

# Molecule Shapes with PhET

Your Name:

Date:

Go to the PhET site by searching for "PhET molecule shapes". Run the HTML5 simulator by pressing the Play button. Answer the following questions. Here is the link:  
<https://phet.colorado.edu/en/simulation/molecule-shapes>.

1. Play with the simulator a bit. Describe the shape that you find most interesting?
2. What options do you have that you can turn on and off? Turn them all on.
3. What additional options do you have on the Real Molecules screen?
4. Using only single-bonded atoms on the Model screen, fill in the following chart. Use no Lone Pairs.

Number of Bonds	Molecule Geometry	Electron Geometry	Bond Angles	Drawing
1				
2				
3				
4				
5				
6				

5. Do an internet search to find out what a tetrahedron looks like. Describe and draw it here.
6. Do an internet search to find out what a octahedron looks like. Describe and draw it here.

7. Now you will use some lone pairs to see how they affect the molecular shape. Build models with the number of bonds and lone pairs you see in the chart.

Number of Bonds	Number of Lone Pairs	Molecule Geometry	Electron Geometry	Bond Angles	Drawing
1	0				
2	0				
3	0				
2	1				
4	0				
3	1				
2	2				
1	3				

Number of Bonds	Number of Lone Pairs	Molecule Geometry	Electron Geometry	Bond Angles	Drawing
5	0				
4	1				
3	2				
2	3				
6	0				
5	1				
4	2				

8. Go back to the previous question. Do any of the geometry names change if you use double or triple bonds instead of single bonds? Give examples.
9. The phrase 'electron domain' is used in discussions of molecular geometry to mean either a lone pair or a bond on the central atom of a molecule. Look at the chart you just finished filling out. Total up the number of electron domains for each row in the chart and write it next to the end of each row. How many different totals are there? What are they?
10. What is the connection between the number of electron domains and the electron geometry?
11. Relate the number of electron domains to the electron geometries:
- | No. of Domains | Electron Geometry |
|----------------|-------------------|
| 1              |                   |
| 2              |                   |
| 3              |                   |
| 4              |                   |
| 5              |                   |
| 6              |                   |
12. Describe how the electron geometry changes if you replace a bond with a lone pair.
13. Describe how the **molecule** geometry changes if you replace a bond with a lone pair.
14. What variations are there on the trigonal planar geometry based on replacing bonds with lone pairs?
15. What variations are there on the tetrahedral geometry based on replacing bonds with lone pairs?
16. What variations are there on the trigonal bipyramidal geometry based on replacing bonds with lone pairs?
17. What variations are there on the octahedral geometry based on replacing bonds with lone pairs?
18. Why is  $\text{CH}_4$  tetrahedral but  $\text{XeF}_4$  square planar?

19. Draw Lewis diagrams of the following molecules. Predict their three-dimensional shape from the drawing you make and from what you have learned in doing this activity. Build a model of each compound in the simulator (or find it on the Real Molecules screen). Confirm or correct each of your predictions.

H<sub>2</sub>, BeCl<sub>2</sub>, CO<sub>2</sub>, HF, H<sub>2</sub>CO, SO<sub>2</sub>, CH<sub>3</sub>Br, NH<sub>3</sub>, H<sub>2</sub>O, PCl<sub>5</sub>, SF<sub>4</sub>, ClF<sub>3</sub>, SF<sub>6</sub>, BrF<sub>5</sub>, XeF<sub>4</sub>

20. Write the name of each compound you drew for the previous question.