

Chemistry
Approximate Timeline

Students are expected to keep up with class work when absent.

CHAPTER 12 – CHEMICAL BONDING		
Day	Plans for the day	Assignment(s) for the day
1	<ul style="list-style-type: none"> • Begin Chapter 12 • 12.1 – Characteristics of Chemical Bonds <ul style="list-style-type: none"> ○ Types of Chemical Bonds <ul style="list-style-type: none"> ▪ Ionic & Covalent ○ Electronegativity ○ Bond Polarity and Dipole Moments 	<ul style="list-style-type: none"> • Assignment 12.0 • Assignment 12.1 • Read section(s) 12.2
2	<ul style="list-style-type: none"> • 12.2 – Characteristics of Ions & Ionic Compounds <ul style="list-style-type: none"> ○ Stable Electrons Configurations & Charges on Ions ○ Ionic Bonding and Structures of Ionic Compounds 	<ul style="list-style-type: none"> • Assignment 12.2 • Read section(s) 12.3
3	<ul style="list-style-type: none"> • 12.3 – Lewis Structures <ul style="list-style-type: none"> ○ Writing Lewis Structures <ul style="list-style-type: none"> ▪ Individual atoms ▪ Molecules with single bonds only ▪ Molecules with multiple bonds 	<ul style="list-style-type: none"> • Assignment 12.3a
4	<ul style="list-style-type: none"> • 12.3 – Lewis Structures <ul style="list-style-type: none"> ○ Writing Lewis Structures <ul style="list-style-type: none"> ▪ Individual atoms ▪ Molecules with single bonds only ▪ Molecules with multiple bonds • Section 12.4 – Structures of Molecules <ul style="list-style-type: none"> ○ Molecular structures ○ The VSEPR Model 	<ul style="list-style-type: none"> • Assignment 12.3b • Read section(s) 12.4
5	<ul style="list-style-type: none"> • 12.4 – Structures of Molecules <ul style="list-style-type: none"> ○ Molecular structures ○ The VSEPR Model 	<ul style="list-style-type: none"> • Assignment 12.4
6	• Discuss & start Shapes of Molecules Lab	•
7	• Finish Shapes of Molecules Lab – due at the end of the hour	•
8	• Work on Assignment 12.5	• Assignment 12.5
9	<ul style="list-style-type: none"> • Grade & discuss Assignment 12.5 • Review for the Chapter 12 Test 	•
10	• Chapter 12 Test	• Read section(s) 13.1

Study Guides
Chapter 12 Quizzes

Quiz 12.1 Characteristics of Chemical Bonds

1. Define the following terms:
 - a. chemical bond
 - b. covalent bond
 - c. electronegativity
 - d. ionic bond
2. Given two atoms, indicate which type of chemical form is most likely to form between the two atoms. (ionic, nonpolar covalent, polar covalent)
3. In general:
 - a. Electronegativity _____ going from left to right across a period.
 - b. Electronegativity _____ going from top to bottom down a group.

Quiz 12.2 Characteristics of Ions & Ionic Bonds

4. Know why, generally speaking, atoms will gain or lose a certain number of electrons.
5. Which is larger, a cation or its parent atom?
6. Which is larger, an anion or its parent atom?
7. Be able to write the electron configuration of an ion.

Quiz 12.3 Lewis Structures

8. Define the term "Lewis structure".
9. How are electrons represented in a Lewis structure?
10. Which electrons are included when drawing a Lewis structure?
11. Be able to draw Lewis structure for:
 - a. individual atoms
 - b. simple molecules
12. Know how many pairs of electrons are needed to form...
 - a. a single bond
 - b. a double bond
 - c. a triple bond

Quiz 12.4a Structures of Molecules

13. What does the acronym "VSEPR" stand for?
14. According to the VSEPR theory, the structure around a given atom is determined by minimizing repulsive forces between ____ ____
15. Whenever two pairs of electrons are present around an atom, they should always be placed at an angle of 180° to each other to give a ____ arrangement.
16. Whenever three pairs of electrons are present around an atom, they should always be placed at the corner of a ____ (in a plane at an angle of 120° to each other).
17. Whenever four pairs of electrons are present around an atom, they should always be placed at the corners of a ____

18. When using the VSEPR model to predict the molecular geometry of a molecule, a double bond is counted the same as a ____ ____ ____

Quiz 12.4b Structures of Molecules

19. Be able to draw Lewis structures for simple molecules and use your Lewis structure to:
- predict the shape of the molecule
 - indicate the bond angles in the molecule
 - determine whether the molecule is polar or nonpolar

Study Guide
Chapter 12 Test

At the completion of chapter 12 you should...

