b> Osmium 190.23	77 <b>Ir</b> Iridium 192.217	78 <b>Pt</b> Platinum 195.084	79 <b>Au</b> Gold 196.966569	80 <b>Hg</b> Mercury 200.592	81 <b>Tl</b> Thallium 204.38	82 <b>Pb</b> Lead 207.2	83 <b>Bi</b> Bismuth 208.98040	84 <b>Po</b> Polonium (209)	85 <b>At</b> Astatine (210)	86 <b>Rn</b> Radon (222)
87 <b>Fr</b> Francium (223)	88 <b>Ra</b> Radium (226)	89 - 103 Actinoids	104 <b>Rf</b> Rutherfordium (267)	105 <b>Db</b> Dubnium (268)	106 <b>Sg</b> Seaborgium (269)	107 <b>Bh</b> Bohrium (270)	108 <b>Hs</b> Hassium (269)	109 <b>Mt</b> Meitnerium (278)	110 <b>Ds</b> Darmstadtium (281)	111 <b>Rg</b> Roentgenium (282)	112 <b>Cn</b> Copernicium (285)	113 <b>Nh</b> Nihonium (286)	114 <b>Fl</b> Flerovium (289)	115 <b>Mc</b> Moscovium (289)	116 <b>Lv</b> Livermorium (293)	117 <b>Ts</b> Tennessine (294)	118 <b>Og</b> Oganesson (294)

57 <b>La</b> Lanthanum 138.90547	58 <b>Ce</b> Cerium 140.116	59 <b>Pr</b> Praseodymium 140.90766	60 <b>Nd</b> Neodymium 144.242	61 <b>Pm</b> Promethium (145)	62 <b>Sm</b> Samarium 150.36	63 <b>Eu</b> Europium 151.964	64 <b>Gd</b> Gadolinium 157.25	65 <b>Tb</b> Terbium 158.92535	66 <b>Dy</b> Dysprosium 162.500	67 <b>Ho</b> Holmium 164.93033	68 <b>Er</b> Erbium 167.259	69 <b>Tm</b> Thulium 168.93422	70 <b>Yb</b> Ytterbium 173.045	71 <b>Lu</b> Lutetium 174.9668
89 <b>Ac</b> Actinium (227)	90 <b>Th</b> Thorium 232.0377	91 <b>Pa</b> Protactinium 231.03588	92 <b>U</b> Uranium 238.02891	93 <b>Np</b> Neptunium (237)	94 <b>Pu</b> Plutonium (244)	95 <b>Am</b> Americium (243)	96 <b>Cm</b> Curium (247)	97 <b>Bk</b> Berkelium (247)	98 <b>Cf</b> Californium (251)	99 <b>Es</b> Einsteinium (252)	100 <b>Fm</b> Fermium (257)	101 <b>Md</b> Mendelevium (258)	102 <b>No</b> Nobelium (259)	103 <b>Lr</b> Lawrencium (266)

# LITHIUM

Lithium (Li) is another element for which we have many uses! It can be given in a pill to people with certain mental illnesses to relieve their symptoms. The power of lithium has been harnessed in the form of lithium-ion battery technology, which is used in many things from flashlights to electric vehicles. Lithium is refined by mining and processing spodumene [SPOD-you-mean], also known as lithium aluminum silicate, which is found in only a few places on Earth.



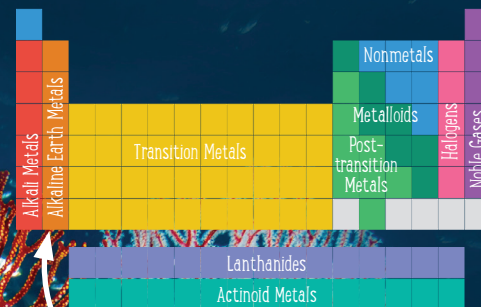
## ALKALINE EARTH METALS

# ALKALINE EARTH METALS

Alkaline earth metals are usually shiny white or gray and are solid. They include beryllium (Be), magnesium (Mg), calcium (Ca), strontium (Sr), barium (Ba), and radium (Ra).

Ca

Calcium is an important element in our bodies. It gives strength and structure to bones! It is also the same element that makes some corals hard.



4  
**Be**  
Beryllium  
9.0121831

12  
**Mg**  
Magnesium  
24.305

20  
**Ca**  
Calcium  
40.078

38  
**Sr**  
Strontium  
87.62

56  
**Ba**  
Barium  
137.327

88  
**Ra**  
Radium  
(226)

## MURKY MERCURY

Mercury (Hg) is toxic to living things. Because of this, mercury is used in an antiseptic that can stop the spread of harmful bacteria. Mercury has long been known as "quicksilver" for its metallic sheen and swiftly flowing liquid form at room temperature. Many cultures believed that it conferred health benefits.

**Q:** Many element symbols are derived from their name. Why is tungsten given W as a symbol?




**A:** Because when it was first identified as an element in 1781, it was called wolfram!

TRANSITION  
METALS

The first emperor of China, Qin Shi Huang, is thought to have died in 210 BC from mercury poisoning. He drank an elixir of mercury because he thought it would give him eternal life. His tomb hasn't been explored, but scientists have detected a potentially large amount of mercury from soil samples taken in the area.



MERCURY



Many post-transition metals are used as alloys—metals added to each other to create a new material.



## POST-TRANSITION METALS



# ALUMINUM IS VERY RECYCLABLE!



It can be melted down and combined with other elements to make new things. Almost all aluminum can be reused without wasting much of it.



