

STUDENT GUIDE

Part I: Elements are the Building Blocks

Fundamental Question: What is an element?



Earth is known as the Water Planet. Water can be found on Earth in three states of matter: solid, liquid, and gas.

What other facts do you know about water? Perhaps you sometimes refer to water using its chemical name: H_2O or H_2O . List some facts that you know about water in your Journal.

H_2O is really a formula, identifying the building blocks of water.

Water is a compound made of two distinct pure substances:

Hydrogen (H) and Oxygen (O)

Hydrogen and oxygen each have their own distinctive properties such as: freezing and boiling temperatures, color, reactivity, and mass.

These two unique substances are classified as ELEMENTS. An element is a PURE SUBSTANCE that cannot be broken down into simpler substances and still maintain its chemical identity.

Elements are sometimes described as the building blocks of the universe because all matter in the universe is made of elements. For example, hydrogen and oxygen are the building blocks of water.

Carbon dioxide might be another chemical that is familiar to you because it is the gas that you exhale with each breath. Carbon dioxide is a compound. Its formula is CO_2 .

The **O** in CO_2 is the same oxygen element that you find in water. You may already know the name of the element that **C** stands for, but if you didn't know the name, you could look it up in the Periodic Table of Elements.

Record answers for these questions in your Journal.





STUDENT GUIDE

Part I: Elements are the Building Blocks (continued)

Fundamental Question: What is an element?

1. What is the name of the element that **C** stands for?
2. What is the atomic number for C?

PERIODIC TABLE OF THE ELEMENTS

1 1A																	18 8A																
1 H 1.008 Hydrogen	2 He 4.003 Helium																																
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											13 B 10.812 Boron	14 C 12.011 Carbon	15 N 14.007 Nitrogen	16 O 15.999 Oxygen	17 F 18.998 Fluorine	18 Ne 20.180 Neon																
11 Na 22.990 Sodium	12 Mg 24.305 Magnesium	3 Al 26.982 Aluminum	4 Si 28.086 Silicon	5 P 30.974 Phosphorus	6 S 32.06 Sulfur	7 Cl 35.453 Chlorine	8 Ar 39.948 Argon									19 K 39.098 Potassium	20 Ca 40.078 Calcium	21 Sc 44.956 Scandium	22 Ti 47.867 Titanium	23 V 50.942 Vanadium	24 Cr 51.996 Chromium	25 Mn 54.938 Manganese	26 Fe 55.845 Iron	27 Co 58.933 Cobalt	28 Ni 58.693 Nickel	29 Cu 63.546 Copper	30 Zn 65.38 Zinc	31 Ga 69.723 Gallium	32 Ge 72.64 Germanium	33 As 74.922 Arsenic	34 Se 78.96 Selenium	35 Br 79.904 Bromine	36 Kr 83.798 Krypton
37 Rb 85.468 Rubidium	38 Sr 87.62 Strontium	39 Y 88.906 Yttrium	40 Zr 91.224 Zirconium	41 Nb 92.906 Niobium	42 Mo 95.96 Molybdenum	43 Tc 98 Technetium	44 Ru 101.07 Ruthenium	45 Rh 102.905 Rhodium	46 Pd 106.42 Palladium	47 Ag 107.868 Silver	48 Cd 112.412 Cadmium	49 In 114.818 Indium	50 Sn 118.711 Tin	51 Sb 121.760 Antimony	52 Te 127.60 Tellurium	53 I 126.904 Iodine	54 Xe 131.294 Xenon																
55 Cs 132.905 Cesium	56 Ba 137.328 Barium	57 La 138.905 Lanthanum	58 Ce 140.116 Cerium	59 Pr 140.908 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 158.925 Terbium	66 Dy 162.500 Dysprosium	67 Ho 164.930 Holmium	68 Er 167.259 Erbium	69 Tm 168.934 Thulium	70 Yb 173.055 Ytterbium																		
87 Fr (223) Francium	88 Ra (226) Radium	89 Ac (227) Actinium	90 Th 232.038 Thorium	91 Pa 231.036 Protactinium	92 U 238.029 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																		

Atomic Number

8

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Symbol

O

←

Element Name

Oxygen

16.000

6

C

↑

Element Name

?????

12.011

↑

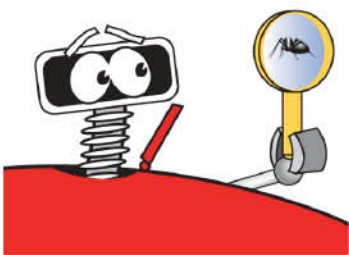
Atomic Mass

Back in 1869, Russian chemist Dimitri Mendeleev organized all the known elements into a chart according to their physical and chemical properties. Today that chart is known as the Periodic Table of Elements. The Periodic Table organizes information about the elements and their properties.

