CHEMICAL BONDING

Chapter 20
## Chapter 20 – Chemical Bonding Vocabulary Words

<table>
<thead>
<tr>
<th>Vocabulary Word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Binary Compound</td>
<td></td>
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<tr>
<td>2. Chemical Bond</td>
<td></td>
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<tr>
<td>3. Chemical Formula</td>
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<tr>
<td>4. Covalent Bond</td>
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<td>5. Hydrate</td>
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<td>6. Ion</td>
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<td>7. Ionic Bind</td>
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<tr>
<td>8. Molecule</td>
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<td>9. Non Polar Molecule</td>
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<td>10. Oxidation Number</td>
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<tr>
<td>11. Polar Molecule</td>
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<tr>
<td>12. Polyatomic Ion</td>
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</tbody>
</table>

### The Lewis Theory:
- **Valence electrons**, or the electrons in the outermost electron shell, have an essential role in chemical bonding.
- **Ionic bonds** are formed between atoms when electrons are transferred from one atom to another. Ionic bond is a bond between nonmetals and metals.
- **Covalent bonds** are formed between atoms when pairs of electrons are shared between atoms. A covalent bond is between two nonmetals.
- Electrons are transferred/shared so that each atom may reach a more stable electron configuration i.e. the noble gas configuration which contains 8 valence electrons. This is called **octet rule**.
Metals & Non-Metals

Metals
Common characteristics:
- Metallic luster (shine)
- Generally solids at room temperature
- Malleable
- Ductile
- Conduct heat and electricity
- Exist as extended planes of atoms
- Combine with other metals to form alloys which have metallic characteristics
- Form positive ions, e.g. Na⁺, Mg²⁺, and Al³⁺

Nonmetals
Common characteristics:
- Rarely have metallic luster (shine)
- Generally gases at room temperature
- Neither malleable nor ductile
- Poor conductors of heat and electricity
- Usually exist as molecules in their elemental form
- Combine with other nonmetals to form covalent
- Generally form negative ions, e.g. Cl⁻, SO₄²⁻, and N₃⁻.

The differences in the characteristics of metals and nonmetals can be explained by the following:
1. Metals have relatively few electrons in their valence shells.
2. Metals have lower ionization energies than nonmetals.
3. Metals have smaller electron affinities than nonmetals.
4. Metals have larger atoms than nonmetals.

1) As you move across a period, metallic character decreases and nonmetallic character increases.

2) As you move down a group, metallic character increases and nonmetallic character decreases.

Semimetals (Metalloids)
- A class of 8 elements that have properties of both metals and nonmetals.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Si</th>
<th>Ge</th>
<th>As</th>
<th>Sb</th>
<th>Te</th>
<th>Po</th>
<th>At</th>
</tr>
</thead>
</table>

Common characteristics:
- Generally look metallic but are brittle (not malleable or ductile)
- Neither good conductors nor insulators; instead they are semiconductors.
Elements and their Symbols

**Directions:** write the symbols for the following elements.

1. Oxygen __________________ 21. Xenon __________________
2. Hydrogen __________________ 22. Arsenic __________________
3. Chlorine __________________ 23. Gallium __________________
4. Sodium __________________ 24. Chromium __________________
5. Fluorine __________________ 25. Cobalt __________________
7. Nitrogen __________________ 27. Vanadium __________________
9. Copper __________________ 29. Mercury __________________
10. Sulfur __________________ 30. Tin __________________
11. Magnesium __________________ 31. Boron __________________
12. Manganese __________________ 32. Nickel __________________
13. Neon __________________ 33. Cadmium __________________
14. Bromine __________________ 34. Beryllium __________________
15. Silver __________________ 35. Polonium __________________
16. Lead __________________ 36. Uranium __________________
17. Iron __________________ 37. Cesium __________________
18. Calcium __________________ 38. Strontium __________________
19. Potassium __________________ 39. Palladium __________________
20. Gold __________________ 40. Barium __________________

**Directions:** Write the name of the element that corresponds to each of the following symbols.

41. Cu ________________ 54. Sb ________________
42. K ________________ 55. In ________________
43. C ________________ 56. Ta ________________
44. Au ________________ 57. Ce ________________
45. Zn ________________ 58. Nb ________________
46. Pb ________________ 59. I ________________
47. At ________________ 60. In ________________
48. Bi ________________
49. W ________________
50. Y ________________
51. Mo ________________
52. Rh ________________
53. Zr ________________
How to Count Atoms

Worksheet

1. The symbol of an element represents one atom of that element.
   e.g., Ba =

2. A subscript is a number written at the lower right corner behind the symbol of an element. If there is more than one atom of the element, then a subscript is used to indicate the number of atoms.
   e.g., Cl₂ =

3. A subscript outside a bracket multiples all the elements inside the brackets.
   e.g., Ca₃(PO₄)₂ =

   \[
   \begin{align*}
   \text{Ca} & = \text{________} \\
   \text{P} & = \text{________} \\
   \text{O} & = \text{________}
   \end{align*}
   \]

3. A coefficient is a number written in front of a chemical symbol and indicates the number of atoms of that element or number of molecules
   e.g., 3C = _____
   2NaSO₄ = _______ _________ _________
   A subscript is a number written after an atom in a formula and indicates the number of atoms of the kind in the molecule.
   e.g. H₂SO₄ The subscript of H = 2 and the subscript of O = _____

   Note: a coefficient multiples the number of atoms of each element in the formula

   e.g.,
   2 H₂O
   _____ molecules of H₂O
   _____ H (hydrogen)
   _____ O (oxygen)

3 Na₂SO₄
   _____ molecules of Na₂SO₄
   _____ Na (copper)
   _____ S (sulphur)
   _____ O (oxygen)

4 Pb(NO₃)₂
   _____ molecules of Pb(NO₃)₂
   _____ Pb (Lead)
   _____ N (nitrogen)
   _____ O (oxygen)
# Counting Atoms

**Worksheet**
Count the atoms present in the different compounds by using the coefficients and subscripts.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Type of Atom</th>
<th># of Atoms</th>
<th>Type of Atom</th>
<th># of Atoms</th>
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</thead>
<tbody>
<tr>
<td>K₂CO₃</td>
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<tr>
<td>Ba₃(PO₄)₂</td>
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<tr>
<td>Na₂CrO₄</td>
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<td>Total</td>
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<tr>
<td>3 CaCl₂</td>
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<td>Total</td>
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<tr>
<td>NH₄C₂H₃O₂</td>
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<td>Total</td>
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<td>Total</td>
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<tr>
<td>Pb(NO₃)₂</td>
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<td>Total</td>
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<tr>
<td>2 (NH₄)₂Cr₂O₇</td>
<td></td>
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<td>Total</td>
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<td>Total</td>
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</tbody>
</table>
Number of Atoms in a Formula

Directions: Determine the number of atoms in the following chemical formulas.

