

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

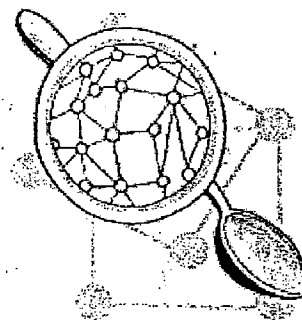
## Notes: The Chemistry of Life

### Matter, Elements, Molecules, and Compounds

By Cindy Grigg



<sup>1</sup> What is matter? Matter is the stuff that makes up everything in the universe. Matter has mass and takes up space. Matter is made of atoms. Solids, liquids, gases, and plasma are all matter. When all atoms that make up a substance are the same, then that substance is an element. Elements are made of only one kind of atom. Because of this, elements are called "pure" substances. An atom is the smallest piece of an element that still has the properties of that element. For example, aluminum is a lightweight, shiny metal. If we took a piece of aluminum and cut it into small pieces, it would still be aluminum. It would still be a lightweight, shiny metal. The smallest piece would be called an atom. Atoms are so small they cannot be seen even with a microscope. Atoms consist of a nucleus that has protons and neutrons surrounded by electrons outside the nucleus.



<sup>2</sup> Atoms of different elements can combine to make new substances. A molecule is formed when two or more atoms join together chemically. If atoms combine that are of two or more different elements, we call that a compound. All compounds are molecules, but not all molecules are compounds. When two hydrogen atoms combine with one oxygen atom, it becomes the compound water. The oxygen we breathe is actually two atoms of oxygen combined, so it is a molecule of oxygen. We use abbreviations for elements, molecules, and compounds. These abbreviations are called chemical symbols. The chemical symbol for an oxygen molecule is O<sub>2</sub>.

<sup>3</sup> The compound water has a chemical symbol of H<sub>2</sub>O. This is like the "recipe" for water. It tells us that a water molecule is made of two atoms of hydrogen and one atom of oxygen. Oxygen is a gas that we can't see, hear, smell, taste, or feel. But it's in the air we breathe, and without it we would die. Hydrogen, also a gas, is the lightest substance on Earth. When two atoms of hydrogen join together with one atom of oxygen, those two gases make a liquid compound we call water. Water, a liquid at room temperature, is a very different substance from the two gases that it is made of. Many different compounds can be made when different atoms combine.

<sup>4</sup> There are 93 elements that naturally occur on Earth. Many more have been made by scientists in a laboratory. With that many elements to form combinations, many millions of different molecules and compounds can be made. How is that possible? Think of our alphabet. The English alphabet has 26 letters. Those 26 letters can be combined in different ways to make millions of words. Atoms are like the letters of the alphabet and the compounds they make are like words.

<sup>5</sup> Now that you have learned the language of chemistry, you are ready to learn more about elements, atoms, and the ways they combine.

Name \_\_\_\_\_



Date \_\_\_\_\_

## Matter, Elements, Molecules, and Compounds

<p>1. What is matter?</p> <ul style="list-style-type: none"><li><input type="radio"/> A The stuff that makes up everything in the universe</li><li><input type="radio"/> B Has mass and takes up space</li><li><input type="radio"/> C Is made of atoms</li><li><input type="radio"/> D Can be solid, liquid, gas, or plasma</li><li><input type="radio"/> E All of the above</li></ul>	<p>2. What is an element?</p> <ul style="list-style-type: none"><li><input type="radio"/> A A pure substance</li><li><input type="radio"/> B Made of only one kind of atom</li><li><input type="radio"/> C Both A and B</li><li><input type="radio"/> D None of the above</li></ul>
<p>3. What is an atom?</p> <ul style="list-style-type: none"><li><input type="radio"/> A A solid</li><li><input type="radio"/> B A metal</li><li><input type="radio"/> C The smallest piece of an element that still has the properties of that element</li><li><input type="radio"/> D A gas</li></ul>	<p>4. Atoms consist of _____.</p> <ul style="list-style-type: none"><li><input type="radio"/> A A nucleus that has protons and neutrons with electrons outside</li><li><input type="radio"/> B Gases</li><li><input type="radio"/> C Two or more molecules</li><li><input type="radio"/> D Solids</li></ul>
<p>5. Abbreviations for elements, molecules, and compounds are called _____.</p> <ul style="list-style-type: none"><li><input type="radio"/> A Shorthand</li><li><input type="radio"/> B Abbr.</li><li><input type="radio"/> C Letters</li><li><input type="radio"/> D Chemical symbols</li></ul>	<p>6. What is the chemical symbol for water?</p> <ul style="list-style-type: none"><li><input type="radio"/> A NaCl</li><li><input type="radio"/> B O<sub>2</sub></li><li><input type="radio"/> C Wa</li><li><input type="radio"/> D H<sub>2</sub>O</li></ul>
<p>7. How many elements naturally occur on Earth?</p> <ul style="list-style-type: none"><li><input type="radio"/> A 1,093</li><li><input type="radio"/> B 26</li><li><input type="radio"/> C 93</li><li><input type="radio"/> D 102</li></ul>	<p>8. What is the lightest substance on Earth?</p> <ul style="list-style-type: none"><li><input type="radio"/> A Water</li><li><input type="radio"/> B Oxygen</li><li><input type="radio"/> C Salt</li><li><input type="radio"/> D Hydrogen</li></ul>