The Periodic Table is made up of horizontal rows and vertical columns of boxes. Each box contains specific information about a single element. This information includes the element's name, the chemical symbol for the element, the element's atomic number, and the element's atomic mass.

Your teacher will provide you with a Periodic Table to color code using the key in the Student Journal. Keep this color-coded Periodic Table for reference during later activities.





STUDENT GUIDE

Part II: The Periodic Table of Elements

Fundamental Question: What is an element?

1. Compare your color-coded Periodic Table with your group members.
2. Locate the boxes for hydrogen (atomic number 1), oxygen (atomic number 8), and carbon (atomic number 6).
3. Consider how the atomic number of each element helped you locate the elements' positions in the Periodic Table.
4. Complete the questions about elements and the Periodic Table in your Student Journal.

Part III: Show and Tell Elements

Fundamental Question: What is an element?

1. Your teacher will supply you with a card providing information on one element.
2. Record the information from your card by placing a check in the appropriate columns of the Show and Tell Elements table in your Student Journal.
3. Once you record your information, complete the rest of your table by switching cards with other students.
4. Repeat step #3 until you complete the table in your Student Journal.





STUDENT GUIDE

Part IV: Earth and Living Elements

Fundamental Question: What elements make up the solid portion of Earth? What elements are common to living matter?

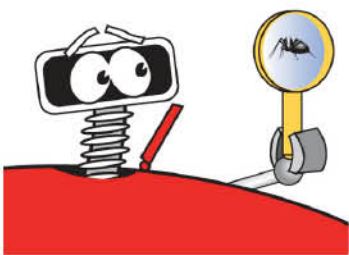
1. Study the Venn diagram circles labeled Solid Earth and Living Matter Elements in your Student Journal. When you finish this Venn diagram, you will have sorted out the elements that the solid Earth and living systems have in common and those elements that are not shared between these two systems.
2. Based on the Element Table you completed in the previous activity, identify the key elements most often found in the solid parts of Earth.
3. Lightly pencil in the names of these key elements in the Solid Earth circle of the Venn diagram. NOTE: Do not place any of the names in the section overlapping the Living Matter circle.
4. Repeat steps #2 and #3 using the key elements most often found in Living Matter.
5. Now compare the two lists. Transfer any element found in both lists to the central area of your Venn diagram, thus indicating that the element is found in both Living Matter and the Solid Earth. Once transferred to the center area, erase the element from the original location in the circles.

Part V: Oceans and Atmosphere Elements

Fundamental Question: What elements make up the ocean? What elements make up the atmosphere?

1. Based on the Element Table you completed in the previous activity, identify the key elements most often found in Earth's oceans.
2. Lightly pencil in the names of these key elements in the Oceans circle of the Venn diagram. NOTE: Do not place any of the names in the section overlapping the Atmosphere circle.
3. Repeat steps #1 and #2 using the key elements most often found in the Atmosphere.
4. Now compare the two lists. Transfer any element found in both lists to the central area of your Venn diagram, thus indicating that the element is found in both Earth's Oceans and Earth's Atmosphere. Once transferred to the center area, erase the element from the original location in the circles.





STUDENT GUIDE

Part VI: Elements are Pure Substances

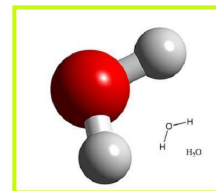
Fundamental Question: Why are elements described as pure substances?

You have already learned that H_2O is a compound made of the elements hydrogen and oxygen. You probably also understand that a single sample of the water molecule is very small. It is impossible to see a single water molecule with the naked eye or even with the most powerful microscope.

In a single drop of water there are 3×10^{21} water molecules. This number is a scientific way of writing a very large number. It is read as, “three times ten to the twenty first power.” Another way to write 3×10^{21} is 3,000,000,000,000,000,000!

In your Journal, record how many hydrogen elements and oxygen elements are in a single water molecule.

In your Journal, record how many hydrogen elements and oxygen elements are in a single water drop.



The process used to break water down into its two building blocks, hydrogen and oxygen is called electrolysis. Your teacher may provide you with a website address so you can watch this process.

Part VII: Elements Combine to Make Compounds

What is the difference between an element and a compound?

There are close to 110 elements on the Periodic Table. Everything in the universe – you, the table, Earth, and all the stars are made up of combinations of these elements. As you know, elements are pure substances, the basic building blocks. Earlier you thought about the many water molecules in a drop of water and realized that when you took a smaller and smaller portion of the drop you still had a water molecule made of hydrogen and oxygen. To break the water molecule down any more would result in the pure elemental substances.

Elements cannot be broken down into smaller substances without totally changing their identity therefore elements are considered pure substances.

When we combine these pure substances with each other they become compounds. Compounds, like water, are also considered pure substances, composed of many H_2O molecules, which in turn can be broken down further into the individual elements of hydrogen and oxygen.

Complete Part VII: Elements Combine to Make Compounds in your Student Journal.

