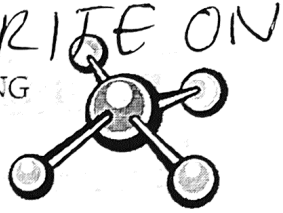
Name Intro Bonding Notes POGIL #1

DO NOT WRITE ON

BONDING



Directions: Use the chart below and your periodic table to answer the questions that follow.

PART I: COMPARING ELEMENTS

Group One and Group Two both show different compounds made by bonding different elements together. There are two types of bonding in food science, as shown in these two groupings. Let's take a closer look at the elements in each compound to see what makes a compound IONIC or COVALENT.

IONIC BONDS	COVALENT BONDS
NaCl (Sodium Chloride)	H_2O (Dihydrogen Monoxide)
MgO (Magnesium Oxide)	CH_4 (Methane)
Li_2O (Lithium Oxide)	CO_2 (Carbon Dioxide)
KF (Potassium Fluoride)	HF (Hydrofluoric Acid)
$FeBr_3$ (Iron III Bromide)	NH_3 (Ammonia)
$CaCl_2$ (Calcium Chloride)	NO_2 (Nitrogen Dioxide)
NiI_2 (Nickel Iodide)	$C_6H_{12}O_6$ (Glucose)
BaS (Barium Sulfide)	CF_4 (Carbon Tetraflouride)

1. List out the FIRST element in each of the GROUP ONE compounds.

2. What do you notice about the FIRST element that makes up each compound in GROUP ONE?

3. What side of the periodic table do you find these FIRST elements on?

4. List out the SECOND element in each of the GROUP ONE compounds.

5. What do you notice about the SECOND element that makes up each compound in GROUP ONE?

6. What side of the periodic table do you find these SECOND elements on?

BIG IDEA #1: When a _____ and a _____ come together, they make an IONIC BOND.

7. What do you notice about ALL of the elements in GROUP TWO?

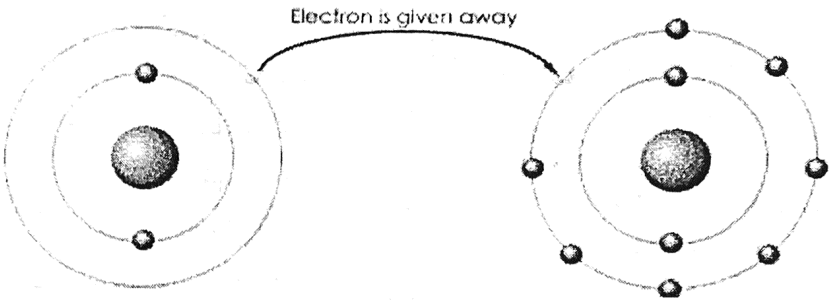
8. What side of the periodic table do you find ALL of these elements on?

BIG IDEA #2: When a _____ and another _____ come together, they make a COVALENT BOND.

PART II: COMPARING PROCESSES

Directions: Examine the following pictures of IONIC and COVALENT bonding.

BONDING PICTURE ONE:



Lithium (Li) atom Fluorine (F) atom

Explain what is happening in the picture in your own words:

9. What are the names of the two elements present in bonding picture one?

10. What TYPE of element is element one? Element two?

11. Therefore, bonding picture one must show the process for which type of bonding; ionic or covalent?

BIG IDEA #3: In IONIC BONDING, the _____ *TRANSFERS* it's electron(s) to the _____.

12. *Read the following and answer the questions that follow:*
Imagine you are in a competition with 20 other people. Everyone starts out with a different number of basketballs in their container. The goal of the competition is to either have 8 OR 0 basketballs in your container by the end of 20 minutes. The prize is $1,000,000. When the timer starts you notice that you have only 1 basketball in your container to start. Which would be easier?
a) Giving away your 1 basketball so that you have 0 at the end of 20 minutes?
OR
b) Trying to get 7 more basketballs so that you has 8 at the end of 20 minutes?
Why did you choose this option?

You look over at your friend and notice that he has 7 basketballs in his container already. What is the easiest way for him to reach the goal?

a) Trying to get rid of the 7 basketballs so that he have 0 at the end of 20 minutes?

