

## Molecules and Polyatomic Ions Containing Atoms with an Expanded Octet

### Teacher's Guide

1. The following parts are needed by each group for this lab. You may want to package each set in a baggy beforehand to save time. There are enough parts in the kit for 15 groups.

ATOM CENTERS		
Qty	Element	Color/Holes
4	Oxygen	Red/4
6	Halogen	Green/4
1	Phosphorus/ Selenium/Xenon/ Sulfur/Iodine/ Chlorine	Purple/5
1	Sulfur/Xenon/ Iodine/Bromine	Silver/6
1	Sulfur/Phosphorus	Yellow/4

BONDS	
Qty	Type
12	single
12	double or triple
12	lone pair

- Before doing the lab, please read the student instructions. Each student will be asked to complete the lab table and turn it in, but only one student table per group is checked by you during the lab. Staple the papers from each group together.
- Read the instructions with students to make sure they understand the procedure. You may want to review (or teach) the following topics: Lewis structures and VSEPR shapes. Extra holes are where lone pairs of electrons are located.
- The lab table, with blanks to be filled in, is supplied with the student instructions.

The answer key is on the following page.

1	2	3	4	5	6	7	8
Molecular Formula	Lewis Structure	Shape Angle(s)	Formal Charge of each element	# of bonds on the central atom	# of lone pairs on the central atom	Hybridization of the central atom	Model Checked
PF <sub>5</sub>		trigonal bipyramidal 120/90	P: 0 F: 0	5	0	sp <sup>3</sup> d	
TeF <sub>4</sub>		see saw 90/~170	Te: 0 F: 0	4	1	sp <sup>3</sup> d	
XeF <sub>4</sub>		square planar 90	Xe: 0 F: 0	4	2	sp <sup>3</sup> d <sup>2</sup>	
PF <sub>3</sub> <sup>2-</sup>		T shaped 90	P: -2 F: 0	3	2	sp <sup>3</sup> d	
XeF <sub>2</sub>		Linear 180	Xe: 0 F: 0	2	3	sp <sup>3</sup> d	
SF <sub>4</sub>		see saw 90/~170	S: 0 F: 0	4	1	sp <sup>3</sup> d	
SF <sub>6</sub>		octahedral	S: 0 F: 0	6	0	sp <sup>3</sup> d <sup>2</sup>	
SF <sub>5</sub> <sup>1-</sup>		square pyramidal 90	S: -1 F: 0	5	1	sp <sup>3</sup> d <sup>2</sup>	
SO <sub>4</sub> <sup>2-</sup>		tetrahedral	S: 0 O: -1, 0	4	0	sp <sup>3</sup>	

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### Student Procedure

1. Your teacher will provide your group with atoms and bonds for this activity.
2. Make one copy of the lab the Master Copy and have the teacher check that one sheet. Each student should fill out a sheet, but only the Master Copy will be used for the final grade.
3. Use a pencil to fill in all blank boxes except the Model Checked (COLUMN 10). This is where your instructor stamps or initials that the models are correct. You will fill in an entire horizontal row and then bring the model to the instructor for verification.

### Doing the lab

1. Draw the Lewis Structure in COLUMN 2, and then use it to determine molecular structure. Rules for making Lewis structures will be supplied by your teacher.
2. In COLUMN 3, Shape Angles °, the shape name should go on top (such as linear, bent, etc.), and the angle in degrees goes on the bottom. The shape is determined by the position of the atoms, not the bonds.
3. In COLUMN 4, Formal Charge, write the formal charge of the each atom in the structure.
4. In COLUMN 5, SN/CN/# Bonds, your teacher will tell you how to report the appropriate answer.
5. In COLUMN 6, # of lone pairs, write the number of pairs of nonbonding electrons. The purple paddles represent lone pairs of electrons.
6. In COLUMN 7, write the hybrid orbitals of the central atom, (e.g.  $sp^3$ ,  $sp^2$ ,  $sp^3d$ , etc.)
7. In COLUMN 8, Model, your teacher will initial or stamp to verify if you made the correct model.

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PF <sub>5</sub>			P: F:				
TeF <sub>4</sub>			Te: F:				
XeF <sub>4</sub>			Xe: F:				
PF <sub>3</sub> <sup>2-</sup>			P: F:				
XeF <sub>2</sub>			Xe: F:				
SF <sub>4</sub>			S: F:				
SF <sub>6</sub>			S: F:				
SF <sub>5</sub> <sup>1-</sup>			S: F:				
SO <sub>4</sub> <sup>2-</sup>			S: O:				