

LESSON 6

ELEMENTARY ELEMENTS

Goal: To identify elements as the purest form of matter and understand their organization on the periodic table.

Gold! Pure gold! Imagine the excitement in a prospector's voice as he finds gold—especially pure gold. When scientists think of a substance that is pure, they are usually thinking of an element.

Remember, everything you see and touch is matter. Matter can be made entirely of one kind of material or of different materials combined. An **element** is the purest form of matter that exists. Gold, sodium, and carbon are all elements. Each of these examples is made of only one kind of atom; gold has only gold atoms, sodium has only sodium atoms, and so on. All the known elements in the universe are organized by their physical properties in the **periodic table of the elements**. This table contains very important information that we will study throughout the next several lessons.



Most jewelry worn every day is not pure gold; instead, it has other metals added to it.

PERIODIC TABLE

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H 1.008 Hydrogen	2 He 4.002602 Helium	3 Li 6.94 Lithium	4 Be 9.0121831 Beryllium	5 B 10.81 Boron	6 C 12.011 Carbon	7 N 14.007 Nitrogen	8 O 15.999 Oxygen	9 F 18.998403163 Fluorine	10 Ne 20.1797 Neon	11 Na 22.98976928 Sodium	12 Mg 24.305 Magnesium	13 Al 26.9815385 Aluminum	14 Si 28.085 Silicon	15 P 30.973761998 Phosphorus	16 S 32.06 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.948 Argon
19 K 39.0983 Potassium	20 Ca 40.078 Calcium	21 Sc 44.955908 Scandium	22 Ti 47.867 Titanium	23 V 50.9415 Vanadium	24 Cr 51.9961 Chromium	25 Mn 54.938044 Manganese	26 Fe 55.845 Iron	27 Co 58.933194 Cobalt	28 Ni 58.6934 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.630 Germanium	33 As 74.921595 Arsenic	34 Se 78.971 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
37 Rb 85.4678 Rubidium	38 Sr 87.62 Strontium	39 Y 88.90584 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.90637 Niobium	42 Mo 95.95 Molybdenum	43 Tc 98 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.90550 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.8682 Silver	48 Cd 112.414 Cadmium	49 In 114.818 Indium	50 Sn 118.710 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.90447 Iodine	54 Xe 131.293 Xenon
55 Cs 132.90545196 Cesium	56 Ba 137.327 Barium	57 La 138.90547 Lanthanum	58 Ce 140.116 Cerium	59 Pr 140.90766 Praseodymium	60 Nd 144.242 Neodymium	61 Pm 145 Promethium	62 Sm 150.36 Samarium	63 Eu 151.964 Europium	64 Gd 157.25 Gadolinium	65 Tb 158.92535 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.93033 Holmium	68 Er 167.259 Erbium	69 Tm 168.93422 Thulium	70 Yb 173.054 Ytterbium	71 Lu 174.9668 Lutetium	72 Hf 178.49 Hafnium
87 Fr 223 Francium	88 Ra 226 Radium	89 Ac 227 Actinium	90 Th 232.0377 Thorium	91 Pa 231.03588 Protactinium	92 U 238.02891 Uranium	93 Np 237 Neptunium	94 Pu 244 Plutonium	95 Am 243 Americium	96 Cm 247 Curium	97 Bk 247 Berkelium	98 Cf 251 Californium	99 Es 252 Einsteinium	100 Fm 257 Fermium	101 Md 258 Mendelevium	102 No 259 Nobelium	103 Lr 266 Lawrencium	104 Rf 267 Rutherfordium
107 Bo 100.961156 Bohrium	108 Hs 269 Hassium	109 Mt 278 Meitnerium	110 Ds 281 Darmstadtium	111 Rg 282 Roentgenium	112 Cn 285 Copernicium	113 Nh 286 Nihonium	114 Fl 289 Flerovium	115 Mc 289 Moscovium	116 Lv 293 Livermorium	117 Ts 294 Tennessine	118 Og 294 Oganesson	119 Ts 294 Tennessine	120 Lv 293 Livermorium	121 Nh 286 Nihonium	122 Ds 281 Darmstadtium	123 Rg 282 Roentgenium	124 Cn 285 Copernicium

Atomic Number
↓

Symbol
↓

Atomic Mass
↓

Name
↓

Ce
140.116
Cerium

- Alkali Metal
- Alkaline Earth
- Transition Metal
- Basic Metal
- Semimetal
- Nonmetal
- Halogen
- Noble Gas
- Lanthanide
- Actinide

Lanthanide Series

Actinide Series



LESSON 6

Nitrogen
14.007

P
Phosphorus
30.974

As
Arsenic
74.922

Sb
Antimony
121.76

Bi
Bismuth
208.98

16

34

52

T
Tellurium
127.6

84

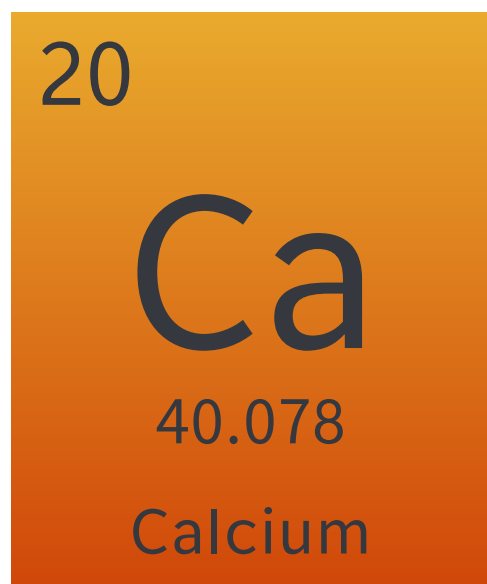
Po
Polonium

116

There are 3 ways to categorize how elements exist. First, scientists have discovered about 92 elements that exist naturally in creation. Second, there are several more that occur in very small amounts, so scientists disagree about whether those can be labeled as naturally occurring. That brings the number to 98. Third, about 20 elements have been manufactured in a laboratory. Even the ones made in the lab are made from elements that already existed—just changed somewhat.