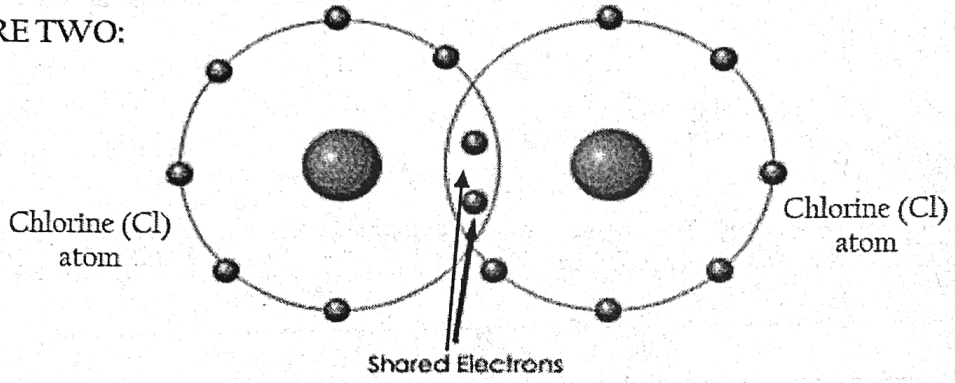
OR

b) Trying to get 1 more basketball (maybe from you!)so that he has 8 at the end of 20 minutes?

Why did you choose this option?

This is kind of like what happens in IONIC BONDING. The METALS have a small amount of electrons in their last shell so it is easier for them to get rid of them than try to gain a bunch. The NONMETALS almost have a full shell of eight so it is easier for them to get a few then get rid of all of theirs. This is why the <u>METALS TRANSFER ELECTRONS TO NONMETALS IN IONIC BONDING</u>.

BONDING PICTURE TWO:



<u>Explain what is happening in the picture in your own words:</u>

13. What are the names of the two elements present in bonding picture two?

14. What TYPE of element is element one? Element two?

15. Therefore, bonding picture two must show the process for which type of bonding; ionic or covalent?

<u>BIG IDEA #3</u>: In COVALENT BONDING, the _____ and the other _____ *SHARE* their electrons.

16. Imagine that you are still in that same basketball competition. You look in your container and see that you have 7 basketballs. You look next to you and notice that your twin brother has 7 also. Both of you have so many that you don't want to give them up, but you both need one more. No one around you is giving any of theirs away! You and your brother come up with a plan. At the end of the 20 minutes when the judges are checking how many basketballs everyone has, you share one of yours to him so he has 8. Then, once he is checked he gives yours back to you and shares one of his with you so you have 8 also. You both split the prize!
Why is this a good option for both of you?

This is kind of like what happens in COVALENT BONDING. Both NONMETALS are almost to their happy eight, so neither wants to give anything away. This is why <u>NONMETALS SHARE ELECTRONS IN COVALENT BONDING.</u>

PRACTICE III: PRACTICE

Based on what you just learned, put the following into the chart as either IONIC or COVALENT COMPOUNDS.

KCl	Rb_2S	Cl_2	PH_3	CH_3Cl	SO_2	$MgCl_2$
Fe_2O_3	NaBr	CaF_2	SCl_6	N_2O_5	CuF_2	CS_2

IONIC COMPOUNDS	COVALENT COMPOUNDS

*In IONIC BONDING metals _____ their electrons to nonmetals so they all have 8.

*In COVALENT BONDING nonmetals _____ their electrons so they all have 8.

* On answersheet → Write a Summary of the important concepts from this assignment.

