

Table of Contents

Elements of the Periodic Table

Hydrogen	6
Helium	8
Lithium	10
Beryllium	12
Boron	14
Carbon	16
Nitrogen	18
Oxygen	20
Fluorine	22
Neon	24
Sodium	26
Magnesium	28
Aluminum	30
Silicon	32
Phosphorus	34
Sulfur	36
Chlorine	38
Argon	40
Potassium	42
Calcium	44
Scandium	46
Titanium	48
Vanadium	50
Chromium	52
Manganese	54
Iron	56
Cobalt	58
Nickel	60
Copper	62
Zinc	64
Gallium	66
Germanium	68
Arsenic	70
Selenium	72
Bromine	74
Krypton	76

Rubidium	78
Strontium	80
Yttrium	82
Zirconium	84
Niobium	86
Molybdenum	88
Technetium	90
Ruthenium	92
Rhodium	94
Palladium	96
Silver	98
Cadmium	100
Indium	102
Tin	104

Elements in Action

The Electrolysis of Water	106
Displacement of Helium	110
Using Borax to Make Slime	112
Generating Carbon Dioxide	114
Fluoride Protection	116
Generation of Chlorine Gas by Electrolysis	118
Study of Calcium and Collagen in Bones	120
Finding Iron Particles in Your Nutritious Breakfast Cereal	122
Electroplating a Quarter with a Thin Layer of Copper	124
Study a "Hygroscopic" Zirconium Compound	126
Quick Quiz Answers	128
Glossary	130
Index	132
Elements of Faith: Periodic Table	134
Selected Bibliography	136

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HYDROGEN: "Forming Water"

"And the Spirit of God moved upon the face of the waters." (Gen. 1:2)



1 H Hydrogen 1.0079	4 Be Beryllium 9.0122	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938	26 Fe Iron 55.845	45 Rh Rhodium 102.9055	46 Pd Palladium 106.42
3 Li Lithium 6.941	12 Mg Magnesium 24.305	22 Ti Titanium 47.867	41 Nb Niobium 92.9064	42 Mo Molybdenum 95.94	43 Tc Technetium (98)	44 Ru Ruthenium 101.07	78 Pt Platinum 195.084
71 Na Sodium 22.9897	20 Ca Calcium 40.078	21 Sc Scandium 44.9559	40 Zr Zirconium 91.224	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.217
19 K Potassium 39.098	38 Sr Strontium 87.62	39 Y Yttrium 88.9059	72 Hf Hafnium 178.49	105 Db Dubnium (262)	106 Sg Seaborgium (266)	107 Bh Bohrium (264)	109 Mt Meitnerium (268)
37 Rb Rubidium 85.4678	56 Ba Barium 137.327	88 Ra Radium (226)	73 Ta Tantalum 180.9479	57 La Lanthanum 138.9055	58 Ce Cerium 140.116	60 Nd Neodymium 144.24	61 Pm Promethium 144.9128
55 Cs Cesium 132.9055	87 Fr Francium (223)		104 Rf Rutherfordium (261)	89 Ac Actinium 227.03	90 Th Thorium 232.0381	91 Pa Protactinium 231.0369	92 U Uranium 238.0289

DATA

- > Hydrogen is the most abundant element in the universe, making up over 90 percent of it.
- > It was discovered in 1766 by the English chemist Henry Cavendish, who later (1781) showed that water was formed by the combustion of hydrogen in air.
- > The word hydrogen comes from two Greek words: *hydros* and *genes*, meaning "water forming."
- > As a gas, hydrogen is a diatomic molecule with the formula H•H or H₂.
- > The formula for water is H₂O.



ANALYSIS

In all of nature, there is nothing quite so beautiful and yet so simple as water. Science gives us a special appreciation for it. Two tiny hydrogen atoms and a single oxygen combine to form the most abundant compound on earth, so common we may be tempted to take it for granted. From a delicate crystal snowflake to the mightiest ocean wave . . . from the clouds of a blazing sunset to a raging waterfall . . . all of these wonders of creation owe their beauty to the unique boomerang shape of the humble little molecule, H₂O.