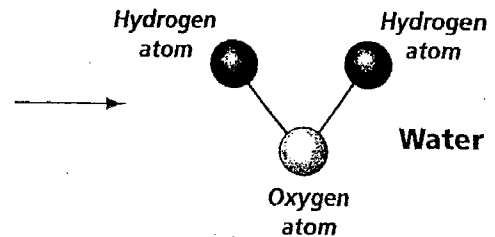
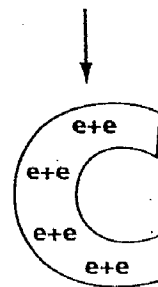
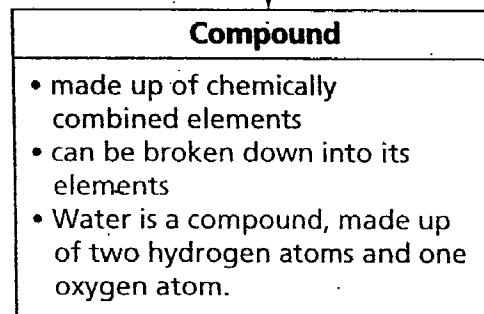
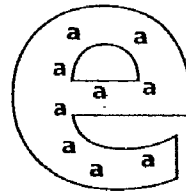
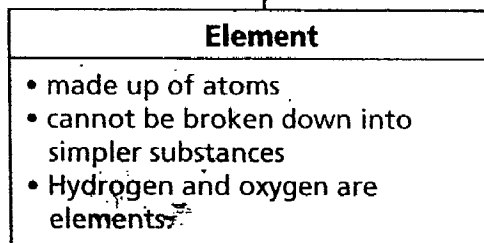
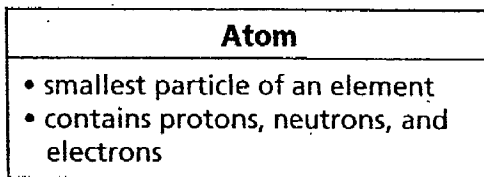
## Chapter

## Content Mastery

## The Chemistry of Life

## Get the Big Picture

Read what is in the boxes and study the pictures. Then fill in the blanks in the statements below.



1. Elements are made up of \_\_\_\_\_.
2. Inside the atoms are \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.
3. Elements combine to form \_\_\_\_\_.
4. Water can be broken down into \_\_\_\_\_ and \_\_\_\_\_.

### Video Quiz

Directions: Fill in the blank with the correct word from the list at the bottom of the page. Not all words from the list will be used.