Post-transition metals have other metals added to them to strengthen them and make them usable. For example, pure aluminum (Al) was once used in power lines, but because it broke too easily, aluminum alloy 6201 is commonly used instead. This alloy contains 98.5% aluminum, 0.8% magnesium, and 0.70% silicon.



ALUMINUM



## NONMETALS

# NONMETALS

In addition to carbon (C), nitrogen (N), oxygen (O), phosphorus (P), sulfur (S), and selenium (Se), the nonmetals group also includes the elements that make up the halogens group—fluorine (F), chlorine (Cl), bromine (Br), iodine (I), and astatine (At).

This group includes some very familiar and important elements! Some of these are essential for life.

6 <b>C</b> Carbon 12.011	7 <b>N</b> Nitrogen 14.007	8 <b>O</b> Oxygen 15.999	9 <b>F</b> Fluorine 18.998403163
15 <b>P</b> Phosphorus 30.973761998	16 <b>S</b> Sulfur 32.06	17 <b>Cl</b> Chlorine 35.45	
	34 <b>Se</b> Selenium 78.971	35 <b>Br</b> Bromine 79.904	
		53 <b>I</b> Iodine 126.90447	
		85 <b>At</b> Astatine (210)	

Alkali Metals, Alkaline Earth Metals, Transition Metals, Lanthanides, Actinoid Metals, Nonmetals, Metalloids, Post-transition Metals, Halogens, Noble Gases

Carbonized fossils are formed when an organism's remains are exposed to intense pressure and heat, releasing gases and liquids and forming a hard, fossilized imprint of the organism's silhouette. This imprint is preserved in a thin layer of carbon.

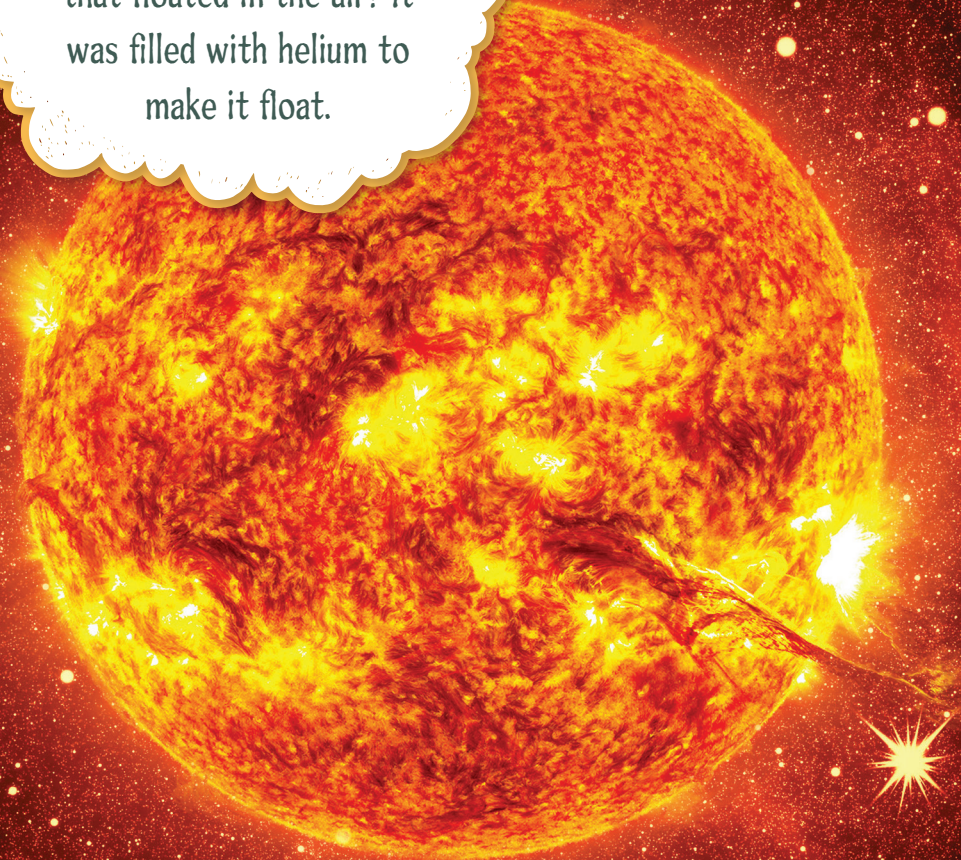


## HELLO, HELIUM!

Helium (He) is the most abundant and common element in the universe after hydrogen. It is named for Helios, the mythical Greek god of the sun, because helium is a large component of the sun.

Helium, which has only two protons in its nucleus, is made by the fusion of two hydrogen atoms. This fusion gives off tremendous energy and is believed to be the chemistry powering our sun and other stars. Maybe someday humans will master fusion as an energy source!

Have you ever had a balloon that floated in the air? It was filled with helium to make it float.



# The BOOK of ELEMENTS

Have you ever wondered what the earth, planets, and stars are made of? In *The Book of Elements*, you will be taken on a journey through God's orderly creation, where elements are clearly defined and behave in predictable ways. We will encounter the periodic table and learn how and why the elements are organized.

 ORIGINAL PUBLICATION

In this book, you will encounter some of the greatest scientific achievements, some fascinating questions, and some facts:

- Where do the sun's light and heat come from?
- What do ancient plumbing and car batteries have in common?
- What do ancient Roman engineering and the Empire State Building have in common?



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