Everything you can feel is made of atoms

Chemistry

Our inquire into “Everything you can feel is made of atoms” will help us better **understand**:

- That the difference between atoms, ions, and molecules is caused by the difference in their structure and components
- The classification of substances as acids, bases, and salts, based on their characteristics, name, and formula
- The difference between organic and inorganic compounds
- Chemical reactions and the Law of conservation of mass
- How the rate of reaction is affected
- Radioactivity using modern atomic theory

Vocabulary

acids, alpha particle, atomic number, atoms, bases, beta particle, Bohr diagrams, bromothymol blue,catalyst, combustion, compounds, concentration, conservation of mass, covalent bonding, daughter isotope, decomposition, electron, fission, fusion, gamma radiation, half-life, indigo carmine, inorganic, ionic bonding, ions, isotope,Lewis diagrams, light, litmus paper, mass number, methyl orange, molecules, neutralization (acid-base), neutron, organic, parent isotope, phenolphthalein, polyatomic, proton,radioactive decay, salts, single and double replacement, surface area, symbolic equations, synthesis, valence electron

Note:

If you lose this package it is your responsibility to print out a new copy from Ms. Veenstra’s webpage: https://lveenstra.wordpress.com/transitional-science-10/

Chapter 4 Learning Goal

Mark		Reference
	1. I can demonstrate knowledge of the three subatomic particles, their properties, and their location within the atom	Chapter 4.1
	2. I can define and give examples of ionic bonding and covalent bonding	Chapter 4.1
	3. I can with reference to elements 1 to 20 on the periodic table, draw and interpret Bohr models, including protons, neutrons, and electrons, of atoms (neutral), ions (charged), molecules - covalent bonding (e.g., O_2, CH_4	Chapter 4.1
	4. I can draw and interpret Lewis diagrams showing single bonds for simple ionic compounds and covalent molecules, and distinguish between lone pairs and bonding pairs of electrons in molecules	Chapter 4.1
	5. I can use the periodic table and a list of ions (including polyatomic ions)to name and write chemical formulae for common ionic compounds, using appropriate terminology	Chapter 4.2
	6. I can convert names to formulae and formulae to names for covalent compounds, using prefixes up to "deca"	Chapter 4.2
	7. I can define and explain the law of conservation of mass	Chapter 4.3
	8. I can represent chemical reactions and the conservation of atoms using molecular models	Chapter 4.3
	9. I can write and balance (using the lowest whole number coefficients) chemical equations from formulae, word equations, or descriptions of experiments	Chapter 4.3

Assign by Ms. V LG = Mark = %	Test result: %

Chapter 4.1 Atomic Theory
Lab 4.1: Building an Atom (PhET simulation)

PART I: ATOM SCREEN

1. *Go to the website: phet.colorado.edu. Click on HTML5 simulations on top right of screen and choose the Build an Atom simulation* (http://phet.colorado.edu/en/simulation/build-an-atom)

2. Explore the ***Build an Atom*** simulation with your group. As you explore, talk about what you find. List two things your group observed in the simulation.

a.

b.

2. Click on the + sign for each of the boxes (element name, net charge and mass number) to view changes as you change the number of particles in the atom.

3. What particle(s) are found in the centre of the atom?

____

4. Play until you discover which **particle(s)** determine(s) the name of the **element** you build.

____

5. What is the **name** of the following atoms?

a. An atom with 3 protons and 4 neutrons: _____________

b. An atom with 2 protons and 4 neutrons: _____________

c. An atom with 4 protons and 4 neutrons: _____________

6. Play with the simulation to discover which particles affect the **charge** of an atom or ion.

____

7. Fill in the blanks below to show your results:

a. Neutral atoms have __the same number of__protons and electrons.

b. Positive ions have _______________________________ protons than electrons.

c. Negative ions have ______________________________ protons than electrons.

8. What is a rule for determining the charge of an ion

9. Play with the simulation to discover what affects the **mass** number of your atom or ion. ______________________________

   a. What is a rule for determining the mass number of an atom or ion?

10. Fill in the blanks below to show your understanding of charge and mass:

    a. Protons have a mass of ________ amu and a charge of _________.

    b. Neutrons have a mass of ________ amu and a charge of _________.

    c. Electrons have a mass of nearly ________ amu and a charge of _________.

11. Practice applying your understanding by playing 1^{st} and 2^{nd} levels on the game screen.

PART II: SYMBOL SCREEN

1. Using the *Symbol* readout box, figure out **which particles** affect each component of the atomic symbol and how the value of the numbers is determined.

$$ {}^{d}_{c}a^{b} $$

Position in symbol box	Term to describe this information	Particle used to determine this	How the value is determined
a	Element symbol	protons	# of p will identify the element
b	Ion charge		
c	Atomic number		
d	Mass number		

3. Practice applying your understanding by playing the 3^{rd} and 4^{th} game levels. Play until you can get all the questions correct on the 4^{th} level. Fill in the information here for your last screen of the 4^{th} game level:

protons ___________

neutrons __________

electrons __________

Finish Worksheet 4.1 Atomic Theory

Chapter 4.1 Bohr Models Notes

Electron shells (orbitals, E levels)
1st shell holds only _______
2nd shell hold _______
3rd shell holds _______
4th shell holds _______

Valence shell:

Valence electrons:

Example: Sodium Atom

Stable:

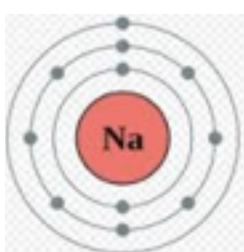
Unstable:

Atoms will tend to **gain** or **lose** e- in order to become stable

ION	vs	ATOM

IMPORTANT NOTE:
Protons are locked in the nucleus so the positive charge can't change...positive ions come from atoms that have lost e-, NOT from gaining protons!