1. A pure substance is the \_\_\_\_\_ throughout.
2. An \_\_\_\_\_ is a simple pure substance that cannot be changed into a simpler substance.
3. An \_\_\_\_\_ is the smallest piece of matter that cannot be commonly broken down.
4. \_\_\_\_\_ are the negatively charged particles in the atom.
5. The \_\_\_\_\_ is the center of an atom.
6. The electron \_\_\_\_\_ is the region where electrons would probably be found.
7. A \_\_\_\_\_ is a pure substance made of more than one element.
8. A \_\_\_\_\_ is two or more atoms that have bonded together.
9. Chemical \_\_\_\_\_ are used to represent elements.
10. Chemical \_\_\_\_\_ are used to represent chemical substances such as compounds.

formulas  
element  
different  
compound  
atom  
same  
symbols  
pictures  
nucleus  
cloud  
spray  
electrons  
molecules

# How to Read the Periodic Table

To keep track of the elements, scientists use the **Periodic Table**, a chart that shows all the elements. (Click here to get the pdf if you don't have it already.) Scientists can quickly find out basic information about an element just by looking at the Periodic Table.

There are over 100 known atoms - one for each of the known elements.

Here's a close-up look at the carbon square from the Periodic Table:

**Atomic Number:** the number of protons in the nucleus (which is the same as the number of electrons in the atom).

**Symbol:** a one or two letter symbol that represents the element. These internationally-used symbols are abbreviations for the common name or the Latin name of the element.

**Name:** the element's common name.

**Atomic Mass:** the mass of an atom of that element.

6
<b>C</b>
Carbon
12.0

Elements are listed in order of increasing atomic number.

Elements in the same row are in the same **period**. This means they have similar physical properties, such as how well they bend or conduct electricity.

Elements in the same column are in the same **group**. This means they react with other elements in similar ways.

1	2											13	14	15	16	17	18																													
1	2											5	6	7	8	9	10																													
2	3	4											13	14	15	16	17	18																												
3	11	12	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																												
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36																												
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54																												
6	55	56	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86																												
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89	90	91	92	93	94	95	96	97	98	99	100	101	102																																	