1. Know the definitions of the following terms.
 - a. Bond
 - b. Ionic Bond
 - c. Covalent Bond
 - d. Electronegativity
 - e. Polar Covalent Bond
 - f. Lewis Structure
 - g. Bonding Pair (shared pair)
 - h. Lone Pair (unshared pair)
 - i. Molecular Structure
 - j. Valence shell
 - k. VSEPR Theory
2. Be able to distinguish ionic bonds and covalent bonds.
3. Understand how electronegativity influences which type of chemical bond forms.
4. Identify chemical bonds as...
 - a. Ionic
 - b. Polar Covalent
 - c. Non-polar Covalent
5. Understand why atoms form particular ions.
6. Be able to draw Lewis structures for...
 - a. individual atoms.
 - b. molecules containing only single bonds.
 - c. molecules containing double or triple bonds.
7. Use Lewis structures to predict...
 - a. The shape of a molecule.
 - b. The polarity of a molecule.
 - c. The bond angles with a molecule.

Assignment 12.0 – Vocabulary

Define each of the following terms.

1. Bond
2. Ionic Bond
3. Covalent Bond
4. Electronegativity
5. Polar Covalent Bond
6. Lewis Structure
7. Bonding Pair (shared pair)
8. Lone Pair (unshared pair)
9. Molecular Structure
10. Valence Shell
11. VSEPR Theory

Assignment 12.1 – Characteristics of Chemical Bonds

(2 pages)

- 1) A) What is meant by the term *chemical bond*? B) What subatomic particles are most important in chemical bonds?

- 2) How are ionic bonds and covalent bonds different?

- 3) How is a polar covalent bond different from a (nonpolar) covalent bond?

- 4) How do electronegativity values help in determining the dipole moment (polarity) of a bond?

- 5) For each of the binary molecules below, draw an arrow under the molecule showing its dipole moment. If it has none, write “none”.
 - A) H—Cl
 - B) H—H
 - C) H—I
 - D) Br—Br
 - E) C—O

- 6) The pairs of atoms below are bonded together. Label the bond as **polar covalent**, **nonpolar covalent**, or **ionic**.

A) C – O _____

B) K – Cl _____

C) H – O _____

D) Li – S _____

E) C – C _____

Assignment 12.2 – Characteristics of Ions & Ionic Compounds

(2 pages)

- 1) How can we predict that oxygen will form an O^{2-} ion and not an O^{3-} ion?

- 2) Write the electron configurations for the pairs of atoms given below. Use them to predict the formula for an ionic compound formed from these elements.
 - A) Mg and S

 - B) K and Cl

 - C) Cs and F

 - D) Ba and Br

- 3) A) Why are cations smaller than their parent atoms? B) Why are anions larger?

4) Write the **full** electron configuration for each of the following ions.

A) Na^+ _____

B) Ca^{2+} _____

C) S^{2-} _____

D) Cl^- _____

Assignment 12.3a – Lewis Structures (1)

Directions: Draw the Lewis structure for each atom, molecule or ion in the space provided.

1. Mg	2. S	3. Cl ₂
4. H ₂ O	5. CH ₄	6. HCl
7. CF ₄	8. NH ₃	9. POCl ₃
10. SCl ₂	11. ClO ¹⁻	12. NF ₃
13. SO ₄ ²⁻	14. SO ₃ ²⁻	15. XeO ₄
16. CHCl ₃	17. CH ₃ CH ₃	18. CH ₃ CH ₂ OH

Assignment 12.3b – Lewis Structures (2)

Directions: Draw the Lewis structure for each atom, molecule or ion in the space provided.

1. O	2. N	3. H ₂
4. H ₂ S	5. CF ₄	6. HBr
7. O ₂	8. H ₂ CO	9. CH ₂ CH ₂
10. N ₂	11. C ₂ H ₂	12. SO ₃

Assignment 12.4 – VSEPR Theory

(2 pages)

Directions: First, draw the Lewis structure for the molecule. Next, use it to predict the shape and polarity of the molecule.