Example
Single e^- in valence shell
Unstable
gain 7 or lose 1 e^-?



4.1 Bohr Model Compounds Notes

NOTE:
Metals are found

Forming Compounds
Atoms wants to be **stable** (have a full valence shell). Atoms can become stable by

1.
   - metals tend to ___________ and become ___ (called________________)
   - non-metals tend to ___________ and become ___ (called________________)
2.

A. Ionic Compounds

Ionic bonds are formed between positive ions and negative ions.

- Generally, this is a metal (+) and a non-metal (-) ion.
- For example, lithium and oxygen form an ionic bond in the compound Li_2O.

Covalent Compounds

Covalent bonds are formed between two or more non-metals.

- Electrons are shared between atoms.
- For example, hydrogen and fluoride form a covalent bond in the compound HF.

Ionic	vs.	Covalent

4.1 Lewis diagram Notes

Lewis Structures

Lewis diagrams illustrate chemical bonding by showing only an **atom's valence electrons** and the **chemical symbol**.

-
-

Example

Draw Lewis structure for Ca, a chlorine ion and a beryllium ion.

NOTE: Square brackets are placed around each ion and the charge is added outside the bracket.

Ionic Compounds

Beryllium and chlorine can form an ionic compound:

Let's try CaO:

Covalent Compounds

Lewis diagrams can also represent covalent bonds.

- The shared pairs of electrons are usually drawn as a straight line.

Example:

HF H_2O Bonding e^-:

Lone pairs:

NOMENCLATURE - Summary Notes

1. METAL + NON-METAL

Name:

- metal written first
- non-metal written second but modified to end in “ide"

Examples:

Formula:

- balance charge to get an overall neutral compound. Simplify.

Examples:

Try it:

1. Write the formulas for the following:

(a) Zn^{2+} and I^{-}

(b) Ca^{2+} and O^{2-}

(c) Al^{3+} and S^{2-}

(d) lithium oxide

(e) aluminium nitride

2. Write the name for the following

(a) Li_3N

(b) CaI_2

(c) CsF

(d) Na_2O

(e) Sr_3P_2

2. TRANSITION METAL (two or more possible charges) + NON-METAL

Name:

- uses roman numerals after the metal to indicate the charge of the metal.

Examples:

Try it:

1. Write the formulas for the following:

(a) copper(I) nitride

(b) manganese(IV) oxide

(c) iron(II) phosphide

2. Write the name for the following

(a) Fe_2O_3

(b) FeI_2

(c) Ag_3N

3. POLYATOMIC IONS

- common polyatomic ions are listed on a table in a data booklet to which you may refer during all homework, quizzes and tests.
- have different endings, such as “**ite**” and “**ate**”
- exceptions: Cyan**ide** (CN^-), hydrox**ide** (OH^-), bisulf**ide** (HS^-). It is best to memorize these.

Examples:

Try it:

Name	Cation	Anion	Formula
aluminium hydroxide	Al^{3+}	OH^-	$Al(OH)_3$
iron(II) nitrate			
calcium sulfite			
ammonium nitrate			
			KCN
			$MnSO_4$
			$Cu(NO_2)_2$

4. Hydrogen

- Some areas of common confusion concerning hydrogen are listed below:

HBr	**hydrogen** bromide	Na**OH**	sodium **hydroxide**
Na**H**	sodium **hydride**		

5. NON-METAL + NON-METAL

- covalent compounds ("molecular")
- prefixes written to indicate the number of atoms of each element in the compound
- prefix "mono" never used in front of the first element
- "WYSIWYG" (what you see is what you get): do not use charges to determine subscripts.

Prefixes (available in data booklet)

1 mono	**2** di	**3** tri	**4** tetra	**5** penta
6 hexa	**7** hepta	**8** octa	**9** nona	**10** deca

Examples:

Try it:

1. Write the formulas for the following:

(a) nitrogen tribromide

(b) dinitrogen tetrasulfide

(c) phosphorous pentabromide

(d) carbon tetraiodide

(e) dichlorine monoxide

2. Write the name for the following

(a) N_2O_4

(b) CO

(c) S_2F_{10}

(d) PI_3

(e) P_4S_{10}

6. Elements

- **Diatomic gases: I_2 Br_2 Cl_2 F_2 O_2 N_2 H_2**

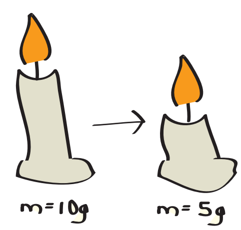
  pneumonic:

- Monoatomic elements: All other elements (Na, K, Fe, etc.)

