

We will use ball and peg models to visualize various compounds and how they form in relation to their valence electrons. We'll examine the shapes these compounds make, how they translate into Lewis Dot Diagrams, practice drawing structural models, and to evaluate if the various individual bonds are polar or non-polar, as well as to determine if the molecules themselves are polar or non-polar.

Background:

Ionic bonds form between metal cations and non-metal anions. By definition these are "polar" since they have a + and a - side. The valence electrons of the cations are "transferred" to the anions and not shared by the ions.

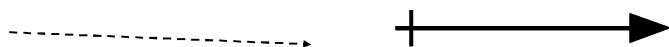
When two non-metals bond (like hydrogen + chlorine) they form bonds called covalent bonds. In covalent bonds 2 non-metals bond by sharing electrons. This sharing is balanced, or not depending upon the difference in their electronegativity values (Table S).

The greater the electronegativity difference, the greater the polarity of the bond.

Molecular Polarity is different, it's based upon shape of the molecule. If it is "balanced" and has radial symmetry (like pizza) then the molecule is nonpolar. If it has polar bonds, they are electrostatically offset by the balanced shape. We show bond polarity with dipole arrows. A dipole arrows are used in Lewis Dot Diagrams to show where the electron was (+ now) and where it went (- charge now, has the arrow head).

That's a + sign

the arrow shows the - side



1. Lewis Dot diagram for water	2. Structural diagram for water	3. Structural with dipole arrows

The dipole arrows DON'T replace the bond lines. Arrows are drawn next to the bonds.

4. Lewis Dot diagram for HCl	5. Structural diagram for HCl	6. Structural for HCl with dipole arrows

7. Define RADIAL SYMMETRY:

8 +9. Draw structural diagrams of water, and Draw structural diagrams of methane
Water has polar bonds, with polar molecules. Methane has polar bonds but is a nonpolar molecule.

State if they have:

RADIAL SYMMETRY = nonpolar molecule or, NO RADIAL SYMMETRY = polar molecule

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Molecules with radial symmetry are NON-POLAR molecules,
Molecules without radial symmetry are POLAR MOLECULES.

The only symmetry that "counts" in chemistry is RADIAL SYMMETRY.

Ionic bonds are polar (cation/anion).

Some covalent bonds are called polar (difference in electronegativity values).

Some covalent bonds are called nonpolar covalent (no difference in electronegativity).

Bonds can be POLAR (ionic or polar covalent) or NON-POLAR.

ONLY covalent bonds can be single, double or triple.

Ionic bonds are "just" ionic - never single double or triple. Ionic bonds are also always polar, but we don't have to say that, of course a bond with a positive cation on one side and a negative anion on the other is polar.

Using the model kits, create models for all of the substances in the boxes. You must make each one, THEN draw. I can tell if you're faking it, the diagrams will be OBVIOUSLY WRONG. Just do your work.

compound name	formula	DRAW a LEWIS dot diagram	DRAW a structural diagram	Does this exhibit RADIAL SYMMETRY?	Is this molecule polar or non-polar?
	NH ₃				
	H ₂ O				
	HCl				
	NBr ₃				
ethane	C ₂ H ₆				
ethyne	C ₂ H ₂				
propane	C ₃ H ₈				

compound name	formula	DRAW a LEWIS dot diagram	DRAW a structural diagram	Does this exhibit RADIAL SYMMETRY?	Is this molecule polar or non-polar?
	CCl_4				
	CH_4				
Trichloro- methane (chloroform)	CHCl_3				
Tribromo- methane	CHBr_3				
Difluoro methane	CH_2F_2				
	SCl_2				
Chlorine mono- fluoride <i>(not iodine!)</i>	ClF				
	PCl_3				

compound name	formula	DRAW a LEWIS dot diagram	DRAW a structural diagram	Does this exhibit RADIAL SYMMETRY?	Is this molecule polar or non-polar?
	F ₂				
	O ₂				
	N ₂				
	H ₂				
	AsCl ₃				
	AsF ₃				
	CS ₂				
	CO ₂				

Part C. Recognize the bonding... Using the LETTERS, decide which bonds are present in each compound. Some have more than one bond.

A. Single Polar Covalent
 D. Single Nonpolar Covalent
 G. Triple Nonpolar Covalent

B. Double Polar Covalent
 E. Double Nonpolar Covalent
 H. Resonating

C. Coordinate Covalent
 F. Triple Polar Covalent
 I. Ionic

Bonds Present	Chemical Formula	Proper Chemical Name
A	H ₂ O	water
	CH ₄	
	F ₂	
	PCl ₃	
	KCl	
	Fe ₂ O ₃	
	TiCl ₄	
	C ₂ H ₂	
	C ₂ H ₄	
	H ₂ S	
	AsF ₃	
	CO	
	CO ₂	
	OF ₂	
	Rb ₂ S	
	SiO ₂	

Bonds Present	Chemical Formula	Proper Chemical Name
	NH ₃	
	MgO	
	SF ₂	
	O ₃	
	CCl ₄	
	I ₂	
	HF	
	BF ₃	
	O ₂	
	Li ₂ O	
	CS ₂	
	N ₂	
	AuCl ₃	
	H ₂	
	NBr ₃	
	CH ₂ F ₂	

This Lab Report Requires: You to make a cover page with a sentence stating why we did this lab for one point, provide answers for the all of the questions, fill in all of the boxes for the models, name all of the compounds determine molecular polarity, then name the bonds in Part C. Finally, write the longish conclusion. The total of 60 points.

This is AN IMPORTANT TOPIC, and one that will take a large effort for you to master.

Bonding Lab	Do this	Points
Cover page	Include one sentence explaining why we did this lab.	1
Lab part A	Lab Handout Questions 1- 9	9
24 Models (boxes)	Dots, structural, radial symmetry, and molecular polarity	24
Part C	Naming compounds, determining bond types	10
Conclusion	See below	16
Due on:	total	60

Your long, illustrated, and very wordy conclusion, worth 16 points includes...

1. What substances forms ionic bonds, which form covalent bonds? Give 2 examples of each.
2. How is electro-negativity difference used to determine bond polarity? Who won the Nobel Prize for this work in chemistry?
3. Why do all of the HONClBrIF twins exhibit non-polar bonds?
4. Draw small structural diagrams for all of the HONClBrIF twins. H, O₂, etc. Which of the bonds between each pair are the same, which are different?
5. Describe the coordinate covalent bond in carbon monoxide.
6. Describe the resonate bonding found in ozone.
7. What is the "octet rule"? What compound breaks the octet rule with 10 valence electrons?
8. Explain how to determine if molecules are polar or non polar. Give 2 examples for polar, and for non polar.
9. Explain why some molecules have polar bonds but the molecules are non-polar (ex: CH₄). Name two other non polar molecules with polar bonds.
10. Explain how NBr₃ is exactly opposite the examples in question nine.
11. Name the 3 kinds of intermolecular bonding. Give examples that show each kind.
12. Describe metallic bonds and give examples of metals that exhibit these. How does the theory of this metallic bonding explain the 3 main properties of metals