1. NaCl  
2. H₂SO₄  
3. KNO₃  
4. CaCl₂  
5. C₂H₆  
6. Ba(OH)₂  
7. NH₄Br  
8. Ca₃(PO₄)₂  
9. Al₂(SO₄)₃  
10. Mg(NO₃)₂  
11. Cu(NO₃)₂  
12. KMnO₄  
13. H₂O₂  
14. H₃PO₄  
15. (NH₄)₃PO₄  
16. Fe₂O₃  
17. Na₂C₂H₃O₂  
18. Mg(C₂H₅O₂)₂  
19. Hg₂Cl₂  
20. K₂SO₃

Hint:

**Coefficients:**

Coefficients apply to the entire compound. You multiply the coefficients and the subscripts.

**Example:** 2 H₂S

Atoms of Hydrogen = (2 X 2) = 4
Atoms of Sulfur = (2 X 1) = 2
Total Atoms equals = 6 atoms

If there isn’t a subscript behind an element, there is only one atom of that element.
Directions for each problem

1. Write down the different elements in each compound.
2. Write down how many of that particular atom there are.
3. How many atoms are there total in the compound.

Examples:
A) MgCl₂  Mg – 1
     Cl – 2
     3 total

B) 5 ZnSO₄  Zn – 5
     S – 5
     O – 20
     30 total

1) NaOH  ____________  2) 4 HNO₃  ____________  3) MgCl₂ ____________

4) 4 Li₂O  ____________  5) 2 NaOH  ____________  6) Li₂SO₄ ____________

7) 3 H₂O  ____________  8) Na₂C₂H₃O₂  ____________  9) 3 Al₂O₃ ____________

10) NH₄Cl  ____________  11) 5 ZnSO₄  ____________  12) 7 C₂S₂ ____________

SUPER STAR CHALLENGE!

13) 2 Sr₃(PO₄)₂  ____________  14) 4 Al(OH)₃  ____________  15) Ca (C₂H₃O₂)₂ ____________

16) 4 Al₂(SO₃)₃  ____________  17) 2 (NH₄)₃PO₄ ____________  18) 4 Mg(OH)₂ ____________
Counting Atoms

The formula for a compound indicates the elements that make up the compound and the number of atoms of each element present in the compound. These numbers of atoms are indicated by the use of small numbers called subscripts. Sometimes groups of atoms act as a single atom. Such a group of atoms is called a polyatomic ion. If a polyatomic ion is used in a formula more than once, it is put in parentheses and the subscript appears outside the parentheses. When a subscript appears outside the parentheses, it indicates that all the elements inside the parentheses should be multiplied by that subscript. For example, the formula Fe(OH)$_3$ indicates the combination of one atom of iron, Fe, three atoms of oxygen, O, and three atoms of hydrogen, H.

In the following examples, list each element in the compound and the number of atoms of each element present. The first example has been done for you. You may already be familiar with some of the compounds.

<table>
<thead>
<tr>
<th>NAME</th>
<th>USE</th>
<th>FORMULA</th>
<th>ATOMS IN FORMULA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium carbonate</td>
<td>limestone</td>
<td>CaCO$_3$</td>
<td>Ca = calcium 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>C = carbon 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>O = oxygen 3</td>
</tr>
<tr>
<td>Aspirin</td>
<td>Pain reliever</td>
<td>C$_9$H$_8$O$_4$</td>
<td></td>
</tr>
<tr>
<td>Magnesium hydroxide</td>
<td>found in milk of magnesia</td>
<td>Mg(OH)$_2$</td>
<td></td>
</tr>
<tr>
<td>Paradichlorobenzene</td>
<td>Moth Crystals</td>
<td>C$_8$H$_4$Cl$_2$</td>
<td></td>
</tr>
<tr>
<td>Acetic acid</td>
<td>found in vinegar</td>
<td>C$_2$H$_4$O$_2$</td>
<td></td>
</tr>
<tr>
<td>Trinitrotoluene (TNT)</td>
<td>explosive</td>
<td>C$_7$H$_5$(NO$_2$)$_3$</td>
<td></td>
</tr>
<tr>
<td>Calcium dihydrogen Phosphate</td>
<td>fertilizer</td>
<td>Ca(H$_2$PO$_4$)$_2$</td>
<td></td>
</tr>
<tr>
<td>Pyrite</td>
<td>fools gold</td>
<td>FeS$_2$</td>
<td></td>
</tr>
</tbody>
</table>
Types of Chemical Bonds

Ionic Bonds
The ionic bond is formed by the attraction between oppositely charged ions. Ionic bonds are formed between metals and nonmetals. Remember that metal atoms lose one or more valence electrons in order to achieve a stable electron arrangement. When a metal atom loses electrons it forms a positive ion or cation. When nonmetals react they gain one or more electrons to reach a stable electron arrangement. When a nonmetal atom gains one or more electrons it forms a negative ion or anion. The metal cations donate electrons to the nonmetal anions so they stick together in an ionic compound. This means that ionic bonds are formed by the complete transfer of one or more electrons.

