NAME THAT MOLECULE CHALLENGE

ENTRIES OPEN MARCH 26, 2019- JULY 3, 2019

SCIENCE LESSON

MOLECULAR STRUCTURES

Everything around us is made up of molecules. A molecule is a group of two or more atoms of the same or different element bonded together. We can't see molecules without a powerful microscope, so scientists use a variety of models to showcase their properties.

FOR THE CLASSROOM

POSSIBLE APPROACH FOR THE CLASSROOM

LESSON LENGTH
50-60 MINUTES

OBJECTIVE
LEARN ABOUT MOLECULES & MOLECULAR STRUCTURES

MATERIALS
SEE BELOW

VOCABULARY:

- Element
- Atom
- Molecule
- Bond
- Compound
- Molecular Formula
- Structural Formula
- Ball and Stick Model
- Perspecitve Drawing
- Space Filled Model

MATERIALS

Powerpoint, Worksheet, Computer, Internet, Toothpicks + Colored Mini Marshmallows or Ball & Stick Model Kit

PROCEDURE

1. Download and teach the MOLECULAR STRUCTURES POWERPOINT: We have provided a Future Engineers PPT. Feel free to customize it to suit your teaching needs.

2. Student Activity 1 Have your students complete the "Decoding Molecular Formulas" worksheet and follow the steps below.

a. Take a look at the molecular formulas listed in your worksheet and use a periodic table and the steps below to decode what they are made of.

b. Step 1: Underline the Capital Letters. This will tell you how many elements are in your molecule.

c. Step 2: Symbols-Write the symbols the molecule has in the symbol column.

d. Step 3: Element Name-Use the periodic table to identify what elements the symbol represents and write the down in the element column.

e. Step 4: How many atoms? - Write the number of atoms of each element in the How many atoms column. If there is a small number beside the symbol, this indicates how many atoms of this element there are in the molecule. If there is NO small number beside the Atomic Symbol, it has 1 atom.

3.. Student Activity 2: Have your students complete the "Building Simple Molecules" worksheet and follow the steps below. Students can work individually or in groups to build simple molecules out of molecular model sets or marshmallows and toothpicks. Take a look at the molecular formulas listed in your worksheet and use a periodic table and the steps on the following page to decode what they are made of.

LESSON PLAN CONTINUED

MOLECULAR STRUCTURES

PROCEDURE (Continued)

3. Student Activity 2

a. If using marshmallows, Oxygen is orange, Carbon is green, and Hydrogen is pink.
b. Pass out a piece of paper to each student/group. Students/group should write the following key at the top of the paper "Orange=Oxygen Green=Carbon and Pink=Hydrogen"
c. Students should fold the paper into 4 sections and label the sections with the following molecules: O2 (Oxygen), H2O (Water), CO2 (Carbon Dioxide), and CH4 (Methane)
d. Pass out 20 colored marshmallows and 15 toothpicks to each group.
e. Have the students use their worksheets as a guide to build each of the 4 molecules in the section designated section.
f. If time allots, challenge them to reuse their supplies to build other molecular structures of your choice.

BACKGROUND INFORMATION

ATOMS AND ELEMENTS

Atoms are found in everything around us and are the building blocks of matter. The word "atom" comes from the Greek word "atom-os" which means uncuttable or undividable. Atoms are made up of particles called protons, neutrons and electrons. The protons and neutrons make up the nucleus and the electrons buzz around the nucleus. Atoms differ from one another by the number of protons (atomic number) in the nucleus. This number tells us what element the atoms is. For example, atoms with the atomic number 1 are Hydrogen atoms.

All substances are made up of elements. There are currently 118 known elements and they can be found listed in the Periodic Table of Elements. The Periodic Table tells us the name of an element, atomic symbol, the atomic number and its properties. Hydrogen (atomic number 1) has one proton and Oganesson (atomic number 118) has 118 protons respectively.

MOLECULES

Even though there are 118 elements, there are over 50 million chemical substances registered with the American Chemical Society. These chemicals are molecules formed from a combination of the 118 elements. Molecules can be made from two or more atoms of the same element or different elements. For example, the oxygen (O2) molecule is made up of 2 oxygen atoms while water (H2O) molecule is made up an Oxygen and two Hydrogen atoms. When a molecule is made up of 2 or more different types of atoms, it is called a compound.

How do atoms combine to form molecules? Atoms combine by gaining, losing or sharing electrons. When atoms combine, they form bonds.

Generally speaking, we refer to molecules by their common names (ex. carbon dioxide) or their molecular formula (ex.CO2). One of the most practical ways to refer to molecules is by using their molecular formulas. Molecular formulas list the atomic symbol and numbers to show how many atoms are in a molecule. For instance, CO2 has one Carbon atom and two Oxygen atoms..

LESSON PLAN CONTINUED

MOLECULAR STRUCTURES

BACKGROUND INFORMATION CONTINUED

WAYS TO VISUALIZE MOLECULES

Molecular structures consist of two or more atoms and can get pretty complex. There are many different ways we visualize them but let's take a look at the most common ways.

Structural Formula

The structural formula of a molecule shows how the atoms are arranged. The chemical bonding can also be shown.

Perspective Drawing

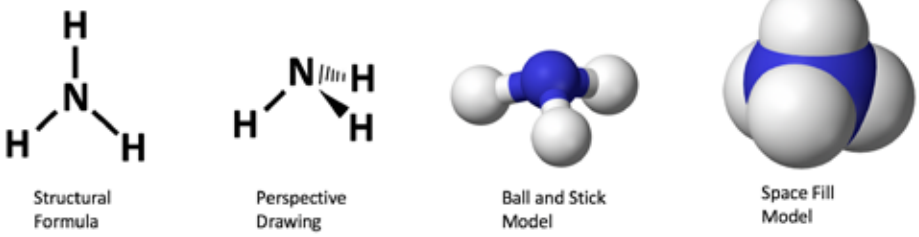
A drawing that shows the bonds to atoms going into (bolded wedge) the viewer and away (hash wedge).