Unit 6 Bonding & IMFs POGIL #2

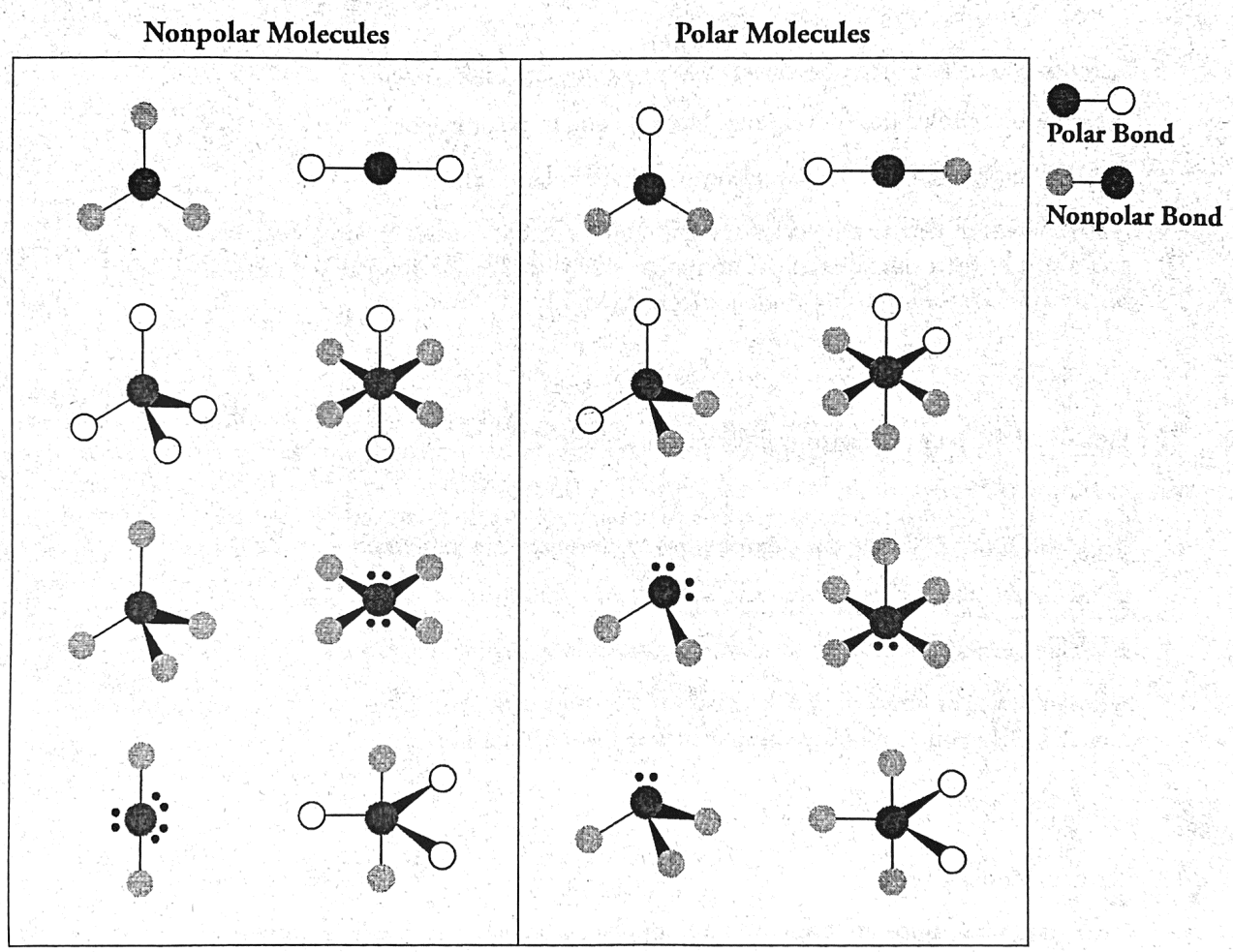
Polar and Nonpolar Molecules

What makes a molecule polar?

Why?

The physical properties of a substance are dictated in part by whether or not a molecule is polar. For example, oil and water do not mix because water is polar whereas oil is nonpolar. Another example is carbon dioxide and water. At room temperature, carbon dioxide is a gas while water is a liquid because carbon dioxide is nonpolar while water is polar. In this activity, you will explore the factors that contribute to a molecule's polarity or nonpolarity.

Model 1 – Examples of Nonpolar and Polar Molecules



1. Consider Model 1. How is a polar bond differentiated from a nonpolar bond?

2. Formaldehyde has the chemical formula CH_2O, and it is trigonal planar. Draw this molecule using open and shaded circles as it might be shown in Model 1.

3. Label each diagram in Model 1 with the three-dimensional electronic shape that it represents.

4. According to Model 1, can the shape of a molecule explain polarity? Justify your reasoning.

5. Refer to Model 1. Circle the correct word to complete each sentence.

   a. Nonpolar molecules (never, may, always) contain polar bonds.

   b. Polar molecules (never, may, always) contain polar bonds.

6. A student states "Polar molecules are just molecules that contain polar bonds. If there are no polar bonds, then the molecule is nonpolar." Do you agree or disagree with this statement? Justify your reasoning using evidence from Model 1.

7. How is a lone pair of electrons illustrated in Model 1?

8. Refer to Model 1. Circle the correct word to complete the sentence.

   a. Nonpolar molecules (never, may, always) contain lone pairs of electrons.

   b. Polar molecules (never, may, always) contain lone pairs of electrons.

9. Is the presence or absence of a lone pair of electrons sufficient to explain the polarity of molecules? Justify your reasoning using evidence from Model 1.

10. Refer to Model 1.

   a. When polar bonds are present in a nonpolar molecule, how are they arranged around the center atom—on the same side of the molecule or on opposite sides of the molecule?

   b. When polar bonds are present in a polar molecule, how are they arranged around the center atom—on the same side of the molecule or on opposite sides of the molecule?

11. Refer to Model 1.

a. When lone pairs of electrons are present in a nonpolar molecule, how are they arranged around the center atom—on the same side of the molecule or on opposite sides of the molecule?

b. When lone pairs of electrons are present in a polar molecule, how are they arranged around the center atom—on the same side of the molecule or on opposite sides of the molecule?

12. Consider the term "symmetry" as it is used in the English language. As a group, rank the following shapes from most symmetric to least symmetric.

13. Which set in Model 1, the nonpolar molecules or polar molecules, contains molecules that are symmetric about multiple planes of symmetry?

Read This!