Covalent Bond
A covalent bond is formed between nonmetal atoms. The nonmetals are connected by a shared pair of valence electrons. Remember, nonmetals want to gain valence electrons to reach a stable arrangement. If there are no metal atoms around to give them electrons, nonmetal atoms share their valence electrons with other nonmetal atoms. Since the two atoms are using the same electrons they are stuck to each other in a neutral particle called a molecule. A molecule is a neutral particle of two or more atoms bonded to each other. Molecules may contain atoms of the same element such as N₂, O₂, and Cl₂ or they may contain atoms of different elements like H₂O, NH₃, or C₆H₁₂O₆. Therefore, covalent bonding is found in nonmetallic elements and in nonmetallic compounds. Covalent bonds are intramolecular forces; that is, they are inside the molecule and hold the atoms together to make the molecule. Covalent bonds are strong bonds and it is difficult and requires a lot of energy to break a molecule apart into its atoms. However, since molecules are neutral one molecule does not have a strong electrical attraction for another molecule. The attractions between molecules are called intermolecular forces and these are weak forces. Covalent substances have low melting points and boiling points compared to ionic compounds or metals. At room temperature, covalent substances are gases, liquids or low melting point solids. They do not conduct electricity as solids or when molten and usually do not conduct when dissolved in water.
COVALENT BONDING

Covalent bonding occurs when two or more nonmetals share electrons, attempting to attain a stable octet of electrons at least part of the time. For example:

\[ \text{H}^+ + \text{Cl}^- \rightarrow \text{HCl} \]

Note that hydrogen is content with 2, not 8, electrons.

Show how covalent bonding occurs in each of the following pairs of atoms. Atoms may share one, two or three pairs of electrons.

1. \( \text{H} + \text{H} \) \( (\text{H}_2) \)

2. \( \text{F} + \text{F} \) \( (\text{F}_2) \)

3. \( \text{O} + \text{O} \) \( (\text{O}_2) \)

4. \( \text{N} + \text{N} \) \( (\text{N}_2) \)

5. \( \text{C} + \text{O} \) \( (\text{CO}_2) \)

6. \( \text{H} + \text{O} \) \( (\text{H}_2\text{O}) \)
**Steps for drawing a covalent bond**

1. Determine the number of valence electrons for each element.

2. Decide which one needs more bonds (more electrons to become full). Draw the Lewis dot structure for this element (Element #1) in the center.

3. Create a bond for each unpaired electron in Element #1 by:
   a. Drawing the Lewis dot structure for the other element (Element #2) next to the unpaired electron
   b. Remember to include all electrons (dots) that the element had originally.
   c. Circle Element #2 if it now has a full outer shell.

4. Continue adding bonds until Element #1 has a full outer shell and circle Element #1.

**Example (Carbon and Hydrogen)**

1. Carbon = 4 valence electrons  
   Hydrogen = 1 valence electron

2. Carbon needs 4 more and hydrogen needs only 1 more.


3. 

   ![Lewis dot structure](h)

4. 

   ![Lewis dot structure](h)

**Practice:**

1. Hydrogen and hydrogen

2. Silicon and hydrogen

**Chemical formula:**

- Chemical formula:

- Chemical formula:
3. Carbon and Fluorine

Chemical formula: ____________

4. Sulfur and Chlorine

Chemical formula: ____________

5. Bromine and Iodine

Chemical formula: ____________
IONIC BONDING

Ionic bonding occurs when a metal transfers one or more electrons to a nonmetal in an effort to attain a stable octet of electrons. For example, the transfer of an electron from sodium to chlorine can be depicted by a Lewis dot diagram.

\[
\text{Na}^+ + \text{Cl}^- \rightarrow \text{Na}^+\text{Cl}^-
\]

Calcium would need two chlorine atoms to get rid of its two valence electrons.

\[
\text{Ca}^+ + 2\text{Cl}^- \rightarrow \text{Ca}^{++}\text{Cl}_2
\]

Show the transfer of electrons in the following combinations:

1. K + F
2. Mg + I
3. Be + S
4. Na + O
5. Al + Br
### Chemical Bonding Worksheet

**Ionic Bond**
- between a Metal and Non-Metal \((M + NM)\)

**Covalent Bond**
- between a Non-Metal and Non-Metal \((NM + NM)\)

**Metallic Bond**
- between a Metal and Metal \((M+ M)\)

**Directions:**
1. Determine if the elements in the following compounds are metals or non-metals.
2. Describe the type of bonding that occurs in the compound.

<table>
<thead>
<tr>
<th>Compound</th>
<th>Element 1 (Metal or non-metal?)</th>
<th>Element 2 (Metal or non-metal?)</th>
<th>Bond Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>N = non-metal</td>
<td>O = non-metal</td>
<td>covalent</td>
</tr>
<tr>
<td>NaCl</td>
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<tr>
<td>SO₂</td>
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<td>PO₄³⁻</td>
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<tr>
<td>MgBr₂</td>
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<tr>
<td>CaO</td>
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<td></td>
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<tr>
<td>H₂O</td>
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<td></td>
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<tr>
<td>K₂O</td>
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<tr>
<td>Cu-Zn alloy</td>
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<tr>
<td>O₂</td>
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<td></td>
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<td>CuCl₂</td>
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<tr>
<td>NO₃⁻</td>
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<tr>
<td>TiO₂</td>
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<td>HF</td>
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<td>Rb₂S</td>
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<tr>
<td>Au-Ag mixture</td>
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<tr>
<td>Fe₂O₃</td>
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<tr>
<td>C₆H₁₂O₂₂</td>
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</table>
The microscope seemed like a good tool for Robo Rat to find out more about matter. He overheard Dr. Sparks talking about how matter is made up of small particles called *atoms*, which combine together to make different substances called *compounds*. When Robo looked in the microscope, he saw some atoms hanging around together in groups (called *molecules*). For any compound, a formula can be written to show what atoms combine to make the molecules of the compound.

Read the compound names below. Then try to write the formula for each molecule that Robo saw. Number 3 is done for you as an example!

1. **Hydrogen Chloride**

![Diagram of hydrogen chloride molecule]

2. **Carbon Dioxide**

![Diagram of carbon dioxide molecule]

3. **Phosphorus Pentoxide**

![Diagram of phosphorus pentoxide molecule]

4. **Water**

![Diagram of water molecule]

5. **Hydrogen Peroxide**

![Diagram of hydrogen peroxide molecule]

6. **Silicon Dioxide**

![Diagram of silicon dioxide molecule]

**Symbols**

- Bromine: Br
- Calcium: Ca
- Carbon: C
- Chlorine: Cl
- Fluorine: F
- Hydrogen: H
- Lead: Pb
- Nitrogen: N
- Oxygen: O
- Phosphorus: P
- Silicon: Si
- Silver: Ag
- Sodium: Na

Use with page 27.