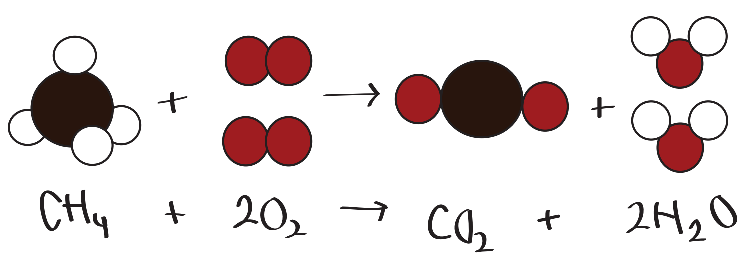
Chapter 4.3 Chemical Equations Notes

Chemical Equation:				
Word equation:				
Symbolic equation:	**Skeleton Equation** reactants products **Balanced Equation** coefficient subscript			
States of Matter:				

4.3 Law of conservation of mass notes



4.3 Law of conservation of atoms notes



Chapter 4.3 Lab
The Mass of Reactants and Products

Question: In a chemical reaction, will the reactants weigh the same as the products?

Background:

In this experiment, we investigate two chemical reactions.

1. The reaction between calcium chloride and sodium carbonate:

    calcium chloride + sodium carbonate → calcium carbonate + sodium chloride

    $CaCl_2 + Na_2CO_3 \rightarrow CaCO_3 + NaCl$

2. The reaction of vinegar (the chemical name for vinegar is acetic acid) and baking soda (the chemical name for baking soda is sodium bicarbonate):

    baking soda + vinegar → carbon dioxide + water + sodium acetate

    $NaHCO_3 + HC_2H_3O_2 \rightarrow CO_2 + H_2O + NaC_2H_3O_2$

We will use this experiment to find out if the reactants weigh the same as the products.

Pre-lab questions:

1. How do you know that a chemical reaction have occurred?

2. What do you think happens to the mass in a chemical reaction?

3. Make drawings of the procedural steps (on the next page)

Materials:

- 2 beakers
- Balance
- calcium chloride ($CaCl_2$)
- sodium carbonate (Na_2CO_3)
- Baking Soda ($NaHCO_3$)
- Vinegar (CH_3COOH)

Procedure/Data/Observations:

1. Put on safety goggles.

Part 1

	Description	Drawing	Data/Observation
A	Add approximately 10 mL of calcium chloride to one beaker and 10 mL of sodium carbonate to another beaker.		
B	Record the mass of the two beaker.		Mass of reactants:
C	Add the content of one beaker to the other beaker.		Record your observations: (Change in colour, temperature, formation of bubbles or similar)
D	Record the mass of the two beakers again.		Mass of products:
E	Rinse the beakers. The solutions can be washed down the sink.		

Part 2

Step	Description	Data/Observation
A	Add approximately 10 mL of vinegar to one beaker and 1 tsp of baking soda to another beaker.	
B	Record the mass of the two beaker.	Mass of reactants:
C	Add the vinegar to the baking soda.	Record your observations: (Change in colour, temperature, formation of bubbles or similar)
D	Record the mass of the two beakers again.	Mass of products:
E	Rinse the beakers. The solutions can be washed down the sink.	

Analysis:

1. How did you know that reactions occurred?

2. In part 1 did the mass of the reactants equal the mass of the products?

3. What is the law of conservation of mass? How does it relate to this experiment?

4. In part 2, did the mass of the reactants equal the mass of the products?

5. In part 2, was mass destroyed?

insert balancing equation activity

insert balancing activity

4.3 Balancing Notes

Counting atoms

$Mg_3(PO_4)_2$

$2Ca(NO_2)_2$

Balancing Basics

- If a chemical reaction is ______________, then mass, atoms and charge are __________
- The number of each atom is the same on both sides of the arrow.
- Balance by placing ________________________ in front of each compound.

Tips for Balancing

- Balance ______________________ first and ________________________ last
- Balance hydrogen and oxygen _______________
- You can often treat polyatomic ions, such as SO_3^{2-}, as a unit
- If an equation is balanced by using half a molecule ($1/2O_2$), you must double all the coefficients to get whole numbers.
- Examples:

$$\_\_\_\_\_\ AlBr_3 + \_\_\_\_\_\ K_2SO_4 \rightarrow \_\_\_\_\_\ KBr + \_\_\_\_\_\ Al_2(SO_4)_3$$

$$\_\_C_4H_{10} + \_\_\_\ O_2 \rightarrow \_\_\_CO_2 + \_\_\ H_2O$$

4.3 Tips for changing word equations to symbolic equations

- Memorize the following:

  methane =

  ammonia =

  water =

- The following elements are diatomic (they come in pairs when NOT in a compound)

  H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2 ____

- All other elements are not diatomic and no subscripted is used. Eg. Pb, Na, V

Example:

iron(III) oxide + hydrogen → water + iron

sodium phosphate + calcium hydroxide → sodium hydroxide + calcium phosphate