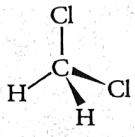
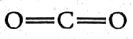
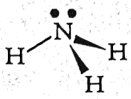
Polar molecules have an unequal distribution of charge around the molecule as a whole. This could be due to a bond being polar or a lone pair of electrons being present. Both would cause a concentration of negative charge on one side or in one area of the molecule due to an unequal distribution of electrons among nuclei. If a molecule has more than one polar bond or lone pair of electrons and they are symmetrically arranged, there is no unequal distribution of charge and the molecule is nonpolar.

14. Suppose a molecule contained two bonds around the center atom, and both those bonds were polar. What would the angle between those two bonds need to be for the molecule to be considered nonpolar? (Assume there are no lone pairs on the center atom.)

15. Suppose a molecule contained four identical bonds around the center atom, and all four of those bonds were polar. What would the angle between any of the four bonds need to be for the molecule to be considered nonpolar? (Assume there are no lone pairs on the center atom.)

16. If a molecule contains only one polar bond and no lone pairs, is there an arrangement that will make that molecule nonpolar? Justify your reasoning.

17. Fill in the table below for each molecule to determine if the molecule is polar or nonpolar. You may want to refer to a table of electronegativity values.

Name	Dichloromethane	Carbon dioxide	Ammonia
Structure			
Does the molecule have polar bonds? If yes, which ones?			
Does the molecule have lone pairs on the center atom?			
If there are polar bonds and/or lone pairs, are they symmetric?			
Is the molecule polar or nonpolar?			

18. Draw the three-dimensional structures for each molecule. Fill in the table for each molecule to determine if the molecule is polar or nonpolar.

Name	Methane (CH_4)	Formaldehyde (CH_2O)	Xenon tetrafluoride (XeF_4)
Structure			
Does the molecule have polar bonds? If yes, which ones?			
Does the molecule have lone pairs on the center atom?			
If there are polar bonds and/or lone pairs, are they symmetric?			
Is the molecule polar or nonpolar?			

19. Determine if the following molecules are polar or nonpolar.

a. Carbon tetrafluoride (CF_4)

b. Water (H_2O)

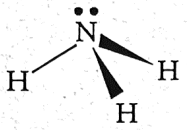
c. Sulfur dioxide (SO_2)

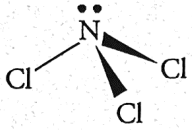
d. Phosphorous pentachloride (PCl_5)

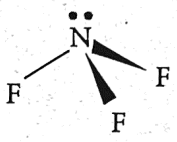
e. Hydrogen sulfide (H_2S)

Extension Questions

Model 2 – A Series of Polar Molecules







Dipole Moment	1.42 D	0.60 D	0.23 D

20. The polarity of a molecule can be quantified as the dipole moment. The dipole moment is either found indirectly through experiment or calculated theoretically. The dipole moment is measured in debyes.

    a. What is the abbreviation for the unit "debye"?

    b. Which molecule in Model 2 is the most polar according to the dipole moments given?

21. Discuss as a group the dipole moment values provided in Model 2. Propose some possible explanations for the changes in the dipole moments between the three molecules. In particular note anything that seems unusual in the data.

22. The dipole moment of a bond or molecule is often represented with an arrow that points toward the more negative side of the bond.

    a. Determine which bonds in Model 2 are polar bonds using a table of electronegativity values. A large difference in electronegativity is characteristic of a polar bond.

    b. For any bond shown in Model 2 that is significantly polar, draw an arrow next to the bond to show the direction of polarity.

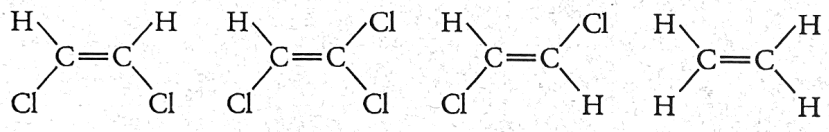
23. The lone pairs in a molecule also provide a dipole. Draw an arrow that points away from the center atom for any lone pairs on the molecules in Model 2.

24. Consider the arrows you have drawn in Model 2. Explain why NH_3 is the most polar of the three molecules.

25. Consider the arrows you have drawn in Model 2. Explain why NF_3 is the least polar of the three molecules.

26. The phosphorus trifluoride molecule (PF_3) has a dipole of 1.03 D. Compare this molecule to the nitrogen trifluoride molecule in Model 2. Propose a reason for the larger dipole in the molecule containing phosphorus.

27. Rank the following molecules in order of polarity from least to most. Use arrows on each molecule to support your answer.



28. Select the molecule in each pair that has the largest dipole moment. Include diagrams and complete sentences to justify your reasoning.

a. CS_2 vs. SO_2

b. H_2O vs. OF_2

c. CF_4 vs. SF_4