**Bond Types**

- **Metallic** (metal – metal)
- **Ionic** (metal – nonmetal)
- **Covalent** (nonmetal– nonmetal)

Key difference between the bonds is in the nature of the “positive/negative” attraction.
Elements and Bonding Worksheet

1) Classify each of the following elements as an alkali metal, an alkaline-earth metal, transition metal, metalloid, halogen, or noble gas based on its position in the periodic table:
   • boron
   • gold
   • krypton
   • calcium

2) How many valence electrons do each of the following elements have?
   • carbon ______
   • xenon ______
   • selenium ______
   • potassium ______

3) Which of the following ions are likely to be formed?
   • N⁺⁵ ______
   • Ar⁺² ______
   • He⁺ ______
   • P⁻³ ______
   • F⁻¹ ______
   • Mg⁺² ______

4) Explain why oxygen is a fairly reactive element while neon is not.

5) Explain why beryllium loses electrons when forming ionic bonds, while sulfur gains electrons.

6) Explain why fluorine and chlorine have similar reactivities (the word "valence" should be somewhere in your answer!)
Identifying Ionic & Covalent Bonds

Directions:

1. Use your periodic table & notes to complete this assignment
2. Identify the elements in each formula
3. Categorize them as either “metals” or “non-metals”
4. Determine the type of bond each compound has.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Metals</th>
<th>Non-Metals</th>
<th>Type of Bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. HF</td>
<td></td>
<td>Hydrogen</td>
<td>Covalent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fluorine</td>
<td></td>
</tr>
<tr>
<td>2. NaCl</td>
<td>Sodium</td>
<td>Chlorine</td>
<td>Ionic</td>
</tr>
<tr>
<td>3. C₄H₁₀</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Al₂O₃</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. CBr₄</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Na₂S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sr₃N₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. H₂S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. BaF₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. C₂H₆</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. NO₂</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. MgCl₂</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## TYPES OF CHEMICAL BONDS

Classify the following compounds as ionic (metal + nonmetal), covalent (nonmetal + nonmetal) or both (compound containing a polyatomic ion).

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CaCl₂</td>
<td>11</td>
<td>MgO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CO₂</td>
<td>12</td>
<td>NH₄Cl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>H₂O</td>
<td>13</td>
<td>HCl</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>BaSO₄</td>
<td>14</td>
<td>KI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>K₂O</td>
<td>15</td>
<td>NaOH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NaF</td>
<td>16</td>
<td>NO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Na₂CO₃</td>
<td>17</td>
<td>AlPO₄</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>CH₄</td>
<td>18</td>
<td>FeCl₃</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>SO₃</td>
<td>19</td>
<td>P₂O₅</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>LiBr</td>
<td>20</td>
<td>N₂O₃</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Introduction to Bonding

Write your own definition of a chemical bond and explain why most atoms form chemical bonds. Use your own words!

Bonding Comparison Chart

<table>
<thead>
<tr>
<th>Types of Atoms Involved</th>
<th>IONIC</th>
<th>COVALENT</th>
<th>METALLIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of Bond Formation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical State</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Melting Point</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solubility in Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical Conductivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Questions: Answer in complete sentences the following four questions on a separate sheet of paper.

1. Why do most atoms form chemical bonds?
2. How are the ionic bonds formed? The covalent bonds? The metallic bonds?
3. What are the typical properties of an ionic bond? A covalent bond? A metallic bond?
4. Identify two compounds that are the result of an ionic bond. A covalent bond. A metallic bond.

Application: Complete one of the following.

- STORY - Choose one type of bonding and write "A Day in the Life of an Atom" story describing what it’s like to be an atom that forms your chosen bond type. The story should incorporate at least 5 properties from your Bonding Comparison Chart.
- COMIC STRIP - Choose one type of bonding and write a comic strip with 3+ frames. The comic should incorporate at least 3 properties from your Bonding Comparison Chart.
- SINGLE-FRAME CARTOON - Draw a single-frame cartoon for each type of bonding. Each cartoon should incorporate at least one key property from your Bonding Comparison Chart.

http://www.isd1.net/communicationsarts/pages/chem/come_together/index.html
Dot Diagrams

You have learned that atoms are composed of protons, neutrons, and electrons. The electrons occupy energy levels that surround the nucleus in the form of an “electron cloud.” The electrons that are involved in forming chemical bonds are called **valence electrons**. Atoms can have up to eight valence electrons. These electrons exist in the outermost region of the electron cloud often called the “valence shell.”

The most stable atoms have eight valence electrons. When an atom has eight valence electrons, it is said to have a complete octet. Atoms will gain or lose electrons in order to complete their octet. In the process of gaining or losing electrons, atoms will form chemical bonds with other atoms. The method we use to visually represent an atom’s valence state is called a **dot diagram**, and you will practice drawing these in the following exercise.

**What is a dot diagram?**

Dot diagrams are composed of two parts—the chemical symbol for the element and dots surrounding the chemical symbol. Each dot represents one valence electron.

- If an element, such as oxygen (O), has six valence electrons, then six dots will surround the chemical symbol as shown to the right.

  ![Oxygen Dot Diagram](image)

- Boron (B) has three valence electrons, so three dots surround the chemical symbol for boron as shown to the right.

  ![Boron Dot Diagram](image)

There can be up to eight dots around a symbol, depending on the number of valence electrons the atom has. The first four dots are single, and then as more dots are added, they fill in as pairs.

**PRACTICE 1**

Using a periodic table, complete the following chart. With this information, draw a dot diagram for each element in the chart. Remember, only the valence electrons are represented in the diagram, not the total number of electrons.