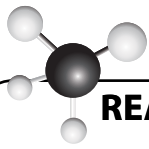
WHAT MAKES WATER UNIQUE? Water, made up of just three small atoms, is considered to be a "light" molecule. Most molecules of similar size (methane [CH₄], ammonia [NH₃], carbon dioxide [CO₂], etc.) are gasses at normal temperatures on earth. But water is a liquid. Why? It is largely due to a phenomenon scientists call the "hydrogen bond," although it is hardly a bond at all. It is just a fleeting attraction among water molecules as they pass each other.

WHAT ARE HYDROGEN BONDS? Although the three atoms in a water molecule share their ten electrons, that sharing is not equal. It is like a very large person and a very thin person sharing a bed on a cold night; the larger one is likely to get more than his share of the blanket. Likewise, in H₂O, the oxygen atom "hogs" more than its share of electrons, giving it a slight negative charge and leaving each positively charged hydrogen nucleus partially exposed. This distribution of charge, along with water's boomerang shape, causes a "tug" between the oxygen in one molecule and the hydrogen in another. This causes water to stick together and remain liquid when other light molecules would evaporate. Without hydrogen bonding, water would boil away at about 150°F below zero! This and other unique properties of water caused by hydrogen bonding allow life to exist.

WHY DOES ICE FLOAT? Hydrogen bonds cause water molecules to arrange themselves in a certain way as the temperature nears freezing, making ice lighter than liquid water, causing it to float. (Water is one of the few substances in which the solid form is lighter than the liquid; another is Bismuth, element no. 83.) Without ice's buoyancy, lakes and rivers in cold climates would freeze solid and remain frozen much of the year.

WHY IS WATER BLUE? Hydrogen bonds absorb certain wavelengths of light to make large quantities of water appear blue.

When we experience the coolness of a drink of water or the comfort of a warm bath, the graceful waves of the sea or the beauty of a sunset, let us never cease to marvel at the wisdom of our Maker, the Creator of the hydrogen bond.



REACTION: LIVING WATER



Today we have many varieties of water to choose from: bottled water, tap water, mineral water, softened water, imported water, and more. But there is a type of water that will never be bought or sold: living water.

When Jesus met a woman at a well in Samaria, He told her that His followers would receive “living water” that would give them eternal life. He said “. . . whoever drinks of this water [Greek: *hydros*] will thirst again, but whoever drinks of the water that I shall give him will never thirst. But the water that I shall give him will become in him a fountain of water springing up into everlasting life” (John 4:10–14).

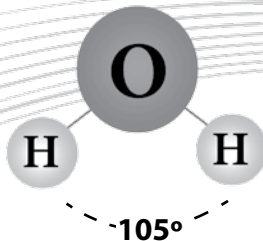
Later John explains (in John 7:39) that living water is actually the Holy Spirit, the same Spirit that moved upon “the face of the waters” in Genesis 1:2. And at the other end of the Bible, in Revelation, we read that living water is free and available to all, when Jesus invites us to . . .

“Come. And let him that is athirst come. And whosoever will, let him take the water of life freely” (Rev. 22:17; KJV).

Just as physical water is needed for biological life, “living water” is vital for our life and growth as Christians. No athlete can compete without consuming enough water, and we cannot expect to grow and prosper in our Christian lives unless we have a healthy amount of the “water of life” in our spiritual diets. All we have to do is ask.



1. What force causes water molecules to be attracted to each other?
 - a. gravity
 - b. magnetism
 - c. hydrogen bonding
 - d. diffusion
2. Which of the following best describes the shape of a water molecule?
 - a. cross
 - b. barbell
 - c. boomerang
 - d. triangle
3. TRUE or FALSE: The hydrogen and oxygen atoms in a water molecule share their electrons equally.
4. The Greek word for “water” is _____. (Fill in the blank.)
5. Hydrogen makes up more than _____ percent of the universe.



The water molecule is shaped like a boomerang.



RESPONSE

“Heavenly Father, thank You for the beauty of our created world. Thank You for the enjoyment we can receive from even the simplest of Your gifts, water itself.

“Give me the gift of living water, so that my soul will be satisfied, and so that I will have the strength each day to do the work You have set before me. Amen.”