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**MODELS OF ATOMS LAB**

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_

**Objective:** To construct and observe models of common basic molecules.

**Vocabulary:**

 1. **Element-** a substance made up of a single kind of atom, like carbon or hydrogen

 **2. Atom-** the smallest part of an element that can exist alone

 **3. Compound-** a substance formed by chemical combination of two or more different

 types of atoms in definite proportions by weight, like water (H2O), or

 carbon dioxide (CO2)

 **4. Molecule-** the smallest particle into which a substance can be divided in which

 the electrons are shared; An example of a molecule of an element would

 be H2 , an example of a molecule of a compound would be H2O.

 **5. Chemical equation-** This shows the symbols and numbers of each element taking

 part in a chemical reaction.

 **6. Chemical reaction-** A process in which atoms of the same or different elements

 rearrange themselves to form a new substance.

 **6. Law of conservation of mass-** The law stating that in a chemical reaction, matter is

 neither gained nor lost, or the same number of each

 type of atom will exist before and after the reaction.

**Hypothesis:** Models to represent a chemical equation will be made in the last part of this lab.

 When the number of each type of atom on both sides of the reaction are counted,

 what do you predict will be the result?

**Materials:** 4 different-colored types of Play Doh

**(Per student)**  20 Toothpicks

 Piece of construction or copy paper

 Centimeter ruler

**Procedure:**

1. Make colored balls of Play Doh about 2 cm in diameter to represent **atoms;** each ball equals

 a single atom. The hydrogen atoms should be made about ¼ the size of the other elements

 (.5 cm). In nature, the other 3 elements are slightly different sizes, but for this lab they can

 be all made the same size.

2. The color that will represent each element will be supplied by your teacher.

|  |  |  |
| --- | --- | --- |
| Element  | Color | Number of atoms  |
| Hydrogen (H) |  | 10 |
| Carbon (C ) |  | 2 |
| Nitrogen  |  | 2 |
| Oxygen  |  | 5 |

3. The toothpicks will represent **chemical bonds** that hold the atoms together to form

 molecules and/or compounds. Molecules can have **single bonds** (one toothpick), **double**

 **bonds** ( 2 toothpicks), or **triple bonds** ( 3 toothpicks). This concept is complex and will be

 explained in a future physical science or chemistry course.

4. Now join your atoms to form the following compounds and/or molecules as shown on the

 following diagrams and label them on a piece of construction or copy paper.

A. Hydrogen gas molecule (H2): How many total atoms? \_\_\_\_

B. Oxygen gas molecule (O2): How many total atoms? \_\_\_\_

C. Nitrogen gas molecule (N2):  How many total atoms? \_\_\_\_

D. Water molecule (H 2 O):  How many total atoms? \_\_\_\_

 E. Carbon dioxide molecule (CO2):  How many total atoms? \_\_\_\_\_\_

 F. Methane molecule (CH4):  How many total atoms? \_\_\_\_\_\_

G. Now use your H2 and O2 molecules already made and make one more H2 molecule to represent the 3 molecules on the left side of the arrow:

 **Chemical equation:** 2 H2 + O2 → 2 H2O

   

 **\***The 2 in front of the H2 means you have 2 molecules of hydrogen. If no number is present before or after a symbol, it means you have one atom or molecule of that element or compound.

H. Now take the three molecules on the left side of the equation apart and try to form the 2

 water molecules on the right side of the arrow from the same atoms.

 Can this be done? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 How many total atoms are on the left side of the arrow? \_\_\_\_\_\_\_ Right? \_\_\_\_\_

 According to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (see vocabulary terms) the total number

 of \_\_\_\_\_\_\_\_ on both sides of a chemical \_\_\_\_\_\_\_\_\_\_\_\_\_\_ should be the \_\_\_\_\_\_\_\_\_.

**Reflection:** Summarize in 3 complete sentences what you have learned from this lab activity.

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**More on Chemical Bonding (Supplement)**

**Background Information:** The three main parts of an atom are:

1) **Protons**- which have a positive (+) charge and are found in the nucleus.

2) **Neutrons**- which do not have a charge (0) and are also found in the nucleus.

3) **Electrons**- which have a negative (-) charge and orbit around the nucleus. Electrons are the parts of the atom that make chemical reactions (bonds) possible.

A. Electrons can be lost, gained, or shared.

B. Moving electrons are explained as existing in “shells” with an expected number of electrons in each shell. The formula is 2*n*2 , where n = shell number.