<table>
<thead>
<tr>
<th>Element</th>
<th>Chemical symbol</th>
<th>Total number of electrons</th>
<th>Number of valence electrons</th>
<th>Dot diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrogen</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>Be</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neon</td>
<td>Ne</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
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Dot Diagrams

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<th>Total number of electrons</th>
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</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>K</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td>N</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>Be</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neon</td>
<td>Ne</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulfur</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Using dot diagrams to represent chemical reactivity

Once you have a dot diagram for an element, you can predict how an atom will achieve a full valence shell. For instance, it is easy to see that chlorine has one empty space in its valence shell. It is likely that chlorine will try to gain one electron to fill this empty space rather than lose the remaining seven. However, potassium has a single dot or electron in its dot diagram. This diagram shows how much easier it is to lose this lone electron than to find seven to fill the seven empty spaces. When the potassium loses its electron, it becomes positively charged. When chlorine gains the electron, it becomes negatively charged. Opposite charges attract, and this attraction draws the atoms together to form what is termed an ionic bond, a bond between two charged atoms or ions.

![K⁺ + Cl⁻ → K⁺Cl⁻](image)

Because chlorine needs one electron, and potassium needs to lose one electron, these two elements can achieve a complete set of eight valence electrons by forming a chemical bond. We can use dot diagrams to represent the chemical bond between chlorine and potassium as shown above.

For magnesium and chlorine, however, the situation is a bit different. By examining the electron or Lewis dot diagrams for these atoms, we see why magnesium requires two atoms of chlorine to produce the compound, magnesium chloride, when these two elements chemically combine.

![Cl⁻ + Mg⁺ + Cl⁻ → MgCl₂](image)

Magnesium can easily donate one of its valence electrons to the chlorine to fill chlorine’s valence shell, but this still leaves magnesium unstable; it still has one lone electron in its valence shell. However, if it donates that electron to another chlorine atom, the second chlorine atom has a full shell, and now so does the magnesium.

The chemical formula for potassium chloride is KCl. This means that one unit of the compound is made of one potassium atom and one chlorine atom.

The formula for magnesium chloride is MgCl₂. This means that a one unit of the compound is made of one magnesium atom and two chlorine atoms.

**Practice 2**

Now try using dot diagrams to predict chemical formulas. Fill in the table below:

<table>
<thead>
<tr>
<th>Elements</th>
<th>Dot diagram for each element</th>
<th>Dot diagram for compound formed</th>
<th>Chemical formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na and F</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Br and Br</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mg and O</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LEWIS DOT DIAGRAMS

Lewis diagrams are a way to indicate the number of valence electrons around an atom.

Na⁺, Cl⁻, N:
are all examples of this type of diagram.

Draw Lewis dot diagrams of the following atoms.

1. calcium
2. potassium
3. argon
4. aluminum
5. bromine
6. carbon
7. helium
8. oxygen
9. phosphorus
10. hydrogen

Name: ____________________________
DOT DIAGRAM WORKSHEET

Using a periodic table or electron configuration, place dots around the following element symbols to represent the number of electrons in the outer shell.

1. Li  
2. C  
3. O  
4. F  
5. Ne  
6. Na  
7. Al  
8. P  
9. S  
10. Cl  
11. Ar  
12. K  
13. C  
14. Ti  
15. Ni  
16. As  
17. Br  
18. Kr  
19. Rb  
20. Sr
Rules for Drawing Lewis Dot Diagrams of Covalent Compounds:

1. Calculate the number of valence electrons for each atom and the total for the molecule or ion. For ions, add or subtract electrons as necessary to obtain the correct charge.
2. Write the skeletal structure; place correct number of electrons around each atom.
3. Replace pairs of electrons with a bond.
4. Make certain each atom has a complete octet. Use multiple bonds if necessary to complete octet. Double check total number of electrons.

Additional Hints:
H is always an end (terminal) atom. It has one electron and thus is only able to bond covalently with one other atom.
Halogens and Oxygen are often terminal atoms.
In binary compounds, the central atom has the lowest subscript and is usually listed first.
Carbon has four bonds in most compounds.
Practice Problems

2. Draw the Lewis dot structures for each of the following molecules:
   a. $\text{H}_2\text{S}$  
   b. $\text{CH}_2\text{Br}_2$  
   d. $\text{H}_2\text{S}_2$  
   c. $\text{SO}_3$  
   d. $\text{H}_2\text{CN}$

3. Draw the Lewis dot structure for each of the following polyatomic ions:
   a. $\text{NH}_4^+$  
   b. $\text{NO}_3^-$
   d. $\text{CO}_3^{2-}$
   c. $\text{PO}_4^{3-}$

4. For the following molecules or ions (where the central atom is underlined):
   i. Draw the Electron dot structure.
   ii. Determine the shape of the molecule.
   iii. Determine the approximate bond angles.
   
   a. $\text{CH}_2\text{F}_2$  
   b. $\text{OF}_2$
Section A: Binary Compounds

Metals and Non-Metals

- Name the 1st Element
- Change the root of the 2nd element with -ide ending

Name the Following Binary Compounds:

1. NaF
2. K₂O
3. LiBr
4. CaCl₂
5. BaS
6. BaF₂
7. Na₂S
8. MgI₂
9. K₃N
10. BeSe
11. CO
12. SO₂
13. N₂O

Write Formulas for the following:

14. Aluminum chloride
15. Lithium sulfide
16. Calcium phosphide
17. Barium fluoride
18. Potassium oxide
19. Sodium bromide
20. Barium nitride
21. Lithium oxide
22. Aluminum oxide
23. Rubidium iodide
24. Carbon dioxide
25. Nitrogen dioxide
26. Sulfur trioxide

Formulas and Nomenclature Binary Molecular Worksheet

Name the following compounds.

1. N₂O₄
2. N₂O
3. P₂O₅
4. Cl₂O₇
5. CO₂
6. OF₂

Write formulas.

1. phosphorus pentachloride
2. carbon monoxide
3. carbon tetrachloride
4. nitrogen trifluoride
5. sulfur hexafluoride
6. dinitrogen trioxide
Formulas and Nomenclature Binary Ionic Compounds Worksheet

Name the following compounds.

1. KCl
2. Li₂O
3. CaBr₂
4. LiH
5. MgBr₂
6. K₂O
7. ZnO
8. SrS
9. CaS
10. Ag₂S
11. ZnF₂
12. Ag₃N
13. NaF
14. BaO
15. Na₂S
16. AlBr₃
17. Li₃N
18. KF
19. SrI₂
20. MgO
21. Al₂O₃
22. CaH₂

Write formulas.