# PERIODIC TABLE OF ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 <b>H</b> Hydrogen 1.0	2 <b>He</b> Helium 4.0	3 <b>Li</b> Lithium 6.9	4 <b>Be</b> Beryllium 9.0	5 <b>B</b> Boron 10.8	6 <b>C</b> Carbon 12.0	7 <b>N</b> Nitrogen 14.0	8 <b>O</b> Oxygen 16.0	9 <b>F</b> Fluorine 16.0	10 <b>Ne</b> Neon 20.2	11 <b>Na</b> Sodium 23.0	12 <b>Mg</b> Magnesium 24.3	13 <b>Al</b> Aluminum 27.0	14 <b>Si</b> Silicon 28.1	15 <b>P</b> Phosphorus 28.1	16 <b>S</b> Sulfur 32.1	17 <b>Cl</b> Chlorine 35.5	18 <b>Ar</b> Argon 40.0
19 <b>K</b> Potassium 39.1	20 <b>Ca</b> Calcium 40.1	21 <b>Sc</b> Scandium 45.0	22 <b>Ti</b> Titanium 47.9	23 <b>V</b> Vanadium 50.9	24 <b>Cr</b> Chromium 52.0	25 <b>Mn</b> Manganese 54.9	26 <b>Fe</b> Iron 55.9	27 <b>Co</b> Cobalt 58.9	28 <b>Ni</b> Nickel 58.7	29 <b>Cu</b> Copper 63.5	30 <b>Zn</b> Zinc 65.4	31 <b>Ga</b> Gallium 69.7	32 <b>Ge</b> Germanium 72.6	33 <b>As</b> Arsenic 74.9	34 <b>Se</b> Selenium 79.0	35 <b>Br</b> Bromine 79.9	36 <b>Kr</b> Krypton 83.8
37 <b>Rb</b> Rubidium 85.5	38 <b>Sr</b> Strontium 87.6	39 <b>Y</b> Yttrium 88.9	40 <b>Zr</b> Zirconium 91.2	41 <b>Nb</b> Niobium 92.9	42 <b>Mo</b> Molybdenum 95.9	43 <b>Tc</b> Technetium 99	44 <b>Ru</b> Ruthenium 101.0	45 <b>Rh</b> Rhodium 102.9	46 <b>Pd</b> Palladium 106.4	47 <b>Ag</b> Silver 107.9	48 <b>Cd</b> Cadmium 112.4	49 <b>In</b> Indium 114.8	50 <b>Sn</b> Tin 118.7	51 <b>Sb</b> Antimony 121.8	52 <b>Te</b> Tellurium 127.6	53 <b>I</b> Iodine 126.9	54 <b>Xe</b> Xenon 131.3
55 <b>Cs</b> Cesium 132.9	56 <b>Ba</b> Barium 137.3	57 <b>La</b> Lanthanum 138.9	58 <b>Ce</b> Cerium 140.1	59 <b>Pr</b> Praseodymium 140.9	60 <b>Nd</b> Neodymium 144.2	61 <b>Pm</b> Promethium 145	62 <b>Sm</b> Samarium 150.4	63 <b>Eu</b> Europium 152.0	64 <b>Gd</b> Gadolinium 157.3	65 <b>Tb</b> Terbium 158.9	66 <b>Dy</b> Dysprosium 162.5	67 <b>Ho</b> Holmium 164.9	68 <b>Er</b> Erbium 167.3	69 <b>Tm</b> Thulium 168.9	70 <b>Yb</b> Ytterbium 173.0	71 <b>Lu</b> Lutetium 175.0	72 <b>Hf</b> Hafnium 178.5
87 <b>Fr</b> Francium 223.0	88 <b>Ra</b> Radium 226.0	89 <b>Ac</b> Actinium 227.0	90 <b>Th</b> Thorium 232.0	91 <b>Pa</b> Protactinium 231.0	92 <b>U</b> Uranium 238.0	93 <b>Np</b> Neptunium 237	94 <b>Pu</b> Plutonium 242	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 254	100 <b>Fm</b> Fermium 253	101 <b>Cf</b> Mendelevium 256	102 <b>No</b> Nobelium 254	103 <b>Lr</b> Lawrencium 260.0	104 <b>Rf</b> Rutherfordium 261
101 <b>Db</b> Dubnium 262	102 <b>Sg</b> Seaborgium 263	103 <b>Bh</b> Bohrium 262	104 <b>Hs</b> Hassium 265	105 <b>Mt</b> Meitnerium 266	106 <b>Ds</b> Darmstadtium 271	107 <b>Rg</b> Roentgenium 272	108 <b>Cn</b> Copernicium 285	109 <b>Uu</b> Ununennium 286	110 <b>Uub</b> Unbibium 287	111 <b>Uut</b> Untrium 288	112 <b>Uuq</b> Unquadrium 289	113 <b>Uuq</b> Unquadrium 289	114 <b>Pb</b> Lead 207.2	115 <b>Bi</b> Bismuth 209.0	116 <b>Po</b> Polonium 210.0	117 <b>At</b> Astatine 211	118 <b>Rn</b> Radon 222.0

Key

6	←	Atomic number
<b>C</b>	←	Element symbol
Carbon	←	Element name
12.0	←	Atomic mass

Metallic Properties	
<b>Li</b>	Metal
<b>B</b>	Metalloid
<b>C</b>	Nonmetal

Lanthanides

Actinides

## Using the Periodic Table:

### Rules:

#### 1. PROTONS (nucleus):

Atomic Number = the number of protons

#### 2. NEUTRONS (nucleus):

Step 1: Round the atomic mass (an average) to the nearest whole number to find the Atomic Mass Number.

Step 2: Subtract the number of protons from the Atomic Mass Number to find the number of Neutrons.

#### 3. ELECTRONS (energy shells):

Step 1: The number of electrons = the number of protons.

Step 2: Fill the energy shells from the innermost to the outermost:

- up to 2 electrons fit on the 1<sup>st</sup> energy shell
- up to 8 electrons fit on the 2<sup>nd</sup> energy shell
- up to 18 electrons fit on the 3<sup>rd</sup> energy shell

The Atoms Family  
Atomic Math Challenge

Name \_\_\_\_\_

8
O
Oxygen
16.0

←

←

←

←

Atomic number equals  
the number of

\_\_\_\_\_ or \_\_\_\_\_

Atomic mass equals  
the number of

\_\_\_\_\_ + \_\_\_\_\_

8
O
_____
16.0

Atomic # = \_\_\_\_\_  
Atomic Mass = \_\_\_\_\_  
# of Protons = \_\_\_\_\_  
# of Neutrons = \_\_\_\_\_  
# of Electrons = \_\_\_\_\_

