Molecular Shapes Simulation

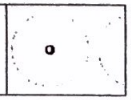
Instructions:

- 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)

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				
4	1				
4	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.

Activity A: Sharing electrons	Get the Gizmo ready: • Click **Reset**. • Select **Hydrogen**.	

Introduction: The electrons that orbit the nucleus of an atom are arranged into **shells**. The first shell contains up to two electrons and the second contains up to eight electrons. Most elements are stable when they have eight valence electrons—a rule of thumb known as the **octet rule**. (Elements with less than five electrons are stable with *two* valence electrons.)

Question: What happens when atoms share electrons?

1. Predict: Each hydrogen atom has one valence electron, but it needs two electrons to be stable. How can both hydrogen atoms each achieve a stable configuration?

   _____

2. Form a bond: Drag the electrons so that they move around both hydrogen atoms. Click **Play** to observe them in orbit, and then click **Check**. You have created a **covalent bond**.

   Congratulations, you have completed a **molecule** of hydrogen! Because the molecule has two atoms, it is a **diatomic molecule**. Click the **camera** (📷) icon to take a snapshot of your completed molecule. Right-click the image, and click Copy Image. Paste the image into a blank document and label the image "H_2."

3. Draw a diagram: Covalent bonds are shown in **Lewis diagrams**. In a Lewis diagram, dots represent unshared valence electrons and dashes represent pairs of shared electrons.

   Turn on **Show Lewis diagram**. What is the Lewis diagram for hydrogen, H_2? **H H**

4. Form a bond: Now select **Fluorine** and create a molecule of fluorine, F_2. Take a snapshot of this molecule and add it to your document. (Be sure to label each molecule you add.)

   What is the Lewis diagram for fluorine, F_2? **F F**

5. Think and discuss: How is the formation of covalent bonds similar to kids sharing markers? How is it different? If possible, discuss your answer with your classmates and teacher.

   _____

   _____

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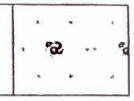
Activity B: Building molecules	Get the Gizmo ready: • Click **Reset**. • Turn off **Show Lewis diagram**. • Select **Oxygen**.	

Question: How do atoms share more than one pair of electrons?

1. Observe: Like fluorine and most other elements, oxygen atoms are most stable with a full complement of eight valence electrons.

   A. How many valence electrons does each oxygen atom have now? _____

   B. How many more electrons does each oxygen atom need to be stable? _____

2. Form a bond: Drag electrons back and forth until the molecule of oxygen (O_2) is stable. Click **Check** to confirm your molecule is stable. Take a snapshot and paste the image into your document (don't forget to label it "O_2").

   How many *pairs* of shared electrons are there in a stable molecule of oxygen? _____

3. Draw a diagram: Draw a Lewis diagram of the oxygen molecule in the space below at left. To check your work, turn on **Show Lewis diagram**. Draw the correct diagram on the right.

   Practice diagram: **O O** Actual: **O O**

4. Practice: Create covalent bonds and stable molecules for the remaining substances. Take a snapshot of each completed molecule and add it to your document. Draw Lewis diagrams for each one. (As above, draw the diagram on your own before checking your work.)

Nitrogen	**N N**	Ammonia	**H** **H N H**
Chlorine	**Cl Cl**	Methane	**H** **H C H** **H**
Water	**H O H**	Silica	**O Si O**
Carbon dioxide	**O C O**		

(Activity B continued on next page)