1. sodium bromide
2. calcium oxide
3. silver chloride
4. silver oxide
5. aluminum nitride
6. zinc iodide
7. magnesium nitride
8. calcium hydride
9. potassium phosphide
10. calcium fluoride
11. sodium nitride
12. magnesium chloride
13. calcium chloride
14. potassium iodide
15. aluminum chloride
16. barium chloride
17. sodium chloride
18. silver bromide
19. magnesium hydride
20. zinc chloride
21. zinc sulfide
Name ___________________  Date ___________________  Period ________

**Naming Binary Covalent Compounds**

COVALENT MOLECULAR COMPOUNDS- COMPOSED OF NONMETALS ONLY.
1. Name of the "more metallic" element is written first. Since both are nonmetals, choose the element closest to the bottom or left of the periodic table.
2. The ending of the second nonmetal is changed to -ide.
3. Prefixes are added to indicate the number of atoms present. Mono is not used on the first element just write the name if there is only one.

<table>
<thead>
<tr>
<th></th>
<th>MO -</th>
<th>DI</th>
<th>TRI</th>
<th></th>
<th></th>
<th>NONA</th>
<th>DECA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MONO</td>
<td>2</td>
<td>DI</td>
<td>3</td>
<td>TRI</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>TETRA</td>
<td>5</td>
<td>PENTA</td>
<td>6</td>
<td>HEXA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>HEPTA</td>
<td>8</td>
<td>OCTA</td>
<td></td>
<td>NONA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

EXAMPLES:
- CO is carbon monoxide
- SF₆ is sulfur hexafluoride
- CO₂ is carbon dioxide
- P₂O₅ is diphosphorus trioxide

1. CO
2. CO₂
3. H₂O
4. NH₃
5. CH₄
6. NO
7. N₂O
8. N₂O₅
9. N₂O₃
10. PCl₃
11. PF₅
12. P₂O₅
13. SO₂
14. S₂O₅
15. SiCl₄
16. B₂C
17. BN
18. CS₂
19. SeF₄
20. H₂O₂
21. Cl₂O
22. N₂O₃
23. Ni₃
24. AsCl₃
25. CCl₄
26. SeF₃
27. SiO₂
28. H₂S
29. SF₆
30. SO₃
31. XeF₂
32. TeF₆
33. BBr₃
34. XeF₂
35. Se₂Cl₂
36. N₂
37. ClF₃
38. BrF₃
39. SCl₂
40. S₂F₁₀
**Section B: Transition Compounds**

Transition Metals and Non-Metals

1. Name the Transition Metal with a Roman Numeral
2. Change the root of the 2nd Non-Metal with –ide ending

<table>
<thead>
<tr>
<th>Name the Following Binary Compounds:</th>
<th>Write Formulas for the following</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. CuCl</td>
<td>11. Mercury (II) sulfide</td>
</tr>
<tr>
<td>2. CuCl₂</td>
<td>12. Copper (I) nitride</td>
</tr>
<tr>
<td>3. FeO</td>
<td>13. Iron (III) bromide</td>
</tr>
<tr>
<td>5. Cr₂O₃</td>
<td>15. Silver fluoride</td>
</tr>
<tr>
<td>7. SnCl₄</td>
<td>17. Chromium (III) iodide</td>
</tr>
<tr>
<td>8. Ag₂P</td>
<td>18. Nickel (II) bromide</td>
</tr>
<tr>
<td>9. ZnS</td>
<td>19. Tin (IV) sulfide</td>
</tr>
<tr>
<td>10. Hg₂Cl₂</td>
<td>20. Zinc oxide</td>
</tr>
</tbody>
</table>


Representative Ions Only

<table>
<thead>
<tr>
<th>Representative Ions Only</th>
</tr>
</thead>
</table>

Mix of Representative Ions & Polyatomic Ions

<table>
<thead>
<tr>
<th>Mix of Representative Ions &amp; Polyatomic Ions</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. NH₄OH   Ammonium   Hydroxide</td>
</tr>
<tr>
<td>22. NH₄C₂H₃O₂</td>
</tr>
<tr>
<td>23. NH₄NO₃</td>
</tr>
<tr>
<td>24. (NH₄)₂CO₃</td>
</tr>
<tr>
<td>25. (NH₄)₃PO₄</td>
</tr>
<tr>
<td>26. LiOH   Lithium   Hydroxide</td>
</tr>
<tr>
<td>27. Li₂C₂H₃O₂</td>
</tr>
<tr>
<td>28. Li₂CO₃</td>
</tr>
<tr>
<td>29. Li₂SO₄</td>
</tr>
<tr>
<td>30. Li₃PO₄</td>
</tr>
<tr>
<td>31. Be(OH)₂</td>
</tr>
<tr>
<td>32. Be(ClO₃)₂</td>
</tr>
<tr>
<td>33. Be(NO₃)₂</td>
</tr>
<tr>
<td>34. Be(C₂H₃O₂)₂</td>
</tr>
<tr>
<td>35. BeSO₄</td>
</tr>
<tr>
<td>36. Be₃(PO₄)₂</td>
</tr>
<tr>
<td>37. B(OH)₃</td>
</tr>
<tr>
<td>38. B(C₂H₃O₂)₃</td>
</tr>
<tr>
<td>39. B₂(SO₄)₃</td>
</tr>
<tr>
<td>40. BPO₄</td>
</tr>
</tbody>
</table>
Section C: Non-Metal & Non-Metal Compounds

1. Non-Metals and Non-Metals
2. Name the 1st element (with prefix if more than one atom)
3. Change the root of the 2nd Non-Metal with –ide ending

Prefixes

<table>
<thead>
<tr>
<th>1. (Mono)</th>
<th>2. (Di)</th>
<th>3. (Tri)</th>
<th>4. (Terta)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Name the Following Binary Compounds:

1- SO₃
2- AsCl₅
3- N₂O₃
4- P₂O₅
5- GeCl₄
6- XeF₆
7- SF₄
8- NO₃
9- SiO₂
10- CO

Write Formulas for the following

11. Sulfur dioxide
12. Phosphorus trichloride
13. Nitrogen monoxide
14. Carbon tetafluoride
15. Dinitrogen pentoxide
16. Sulfur trioxide
17. Carbon monoxide
18. Phosphorus pentachloride
19. Arsenic tribromide
20. Nirtogen triiodide

