Unit 6: Molecular Geometry Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block: \_\_\_\_

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| **Learning Targets** |
| 1. *Review: I CAN draw the Lewis Dot Structure of an atom, ionic compound and a covalent molecule, indicating valence electrons and bonds*
 |
| 1. I CAN describe VSEPR theory and explain how it affects lone pairs and bonded pairs in a molecule.
 |
| 1. I CAN state and model the basic shapes of a covalent molecule (both 2D and 3D) using diagrams and molecular modeling kits
 |
| 1. I CAN predict the shape of a molecule based on the formula
 |
| 1. I CAN state the bond angle between two given atoms in a molecule
 |
| 1. I CAN classify a bond as nonpolar covalent, polar covalent, or ionic using an electronegativity chart
 |
| 1. I CAN define a polar bond, explain why they form and compare its characteristics with a nonpolar bond
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| 1. I CAN predict the polarity of a molecule based on the formula
 |
| 1. I CAN define and explain polymers (formation and composition) and describe how polymers are useful in the real-world.
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| Chemistry Important Dates!  |
| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday |
| March 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15Early Dismissal | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24NO SCHOOL | 25 | 26 |

**Review of Bonding: Lewis Dot Structures**

**Draw a Lewis Dot Structure for each of the following atoms:**

**C H Al Cl Mg Na O Ca**

**Draw a Lewis Dot Structure for the following compounds** *and* **name them. Identify the types of bonds (ionic or covalent) in each compound.**

**H2 K2O Cl2 SCl2**

**MgS Al2O3 KI Cs3N**

**NCl3 PH3 SiS2 PCl3**

**Notes on VSEPR Theory** Draw ALL of the examples. Include the names of the shapes and the bond angles for each.

**Molecular Shapes Simulation**

* Go to <http://phet.colorado.edu> and click play with simulations
* On the left-hand side, click by device and then Chromebook
* Scroll down and click Molecule Shapes, then start the simulation by pressing play
* Click Model, then click the yellow “remove all” button on the right-hand side
* Check the box for molecular geometry (bottom) and the box for show bond angles (right)

**Instructions:**

**Modeling**: Using the simulation, complete the chart below. Feel free to rotate the molecule by clicking and dragging it.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **# of Bonds Attached to Central Atom** | **# of Lone Pairs on Central Atom** | **Molecular Geometry** | **Bond Angles** | **3-D Drawing** | **Examples** |
| 1 | 0 |  |  |  |  |
| 2 | 0 |  |  |  |  |
| 3 | 0 |  |  |  |  |
| 4 | 0 |  |  |  |  |
| 3 | 1 |  |  |  |  |
| 2 | 2 |  |  |  |  |

**Real Molecules:** Click the real molecules button at the bottom of the page. Using the molecule drop down menu, go through and find real molecule examples to add to the above chart.

**Molecular Shapes Practice**

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| --- | --- | --- | --- | --- |
| **Formula** | **Name of Molecule** | **Lewis Dot Structures** | **Molecular Geometry** | **Bond Angle** |
| H2S |  |  |  |  |
| SCl2 |  |  |  |  |
| NCl3 |  |  |  |  |
| SiCl4 |  |  |  |  |
| CS2 |  |  |  |  |
| NH3 |  |  |  |  |
| CH2O |  |  |  |  |

**Bond Polarity Practice**

**Notes on Bond Polarity** Draw ALL of the examples!

1. What is the difference between a polar covalent bond and a nonpolar covalent bond in terms of how they share their electrons?

1. What is the difference between a polar covalent bond and a nonpolar covalent bond in terms of electronegativity values?
2. What is a partial charge called? Draw an example below.
3. What is the difference between a polar covalent bond and an ionic bond?
4. Describe the following bonds as nonpolar covalent, polar covalent, or ionic:
	1. CH4
	2. HF
	3. Na2O

**Molecular Polarity Practice**

**Notes on Molecular Polarity** Draw ALL of the examples!

1. Explain why carbon dioxide is a nonpolar molecule even though its bonds are polar. *(Hint: draw a Lewis Dot Structure to start!)*
2. Divide the following molecules into two categories: polar covalent bonds and nonpolar covalent bonds ­*(Hint: use an electronegativity chart)* N2 HF F2 NO FCl

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| --- | --- |
| **Polar Covalent Bonds** | **Nonpolar Covalent Bonds** |
|  |  |

1. Divide the following molecules into two categories: polar and nonpolar molecules.  N2 HF F2 NO FCl

|  |  |
| --- | --- |
| **Polar Molecule** | **Nonpolar Molecule** |
|  |  |

**Molecular Polarity Simulation**

Search Google for “PhET”. Click on the link and search for the Polarity Lab. Open the simulation by clicking the “Run Now” Icon.

**Introduction:** In this atomic-level simulation, you will investigate how atoms' ***electronegativity*** value affects the bonds they produce. When two nonmetals bond, a pair of more of electrons are shared between atoms. Electronegativity is a measure of a single atom's ability to pull electrons shared in a bond with another atom.

1) From what you've already learned about trends of the periodic table, what would cause an atom to have a **high** **electronegativity value**?

2) How do additional energy levels affect an atoms’ electronegativity value?