	Lewis Structure	Shape & Polar or Nonpolar
1. Cl ₂		Shape: Polarity: Bond Angle: omit
2. H ₂ S		Shape: Polarity: H—S—H Bond Angle:
3. CH ₄		Shape: Polarity: H—C—H Bond Angle:
4. HCl		Shape: Polarity: Bond Angle: omit
5. CBr ₄		Shape: Polarity: Br—C—Br Bond Angle:
6. NCl ₃		Shape: Polarity: Cl—N—Cl Bond Angle:
7. POF ₃		Shape: Polarity: F—P—F Bond Angle:

	Lewis Structure	Shape & Polar or Nonpolar
8. SCl_2		Shape: Polarity: Cl—S—Cl Bond Angle:
9. ClO_2^{1-}		Shape: Polarity: omit O—Cl—O Bond Angle:
10. NF_3		Shape: Polarity: F—N—F Bond Angle:
11. PO_4^{3-}		Shape: Polarity: omit O—P—O Bond Angle:
12. PO_3^{3-}		Shape: Polarity: omit Bond Angle:
13. RnO_4		Shape: Polarity: O—Rn—O Bond Angle:
14. CH_3Cl		Shape: Polarity: H—C—Cl Bond Angle:

Assignment 12.5 – Chapter Review

(6 pages)

- 1) What type of bonding requires the complete *transfer* of an electron from one atom to another?
- 2) What type of bonding involves the *sharing* (either equally or unequally) of electrons between atoms?
- 3) What type of chemical bond exists between the atoms in the hydrogen molecule, H₂?
- 4) What type of chemical bond exists between the atoms in the hydrogen fluoride molecule, HF?
- 5) What does it mean to say that a bond is *polar*?
- 6) What are the conditions that give rise to a bond being polar?
- 7) For each of the following sets of elements, identify the element expected to be most electronegative and that expected to be least electronegative.
 - A) K, Sc, Ca
Most = _____ Least = _____
 - B) Br, F, At
Most = _____ Least = _____
 - C) C, O, N
Most = _____ Least = _____

- 8) On the basis of the electronegativity values given in Figure 12.4 (page 403), indicate whether each of the following bonds would be *ionic*, *nonpolar covalent*, or *polar covalent*.



- 9) Why are cations always smaller than the atom from which they are formed?
- 10) Why are anions always larger than the atom from which they are formed?
- 11) Why are the *valence* electrons of an atom the only electrons likely to be involved in bonding to other atoms?
- 12) How many electrons are involved when two atoms in a molecule are connected by a “double bond”?

- 13) Draw a Lewis structure for each of the following simple molecules. Show all bonding valence electron pairs as lines and all nonbonding valence electron pairs as dots.



- 14) Draw a Lewis structure for each of the following polyatomic ions. Show all bonding balance electron pairs as lines and all nonbonding valence electron pairs as dots.
- A) SO_4^{2-}
- B) PO_4^{3-}
- C) SO_3^{2-}
- 15) A) What is the geometric structure (the shape) of the water molecule? B) How many pairs of valence electrons are there on the oxygen atom in the water molecule? C) What is the approximate H—O—H bond angle in water? (Hint: draw the Lewis structure then answer the questions.)
- 16) A) What is the geometric structure of the ammonia molecule? B) How many pairs of valence electrons are there on the nitrogen atom in the ammonia molecule? C) What is the approximate H—N—H bond angle in ammonia? (Hint: draw the Lewis structure then answer the questions.)

- 17) A) What is the geometric structure of the boron trifluoride molecule, BF_3 ? B) How many pairs of electrons are present on the boron atom in BF_3 ? C) What are the approximate F—B—F bond angles in BF_3 ? (Hint: draw the Lewis structure then answer the questions.)
- 18) A) What is the geometric structure of the CH_4 molecule? B) How many pairs of valence electrons are present on the carbon atom of CH_4 ? C) What are the approximate H—C—H bond angles in CH_4 ? (Hint: draw the Lewis structure then answer the questions.)
- 19) Although the valence electron pairs in ammonia have a tetrahedral arrangement, the overall geometric structure of the ammonia molecule is *not* described as being tetrahedral. Explain.
- 20) Although both the BF_3 and NF_3 molecules contain the same number of atoms, the BF_3 molecule is flat, whereas the NF_3 molecule is trigonal pyramidal. Explain.

21) Using the VSEPR theory, predict the molecular structure of each of the following molecules and ions. (Hint: draw the Lewis structure then answer the question.)



22) A) Predict the geometric structure of the carbonate ion, CO_3^{2-} . B) What are the bond angles in the ion? (Hint: draw the Lewis structure then answer the questions.)