Section D: Compounds with Polyatomic Ions

Non-Metals and Non-Metals

Name the 2 parts (ion names)

Name the Following Binary Compounds:

1- BaSO₄
2- (NH₄)₂CO₃
3- Li₃SO₃
4- CrPO₄
5- Na₂H₂O₂
6- BaOH
7- Fe(NO₃)₃
8- KCN
9- SrCrO₄
10- CaCrO₄
11- Al(OH)₃
12- BaCO₃
13- K₂SO₄
14- ZNF₂
15- Ca₃(PO₄)₂
16- Ag₂S
17- Na₃N
18- ZNBr₂
19- Fe(NO₃)₃
20- H₂SO₄
21- Cu₃S
22- KBr
23- Fe₂O₃
24- Cu(OH)₂
25- NiBr₂
26- MgSO₄
27- NH₄Cl
28- FeO
29- Fe₃
30- Ba(ClO₃)₂

Write Formulas for the following

31. Aluminum sulfate
32. Zinc nitrite
33. Magnesium chlorate
34. Sodium bicarbonate
35. Calcium hydroxide
36. Copper (II) carbonate
37. Ammonium sulfide
38. Iron (III) acetate
39. Lithium bisulfate
40. Strontium phosphate
41. Ammonium nitrate
42. Iron (II) chloride
43. Sodium carbonate
44. Copper (II) chloride
45. Silver phosphate
46. Barium acetate
47. Lithium hydroxide
48. Zinc hydroxide
49. Iron (II) iodide
50. Potassium carbonate
51. Silver nitrate
52. Copper (II) oxide
53. Aluminum hydroxide
54. Calcium sulfide
55. Ammonium carbonate
56. Sodium acetate
57. Silver hydroxide
58. Iron(III) bromide
59. Copper (I) nitrate
60. Lithium Fluoride
Name: ___________________________ Date: __________ Period: __________

**Naming WS #3: Ionic Compounds with Transition Metals**

**Part A** Write the formula for each ionic compound.

<table>
<thead>
<tr>
<th>Name</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tin (II) Hydroxide</td>
<td></td>
</tr>
<tr>
<td>Iron (III) oxalate</td>
<td></td>
</tr>
<tr>
<td>Colbalt (II) bromide</td>
<td></td>
</tr>
<tr>
<td>Chromium (III) Chloride</td>
<td></td>
</tr>
<tr>
<td>Iron (II) Oxide</td>
<td></td>
</tr>
<tr>
<td>Mercury (II) Chloride</td>
<td></td>
</tr>
<tr>
<td>Tin (IV) Sulfide</td>
<td></td>
</tr>
<tr>
<td>Silver (I) Phosphide</td>
<td></td>
</tr>
<tr>
<td>Lead (IV) Iodide</td>
<td></td>
</tr>
</tbody>
</table>

**Part B** Write the Name for each formula. Be sure to include the roman numeral.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fe(NO₃)₃</td>
<td></td>
</tr>
<tr>
<td>Mn(OH)₂</td>
<td></td>
</tr>
<tr>
<td>Ti(NO₃)₄</td>
<td></td>
</tr>
<tr>
<td>PbS₂</td>
<td></td>
</tr>
<tr>
<td>CuCl</td>
<td></td>
</tr>
<tr>
<td>PbSO₄</td>
<td></td>
</tr>
<tr>
<td>ZnCl₂</td>
<td></td>
</tr>
<tr>
<td>Hg₂O</td>
<td></td>
</tr>
<tr>
<td>Cr₂O₃</td>
<td></td>
</tr>
</tbody>
</table>

**Part C**: Fill in the following table. Polyatomic ions and transition metals are mixed up.

<table>
<thead>
<tr>
<th>Ionic Formula</th>
<th>Ionic Compound Name</th>
<th>Balanced Ion Pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CuCl</td>
<td>Sodium Chromate</td>
<td></td>
</tr>
<tr>
<td>ZnSO₄</td>
<td>Sodium Nitrate</td>
<td></td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>Potassium cyanide</td>
<td></td>
</tr>
<tr>
<td>FePO₄</td>
<td>Copper(II) nitrate</td>
<td></td>
</tr>
<tr>
<td>NaClO</td>
<td>Lead(II) sulfide</td>
<td></td>
</tr>
<tr>
<td>Na₂SeO₄</td>
<td>Sodium Carbonate</td>
<td></td>
</tr>
<tr>
<td>Au(ClO₄)₃</td>
<td>Ammonium Bromate</td>
<td></td>
</tr>
<tr>
<td>Au₂S₃</td>
<td>Iron(III) Sulfate</td>
<td></td>
</tr>
</tbody>
</table>
Naming Ionic Compounds Practice Worksheet

Name the following ionic compounds:

1) \( \text{NH}_4\text{Cl} \)
2) \( \text{Fe(NO}_3\text{)}_3 \)
3) \( \text{TiBr}_3 \)
4) \( \text{Cu}_3\text{P} \)
5) \( \text{SnSe}_2 \)
6) \( \text{GaAs} \)
7) \( \text{Pb(SO}_4\text{)}_2 \)
8) \( \text{Be(HCO}_3\text{)}_2 \)
9) \( \text{Mn}_2\text{(SO}_3\text{)}_3 \)
10) \( \text{Al(CN)}_3 \)

Write the formulas for the following compounds:

11) chromium (VI) phosphate
12) vanadium (IV) carbonate
13) tin (II) nitrite
14) cobalt (III) oxide
15) titanium (II) acetate
16) vanadium (V) sulfide
17) chromium (III) hydroxide
18) lithium iodide
19) lead (II) nitride
20) silver bromide

http://www.chemfiesta.com
Color the elements on the Periodic Table

Periodic Table of the Elements

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science everywhere.org
Lewis Dot Structures

Lewis dot structures are a simplified way to show how valence electrons are arranged in the outer shell of an element. This is where chemical bonding takes place. Atoms of elements can either share or give up electrons in order to obtain a full outer shell of 8 electrons or, in the case of hydrogen or helium, a full outer shell of 2 electrons. Lewis dot structures are created by the element symbol of the atom which is surrounded by dots which represent the appropriate number of valence electrons of that atom. Fill in the modified periodic table below, which shows Groups 1A through 8A (not the transition metals), with the appropriate Lewis dot structure. Use the following pattern below by starting with position number 1.