As elements were discovered, scientists named them based on who discovered them, their properties, and or the place where they were originally found. Chemists usually write element names in an abbreviated form called a **symbol** that uses 1 or 2 letters of the alphabet. Some are easy to remember, such as O for oxygen, N for nitrogen, H for hydrogen, Ca for calcium, I for iodine, S for sulfur, and Al for aluminum. Some symbols come from the Latin name for the element, such as Au (*aurum*) for gold and Ag (*argentum*)

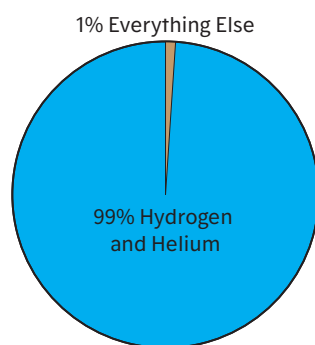
for silver. Does *argentum* sound like any other word you may have heard? The name *Argentina*, which is the country known as the land of silver, is derived from this word.



Ca is the symbol for calcium. C is used for carbon.

There is one element that makes up most of the matter in the universe. Can you guess which one it is? (It is not gold!) About 75% of all matter in the universe has hydrogen in it, including our bodies, plants, water, and even Earth's crust. The second most common element is helium (He), which is found in more places than just balloons. Helium makes up about 24% of matter and is found under Earth's crust. This means that the rest of the elements are much less common and make up only about 1% of matter.

It is not just on Earth that these elements are found but throughout the universe. Elements are in our atmosphere and on other planets.



Hydrogen and helium make up the majority of elements on Earth and in the universe.

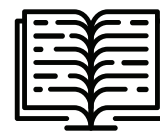
Matter on Mars or in stars comes from the same elements as matter on Earth. Jupiter is made up mainly of hydrogen and helium. Uranus, which is also known as an ice giant, has massive amounts of frozen water, which is made of hydrogen and oxygen. God created these unique building blocks that make up all matter in our universe.



Jupiter is a planet made mostly of hydrogen and helium. If you managed to visit, you would find no ground to walk on.

Just like an element is pure, the way elements combine can be pure. A **pure substance** is made of only one element; its composition is the same throughout. Nitrogen gas is a good example; it's made of only one element—nitrogen. Just like our example earlier, pure gold has nothing else mixed with it.

All matter in the universe is made up of these elements. Our God is a god of order and design, so it's no surprise that He created the smallest parts of everything with order and design as well!



VOCABULARY

element
periodic table of the elements
symbol
pure substance



SCRIPTURE MEMORY

Colossians 1:16: “For by Him all things were created, both in the heavens and on earth, visible and invisible, whether thrones, or dominions, or rulers, or authorities—all things have been created through Him and for Him.”

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14.007

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CREATION CORNER

SILVER

Did you know that nothing rhymes with the word *silver*? There are also scientific things that make silver a unique metal on the periodic table. It is very lustrous and malleable, which means that it can easily be bent into beautiful jewelry and tableware. Silver was one of the first metals to be discovered and the first metal to be used in currency; the United States minted the silver dollar in 1794. It is a better conductor of electricity than gold and copper. But perhaps the most interesting fact about silver is its germ-fighting qualities. A cup or spoon made of silver can kill microbes, fungi, or viruses. The phrase “born with a silver spoon in his mouth” usually refers to a baby born into a wealthy family; however, many people also think it can refer to the health of a baby because of the silver in the spoon. The ancient Greeks used it for stomach pain or to heal wounds. Now silver can be used to purify water or be made into an antiseptic. Even more fascinating is that bacteria don’t become resistant to silver like they do with antibiotics.



MEET THE CHEMIST

STEPHANIE KWOLEK (1923–2014)

When you see a police officer on duty, you will usually notice that he is wearing a bulletproof vest to protect his torso from life-threatening weapons. That body armor is made from Kevlar, a material developed by American chemist Stephanie Kwolek. Kwolek grew up studying nature with her father and learning sewing with her mother. She was an avid reader and found it very easy to memorize information. As a chemist, she worked at a DuPont research laboratory, developing a compound called poly-paraphenylene terephthalamide. Although Kwolek was originally trying to find a material to make tires stronger, her studies demonstrated that the stiff material had incredible strength—enough to stop a bullet. It is stronger than steel and doesn't rust. In addition to the Kevlar that makes bulletproof vests, the compound is used in helmets, tires, ropes, cables, and space equipment. Kwolek won numerous awards for her research, including induction into the National Inventors Hall of Fame. More importantly, her invention has saved thousands of lives.