Ball and Stick Model

A ball a stick model of a chemical substance shows the 3D positions of the atoms and the bonds between them. The atoms are represented by spheres connected by sticks or rods representing the bond/s.

Space Fill Model

The space fill or calotte model is a 3D model where atoms and the space they take up are represented by spheres. The sphere size is typically proportionate to the size of the atom.



ADDITIONAL MOLECULAR STRUCTURE TEACHING RESOURCES:

- What is an atom and how do we know? : https://www.youtube.com/watch?v=LhveTGblGHY
- NASA Gummy Greenhouse Gas Molecules: https://spaceplace.nasa.gov/gumdrops/en/

LESSON PLAN CONTINUED

MOLECULAR STRUCTURES

NEXT GENERATION SCIENCE STANDARDS

MS-PS1-1 Matter and its Interactions Develop models to describe the atomic composition of simple molecules and extended structures. Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.

- PS1.A Structure and Properties of MatterSubstances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g. Crystals)
- Crosscutting Concepts: Scale, Proportion, and Quantity: Time, space and energy phenomena can be observed at various scales using models to study systems that are too small.

SCIENCE LESSON WORKSHEET

DECODING MOLECULAR FORMULAS

Molecular formulas tell us what elements and atoms are in a molecule. Learn how to decode them with help from the Periodic Table of Elements.

HOW TO DECODE A MOLECULAR FORMULA

Use these steps to figure out what each molecules below are made of.
Take a look at the CO2 sample below, then move on to the next page.
Step 1: Underline the Capital Letters. This will tell you how many elements are in your molecule.
Step 2: Symbols-Write the symbols the molecule has in the symbol column.
Step 3: Element Name-Use the periodic table to identify what elements the symbol represents and write the down in the element column.
Step 4: How many atoms? - Write the number of atoms of each element in the How many atoms column. If there is a small number beside the symbol, this indicates how many atoms of this element there are in the molecule. If there is NO small

Molecular Formula: CO2 (Carbon Dioxide)

Symbol	Element Name	How many atoms?
C	Carbon	1
O	Oxygen	2

Use the Periodic Table of Elements to decode the following molecules.

Molecular Formula: NH3 (Ammonia)

Symbol	Element Name	How many atoms?

Molecular Formula: CH4 (Methane)

Symbol	Element Name	How many atoms?

Molecular Formula: H2SO4 (Sulfuric Acid)

Symbol	Element Name	How many atoms?

SCIENCE LESSON WORKSHEET

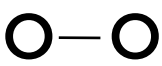
BUILDING SIMPLE MOLECULES

There are more than 50 million different types of molecules. Molecules consist of two or more atoms bonded together. Scientists use a variety of different ways to visualize them including structural formulas, perspecitve drawings, ball and stick and space fill models.

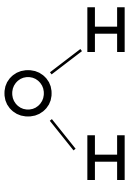
BUILDING SIMPLE MOLECULES

Use colored mini marshmallows and toothpicks or ball and stick model kits to build the molecules listed below. The lines represent which atoms are bonded.

1) O2 (Oxygen)

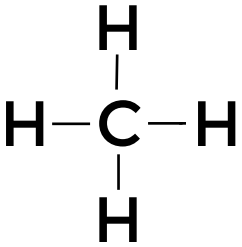


2) H2O (Water)



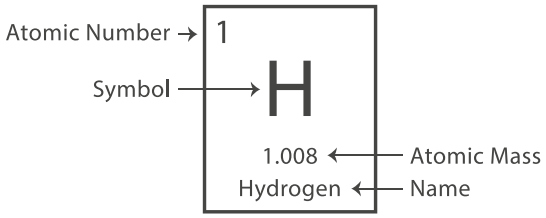
3) CO2 (Carbon Dioxide)

4) CH4 (Methane)



NAME THAT MOLECULE CHALLENGE

ENTRIES OPEN MARCH 26, 2019- JULY 3, 2019



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 Aluminium	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 Caesium	56 Ba 137.327 Barium	57/71	72 Hf 178.49 Hafnium	73 Ta 180.94788 Tantalum	74 W 183.84 Tungsten	75 Re 186.207 Rhenium	76 Os 190.23 Osmium	77 Ir 192.217 Iridium	78 Pt 195.084 Platinum	79 Au 196.966569 Gold	80 Hg 200.592 Mercury	81 Tl 204.38 Thallium	82 Pb 207.2 Lead	83 Bi 208.98040 Bismuth	84 Po 209 Polonium	85 At 210 Astatine	86 Rn 222 Radon
87 Fr 223 Francium	88 Ra 226 Radium	89/103	104 Rf 267 Rutherfordium	105 Db 268 Dubnium	106 Sg 269 Seaborgium	107 Bh 270 Bohrium	108 Hs 269 Hassium	109 Mt 278 Meitnerium	110 Ds 281 Darmstadtium	111 Rg 281 Roentgenium	112 Cn 285 Copernicium	113 Uut 286 Ununtrium	114 Fl 289 Flerovium	115 Uup 289 Ununpentium	116 Lv 293 Livermorium	117 Uus 294 Ununseptium	118 Uuo 294 Ununoctium

Lanthanide Series	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
Actinide Series	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