**Procedure:** 

1) Turn on (check) all view options on the right. In the surface category, click Electrostatic Potential

Create the following situations by dragging the slider above each atom changing the electronegativity values:
Describe in detail the bond character, charges, dipoles, and any other characteristics of the situations following:

**2) Atom A: High electronegativity, Atom B: Low electronegativity:**a) Specifically, where are the charges found in this molecule? (Electrostatic Potential– who is +? and who is -?)

b) Where does the dipole point to?

c) Describe the polarity of the bond: (Polar Covalent/Nonpolar Covalent/Ionic)

**3) Atom A: Low electronegativity, Atom B with an average (middle position) electronegativity:**a) Specifically, where are the charges found in this molecule? (Electrostatic Potential– who is +? and who is -?)

b) Where does the dipole point to?

c) Describe the polarity of the bond: (Polar Covalent/Nonpolar Covalent/Ionic)

**4) Atom A: High electronegativity, Atom B: High electronegativity:**a) Specifically, where are the charges found in this molecule? (Electrostatic Potential– who is +? and who is -?)

b) Where does the dipole point to?

c) Describe the polarity of the bond: (Polar Covalent/Nonpolar Covalent/Ionic)

7) Describe (in your own words) what is meant by each the dipoles, **δ-** and **δ+**.

**In the surface box to the right, switch the view to electron density: Experiment with different situations.**8) Describe the density of electrons around positively charged atoms compared to the density of electrons around negatively charged atoms.

9) A bond is characterized as ionic or covalent by comparing the differences between two atoms' electronegativities. Describe an ionic bond in terms of the atoms' electronegativity values. (Don’t write numbers)

10) Describe a covalent bond in terms of the atoms' electronegativity values. (Don’t write numbers)

11) Additionally, we further separate covalent bonds into ***polar*** *covalent* and ***nonpolar*** *covalent*. What is true about the electronegativity difference for a *nonpolar covalent bond*? (Don’t write numbers)

Switch the tab at the top to three atoms: **In the view category, click on all items!** In this simulation realize that in addition to changing the electonegativities, **you may also move individual atoms by dragging them with the mouse.**

12) Describe how a molecule with strong polar bonds could have no molecular dipole at all?

13) Experiment with the three atoms simulation. Choose **two** situations where the atoms have different electronegativites, and different angles between each atom. Illustrate those situations below including each atom’s electronegativity, draw the bond polarities (bond dipoles), and draw the molecule’s polarity (molecular dipole).

Atom A Atom B Atom C Atom A Atom B Atom C
Electroneg. Electroneg. Electroneg. Electroneg. Electroneg. Electroneg.

 Switch tabs to Real Molecules: View all items and switch surface to Electrostatic Potential. ***Using the simulation***, examine each molecule and indicate **P for Polar and NP for nonpolar** in the table below: **\*\*\*\*Notice that some molecules have been omitted and you will need to skip them!!!\*\*\*\*\*\***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Molecule | H2 | N2 | O2 | F2 | HF | H2O | CO2 | HCN | O3 | NH3 | CH2O | CH4 | CH3F | CH2F2 | CHF3 | CF4 | CHCl3 |
| **Bond Polarity**(Between Atoms) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Molecule Polarity**(Symmetry) |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Molecular Polarity Practice**

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| --- | --- | --- | --- | --- |
| **Formula** | **Lewis Dot Structures** | **Molecular Shape and Bond Angle** | **Bond Polarity** | **Molecule Polarity** |
| NF3 |  |  |  |  |
| SiO2 |  |  |  |  |
| NCl3 |  |  |  |  |
| CH2O |  |  |  |  |
| CF4 |  |  |  |  |
| H2O |  |  |  |  |
| PH3 |  |  |  |  |

**Polymer Webquest**

1. Search for “Microworlds Kevlar” and click on the first link, or type the address: www2.lbl.gov/MicroWorlds/Kevlar
2. On the main page, what are some of the uses for Kevlar?
3. Click on the blue button next to “Clue #1” at the bottom of the page. What are some examples of synthetic polymers?
4. Define what a monomer is. Define what a polymer is.
5. Click on the box that says “Activity” underneath the paragraph of text. Sketch an example of linear, branched, and cross-linked polymers. Where do we find linear and branched polymers in our lives?
6. Click the Back button and then click the blue button next to “Clue #2” at the bottom of the page. Which form of spaghetti is stronger: the tangled mess or the straight stack? How do we make Kevlar fibers in this way?
7. Click on the blue button next to “Clue #3” at the bottom of the page. Describe the two features of Kevlar fibers that give them their strength.
8. Click on the blue button next to “Clue #4” at the bottom of the page. Click on the “Activity” button. Use pieces of tape from one of the dispensers and do the experiment. How does this demonstrate Hydrogen bonding?
9. Click the back button. Click the blue button next to “Putting the Pieces Together.” Read through the summary of why Kevlar ends up being so strong. Make a bullet pointed summary.

**Unit 6 Review: Molecular Geometry and Polymers**

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| **Compound** | **Lewis Dot Structure** | **Molecular Shape** | **Bond Angle** | **Bond Polarity** | **Molecular Polarity** |
| **NH3** |  |  |  |  |  |
| **SH2** |  |  |  |  |  |
| **CF4** |  |  |  |  |  |
| **CS2** |  |  |  |  |  |
| **CO2** |  |  |  |  |  |
| **NCl3** |  |  |  |  |  |
| **Li2S** |  |  |  |  |  |