C. The first shell (closest to the nucleus) can hold 2 electrons; (2x (1) 2) = 2.

D. The second shell can hold 8 electrons; (2 x (2)2 ) = 8.

E. The third shell can hold 18 or 8. 8 can be called the “magic number” as that can always complete any shell. (Except the first, which is always 2). More shells can be made for larger atoms.

F. The goal is for electron numbers to get to a stable energy level (2, 8,18) which is what happens when elements combine to form compounds and/or molecules

 4) Look at the chart below. Electrons are represented as “dots.” Fill in the table below

 for number of dots for each element in the molecule lab for its **outer shell.**

(H) Hydrogen =\_\_\_\_\_\_; (C ) Carbon = \_\_\_\_\_\_\_; (N) Nitrogen = \_\_\_\_\_\_ ; (O) Oxygen = \_\_\_\_\_\_

# needed to = \_\_\_\_\_\_ \_\_\_\_\_\_\_ \_\_\_\_\_\_ \_\_\_\_\_\_

Get to 2 (H) or

8 (C, N, O )



 5) A chemical bond is formed when electrons are transferred or shared. A single bond (1 line) means one pair of electrons is shared; a double bond (2 lines) means \_\_\_\_\_ pairs of electrons are shared, and a triple bond (3 lines) means \_\_\_\_\_ pairs of electrons are shared.

6) Now we will again look at the molecules you made on Page 1 of this lab.

A. Hydrogen gas (H2): hydrogen has 1 electron in its outer shell and needs 2 to complete the first shell, so one (H) hydrogen atom shares a pair of electrons with another hydrogen atom, so each now has \_\_\_\_ electrons in the outer shell. It is a single bond because \_\_\_ pair of electrons is shared.

B. An Oxygen gas molecule (O2): has 6 electrons in the outer shell and needs 8, so two (O) oxygen atoms share 2 pairs of electrons (\_\_\_\_\_\_\_\_ bond), and each now has \_\_\_\_\_ electrons in the outer shell.

C. A Nitrogen gas molecule (N2): has 5 electrons in the outer shell and needs eight, so two (N) nitrogen atoms share 3 pairs of electrons (\_\_\_\_\_\_\_\_ bond), and each now has \_\_\_\_\_\_ electrons in the outer shell.

 D. Water molecule (H2O): The H atoms have 1 electron and each need 1 more to get to 2, and the (O) oxygen atom has 6 electrons and needs 2 more to get to 8, so 2 (H) hydrogen atoms each share 1 electron with the oxygen atom. Now, each (H) hydrogen atom has \_\_\_\_\_ electrons in its outer shell, and the (O) oxygen atom now has \_\_\_\_\_ electrons in its outer shell. All bonds are \_\_\_\_\_\_\_\_ because only 1 pair of electrons is shared.

E. Carbon dioxide molecule (CO2): The (C) carbon atom has 4 electrons in the outer shell and needs 4 more to get to 8; each (O) oxygen atom has 6 electrons and each needs 2 electrons to get to 8. So \_\_\_\_\_\_\_\_\_\_bonds form because both (O) oxygen atoms share 2 pairs of electrons with the single (C) carbon atom. In sharing 2 pairs of electrons, (C) carbon it now has \_\_\_\_\_\_ electrons in its outer shell, and each (O) oxygen atom now has \_\_\_\_\_ electrons as well.

F. Methane molecule ( C H 4 ) : The (C )carbon atom has 4 electrons in the outer shell and needs 4 more to get to 8, and each (H) hydrogen atom has 1 electron in its outer shell and needs 1 more to get to 2. So 4 (H) hydrogen atoms each share \_\_\_\_ pair of electrons with the carbon atom. Now each (H) hydrogen atom has \_\_\_\_\_ electrons in its outer shell, and the (C ) carbon atom has \_\_\_\_\_\_ electrons in its outer shell. \_\_\_\_\_\_\_\_\_ bonds form because each time only 1 pair of electrons is shared.

G. Since all atoms are **sharing** pairs of electrons, these compounds are called \_\_\_\_\_\_\_\_\_\_\_\_\_.

H. What is the **magic number** of electrons needed to complete most outer shells? \_\_\_\_\_\_\_\_\_

**Reflection:** Write at least 3 complete sentences summarizing what you have learned from the

 more on Chemical Bonding section of this lab.

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