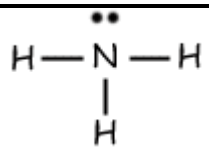
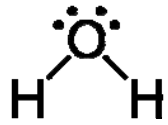
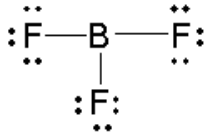
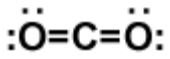
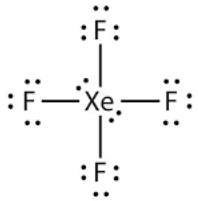
VSEPR: Practice & Review

(1) Draw Lewis structures for the molecules below, and predict the molecular geometry. Then predict the bond angles.
(2) Access the pHET simulation "Molecule shape". Select the "Real Molecules" tab. Then select "Show Lone Pairs" and "Show Bond Angles" in the *Options*. Complete the table with the actual bond angles.

		Lewis structure (showing lone pairs)	**Predicted Molecular Geometry**	**Bond Angles**	
				Predicted	**Actual**
a)	NH_3		Trigonal pyramid	< 109.5	107.8
b)	H_2O		Bent	<109.5	104.5
c)	BF_3		Trigonal planar	120	120
d)	CO_2		Linear	180	180
e)	XeF_4		Square planar	90	90

Questions

1. VSEPR stands for "valence shell electron pair repulsion". How does electron pair repulsion determine the molecular geometry?

   Electron domains spread out due to repulsion. Their arrangement around a central atom determines the geometry of the atoms that are bonded to that atom.

2. What is the difference between *electron geometry* and *molecular geometry*?

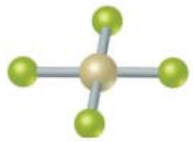
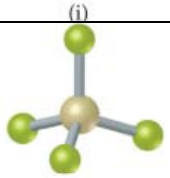
   Electron geometry - the geometry of all of the electron domains (bonding and lone) around a central atom.
   Molecular geometry – the geometry of only the bonding domains around a central atom

3. Under what condition is the molecular geometry the same as the electron geometry?
   when there are no lone pairs

4. LONE PAIRS make actual bond angles smaller than one would predict. Why is this?
They are bulky and take up more space. This pushes bonded atoms closer together.

5. For each shape below, identify both the electron domain geometry and the molecular geometry. You may need to use the simulation to help you.

Table 1. Unknown Molecules

3D structure	Electron domain geometry	Molecular geometry	AXE notation
 (i)	Octahedral	Square planar	AX_4E_2
 (ii)	Tetrahedral	Tetrahedral	AX_4
 (iii)	Trigonal bipyramidal	See-saw	AX_4E

6. Which of the following atoms could be the central atom in structure (iii) in Table 1? Explain your answer. *Several of these are possible.*

Be C S Se Si Xe

Any of those four atoms could be the central atom, since they are located in Periods 3+ and can therefore exceed the octet rule.