Chemistry Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Block \_\_\_\_\_

***Phet Molecular Shapes VSEPR Activity***

Log on to <https://phet.colorado.edu/en/simulation/molecule-shapes> either by Googling “phet simulations molecule shape.” Click on “***Run Now***.” If a screen pops up asking to update Java, click on “***Later***.”

**Introduction**

Atoms bond to satisfy their need for more electrons. If both atoms have high electronegativities (are nonmetals), atoms will share electrons to satisfy the Octet Rule – every atom wants 8 electrons to fill the s and p orbitals in the outer energy level. But, as you will see, if the electronegativities are high enough and both atoms unwilling to give up electrons, sometimes atoms can deviate from and not follow) the Octet Rule.

Because electrons have a negative charge and atoms occupy space, bonds and electrons will spread out as much as possible. Since we write in a two dimensional plane on paper, it is difficult to visualize the true geometry of these molecules. This activity and the program you are about to use allows us to visualize on a more 3-dimensional scale.

**Part 1 – Generic Molecules**

Fill in the chart below by creating the generic molecules below. On your screen in the lower left corner, click on “***molecule geometry***.” Add atoms and electron pairs as needed to produce the generic formula. Once the molecule is assembled, click and drag the screen to spin the atom around. Click on the “***Show bond angles***.” Use the following key:

* ***A*** – central purple atom – *cannot be removed*
* ***B*** – single bonded white atom
* ***C*** – double bonded white atom
* ***D*** – triple bonded white atom
* ***E*** – Electron pairs not bonded

In each box:

1. Draw the molecule you create to the best of your ability
2. Write the Molecule Geometry (MG)name in the box
3. Label the bond angle
4. Look at the central atom, is its octet satisfied?

|  |  |  |
| --- | --- | --- |
| Molecule |  | Molecule |
| ***AC2***  MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |  | ***ABE3***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |

|  |  |  |
| --- | --- | --- |
| ***AB3E***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |  | ***AB***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |
| ***ACE2***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |  | ***AB2E2***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |
| ***AB2C***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |  | ***AB3***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |
| ***AB4***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |  | ***ADE***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Octet? \_\_\_\_\_\_ |

**Part 2 – Real Molecules**

Click on the “***Real Molecules***” tab at the top of the page. Using the pull down menu, select the molecules below and fill in the chart. Match the molecule to the generic structure above. Fill in the generic bond angles.

|  |  |  |  |
| --- | --- | --- | --- |
| Molecule | Generic Formula | Generic bond angles (from part 1) | True Bond Angles |
| H2O |  |  |  |
| CO2 |  |  |  |
| CH4 |  |  |  |
| NH3 |  |  |  |
| BF3 |  |  |  |

**Part 3 – Octet Rule Breakers**

While still in the “**Real Molecules**” tab, select the following molecules. Draw each molecule, name the geometry and write how many electrons are on the central atom.

|  |  |  |
| --- | --- | --- |
| Molecule |  | Molecule |
|  ***SO2***  MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |  | ***XeF2***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |
| ***ClF3***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |  | ***SF4***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |
|  ***XeF4***  MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |  | ***BrF5***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |
| ***PCl5***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |  | ***SF6***MG \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Electrons?\_\_\_\_ |

**Post Lab Questions**

1. What does **VSEPR** stand for? Explain its meaning in your own words.
2. What molecules ***in Part 1*** consisted of only two atoms?
3. The program did not give a bond ***angle*** to a molecule consisting of only two atoms. Why? Think geometry class.

1. Looking at the table in Part 2, some of the angles stayed consistent while others did not. Compare and contrast the two groups of molecules (*those with matching angle measurements* to *those with different measurements*). What is causing the angles to skew? Explain why this might be.
2. What angle is needed to spread 4 bonds as far apart as possible? Hint: look at a molecule with four separate bonds.
3. Find the two generic molecules from Part 1 that are made of 3 atoms.
	1. Compare and contrast these two molecules by listing two similarities and two differences.
	2. Give a real life example of each.

|  |  |  |
| --- | --- | --- |
| Molecule |  |  |
| Similarities |  |  |
| Differences |  |  |
| Real-life Examples |  |  |

1. Who are the 2 most electronegative elements on the periodic table? Why does this question apply to Table 3?