<table>
<thead>
<tr>
<th>1A</th>
<th>2A</th>
<th>3A</th>
<th>4A</th>
<th>5A</th>
<th>6A</th>
<th>7A</th>
<th>8A</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Li</td>
<td>Be</td>
<td>B</td>
<td>C</td>
<td>N</td>
<td>O</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>Na</td>
<td>Mg</td>
<td>Al</td>
<td>Si</td>
<td>P</td>
<td>S</td>
<td>Cl</td>
</tr>
<tr>
<td></td>
<td>K</td>
<td>Ca</td>
<td>Ga</td>
<td>Ge</td>
<td>As</td>
<td>Se</td>
<td>Br</td>
</tr>
<tr>
<td></td>
<td>Rb</td>
<td>Sr</td>
<td>In</td>
<td>Sn</td>
<td>Sb</td>
<td>Te</td>
<td>I</td>
</tr>
<tr>
<td></td>
<td>Cs</td>
<td>Ba</td>
<td>TI</td>
<td>Pb</td>
<td>Bi</td>
<td>Po</td>
<td>At</td>
</tr>
</tbody>
</table>

Examples:

$\text{Ba} \quad \text{In} \quad \text{Se}$
**USES:**

This page should include introductory information. With the element name stated above.

- Include a title for this page called "*(element name)* Uses."
- Describe several uses of your element (more than three; be specific).
- Draw or provide a color picture (if available) of your element. (You may need to be creative here. Show a picture of its use if you can’t draw how the element occurs in nature.) A black and white photo is OK if a color one is not available. The periodic table box is not a drawing of your element and neither is an atomic diagram.
- On this page, make sure you cite the picture source.
- Make sure you label/identify the picture.

On the back cover, include:

- Your full name, class, date completed and due date.
- The name of the printer/publisher (Use your imagination. Make up a Publishing Company that will print your brochure. Use Co. or Inc.)
- List References & Web Sites used (Required). Google can’t be a reference!
- Use Work Cited (BFA Media Center Format) for references and websites used. Use WORK CITED as the title and put references in alphabetical order.
- You must use a MINIMUM of two books and two web sites. [Each is worth 5 points.]

**Helpful Hints:** Remember to check over your brochure after you have finished it. Check for the following:

- Is it neat and readable? Fold the brochure correctly.
- Is all the required information there? Used Bullets?
- Are spelling, punctuation and grammar correct?
- Is the brochure attractive and colorful (not required)? Will the reader want to pick up your brochure and read it?
- Do not use pencil, crayon or colored pencils. Use ink or markers for final product. [If you use pencil, automatic —]
- Be sure your margins are adequate so that text isn’t cut off.
- Do not staple or use tape — glue pictures; glue separate sheets or print on both sides.
- Computer generated is good, but not required.
- List specific books and Web Sites used.
- Make this for a person who does not know this element.
- Do not attach BFA work cited colored slips to this brochure. Type or write the information on the brochure.
- Ask yourself — What finishing touches can I add to my brochure to improve it?
- Do you know the meanings of the words you used?

**Physical Science**

**Chemistry Assignment**

**ELEMENT BROCHURE**

For this assignment, you will be creating a brochure about an element that is assigned to you.

Your element is

---

Use your textbook and resources from the Library/Media Center, such as books and the internet, to locate information about your element.

Refer to this sample brochure for the information you need to include. USE BULLETS WHEN POSSIBLE!

Set up your brochure in the format described.

The assignment is worth **100 points**, so include all the required information and do your very best! Your brochure should be fun and interesting to read.

The assignment is due ___________________.

**The Brochure Cover should include:** [Keep it simple.]

- The element name
- The element symbol
- The Periodic Table "box" and the information usually found inside/around the box like Group and Period Number. [Cite Picture Source here]
ATOMIC DIAGRAMS FOR ______________:  
(Use this as the page title.)

On this page, include the following:

- IDENTIFY EACH PART OF THIS PAGE WITH A NAME.
- Electron Cloud, Shell, Energy Level or Ring Diagram. [Cite Picture Source here?]
- The number of electrons that are in each energy level around the nucleus (Electron Configuration).
- Show the number of Protons and Neutrons in the nucleus and the number of Electrons in the cloud region.
- Draw the Lewis Dot Diagram.
- State the number of Valence Electrons. [Outer orbit e−] Valence Electrons = ______
- Oxidation States (Valences). Be sure to include the charge (− or +). Oxidation States = ______

Broughton High School of Wake County

ELEMENT FACTS: (page title)

The Element is [Put Element Name and Symbol here]

[Use this order of facts. On the middle and right-hand pages, include information about your element. Use bullets and identify what the information represents. Use units where necessary.]

- The atomic number = ______
- The average atomic mass (atomic weight) = ______
- The mass number = ______
- Who discovered the element? Nationality? ______
- When was it discovered? In what Country? ______
- How was the element named? ______
- What is its natural state/phase of matter? [solid, liquid, gas or plasma] ______
- Its melting point in °C? ______
- Its boiling point in °C? ______
- The group it belongs to in the periodic table (Noble gas, metal, nonmetal, Alkali metals, and so forth)? ______
- Some of its characteristics/properties, such as color, odor, whether it is dangerous—explosive, radioactive, nonion, poisonous, etc. ______
- Its number of isotopes and the most important isotope. Use the symbol-mass designation like C-14. ______
- Periodic Table—Group Number = ______
- Periodic Table—Period Number = ______
- Density in g/mL or g/cm³ = ______
- Where is it found? [Location or place on Earth] ______
- Atomic Radius (include units) = ______
- The most common compounds formed. [formulas] ______

ADDITIONAL ELEMENT FACTS:

- What is its crystal shape?
- If known, what does it cost?
- Any other interesting facts about the element?

Remember to check all your facts.

Is there anything you can add to improve your brochure?

Be creative......Have fun!

PLEASE REMEMBER—NO PENCIL. Including Colored Pencils—USE INK, MARKERS, OR A COMPUTER PRINTER. [Automatic ← if you use pencil]