6
_____
Carbon
12.0

Atomic # = \_\_\_\_\_  
Atomic Mass = \_\_\_\_\_  
# of Protons = \_\_\_\_\_  
# of Neutrons = \_\_\_\_\_  
# of Electrons = \_\_\_\_\_

1
H
_____
1.0

Atomic # = \_\_\_\_\_  
Atomic Mass = \_\_\_\_\_  
# of Protons = \_\_\_\_\_  
# of Neutrons = \_\_\_\_\_  
# of Electrons = \_\_\_\_\_

7
_____
Nitrogen
14.0

Atomic # = \_\_\_\_\_  
Atomic Mass = \_\_\_\_\_  
# of Protons = \_\_\_\_\_  
# of Neutrons = \_\_\_\_\_  
# of Electrons = \_\_\_\_\_

15
P
_____
28.1

Atomic # = \_\_\_\_\_  
Atomic Mass = \_\_\_\_\_  
# of Protons = \_\_\_\_\_  
# of Neutrons = \_\_\_\_\_  
# of Electrons = \_\_\_\_\_

33
_____
Arsenic
74.9

Atomic # = \_\_\_\_\_  
Atomic Mass = \_\_\_\_\_  
# of Protons = \_\_\_\_\_  
# of Neutrons = \_\_\_\_\_  
# of Electrons = \_\_\_\_\_



# Macromolecules

Macromolecule	Elements that make up the Macromolecule	Structure	Function it serves to the cell and our bodies	Examples
Carbohydrates	C – Carbon H – Hydrogen O – Oxygen  1 : 2 : 1 ratio (Example: $C_6H_{12}O_6$ )	Linked larger molecules in simple strands: Monosaccharides Disaccharides Polysaccharides	Immediate source of energy (mitochondria)	Fructose (mono...) Sucrose (di...) Glucose (mono...) Glycogen (poly...) Cellulose (poly...)
Proteins	C – Carbon H – Hydrogen O – Oxygen N – Nitrogen	Amino acids are the smaller sub-units of proteins. They form branched molecules.	Structure and support; help to build and maintain muscle tissue → Includes enzymes; <u>Enzymes</u> speed up the rate of chemical reactions in the body (metabolism) →	Skin, nails, shells, fur  <u>Sucrase</u> (enzyme) breaks down sugar into fructose and glucose
Lipids	C – Carbon H – Hydrogen O – Oxygen High proportion of C, H compared to O (Example: $C_{57}H_{92}O_9$ )	Mostly strands of C, H and O	Long term energy storage; do not dissolve in water; serve as hormones and are used to build the cell membrane	Phospholipids – sub-units of the cell membrane; aid in flexibility of the cell.
Nucleic Acids	C – Carbon H – Hydrogen O – Oxygen P – Phosphorous N – Nitrogen	Strands of ringed structures. Nucleotides are the sub-units of nucleic acids	They store the genetic code of organisms that tell the cell how to make protein	DNA and RNA

*In your textbook, read about the role of carbon in organisms.*

For each of the following statements about carbon, write **true** or **false**.

- \_\_\_\_\_ 1. Carbon atoms can bond together in straight chains, branched chains, or rings.
- \_\_\_\_\_ 2. Large molecules containing carbon atoms are called micromolecules.
- \_\_\_\_\_ 3. Polymers are formed by hydrolysis.
- \_\_\_\_\_ 4. Cells use carbohydrates for energy.

Write each item below under the correct heading.

sucrose      glucose      starch       $C_6H_{12}O_6$   
 cellulose      glycogen      fructose       $C_{12}H_{22}O_{11}$

Monosaccharide
5.
6.
7.

Dissaccharide
8.
9.

Polysaccharide
10.
11.
12.

Complete the table by checking the correct column for each description.

Description	Lipids	Proteins	Nucleic Acids
13. Made up of nucleotides			
14. Most consist of three fatty acids bonded to a glycerol molecule			
15. DNA and RNA			
16. Contain peptide bonds			
17. Produce proteins			
18. Commonly called fats and oils			
19. Made up of amino acids			
20. Used for long-term energy storage, insulation, and protective coatings			
21. Contain carbon, hydrogen, oxygen, and nitrogen			