

## Lesson plan for *Build a Molecule*:

<http://phet.colorado.edu>

**Learning Goals:** Students will be able to:

Review:

- Describe the differences between an atom and a molecule.
- Describe what the subscripts and coefficients indicate in chemistry notation.
- Use proper chemistry nomenclature.

New:

- Construct simple molecules from atoms.
- Write rules for how atoms are arranged given formulas for some common molecules
- Draw, name, and write formulas for some common molecules.

**Background:** I will use this in my unit on “Atomic structure, Periodicity and General Concepts of Bonding” which comes later in the year. I will have used *Build an Atom* and *Isotopes and Atomic Mass* in an early unit “Atoms, Molecules Ions and Chemical Foundations”. My students will have done a lab that I adapted from several labs over the years in which students build molecules with kits and marshmallows/toothpicks and use Lewis Dot structures along with VSEPR models to make sense of shapes. I have included the lab in the activity.

This is a very helpful site: [VSEPR method by Gérard Dupuis and Nicole Berland Lycée Faidherbe - LILLE](#)

### *Build a Molecule* Introduction:

The students interviewed during the development of this sim were in middle school and seemed to understand all the tools. The [Tips for Teachers](#) of this lesson plan may be helpful for assisting students in their explorations.

**Pre-Lesson:** See background for my particular use, but I believe this sim could also be used as an introduction to molecules without Lewis and VSEPR content.

**Lesson:** My students will be working in pairs in a computer lab, but they could complete the activity outside of class. I have included clicker questions on my website to allow the student to check each other, but I will not be using them as a whole class discussion unless I see a need.

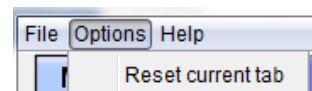
**Post-Lesson:** clicker questions (not planning on using for class time)

**Follow-up sims:** I am hopeful that a “Polarity” PhET sim will be done by the time I do this unit and I have made plans to use it.

### Tips for Teachers for *Build a Molecule*:

#### Tips for controls:

- Try all the different tabs at the top of the simulation. The tabs are designed to help teachers scaffold lessons or make lessons age appropriate by using only some tabs.
- There is an option to allow the entire tab to be reset. This may be useful if you want the class to start with the same kit for a discussion, but note that the students’ collections are cleared.



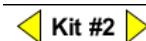
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- The challenge on each tab is to fill **Collections**. There are 3 ways to get the buckets to refill. To start over on a collection, use **Reset Collection**. To just refill the buckets, use **Reset Kit**. To get different buckets, use the yellow arrow on the left or right of the Kit #.








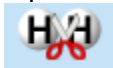
- The  tool opens a Jmol window. The molecules are grabbable, so the students can rotate them to help get a good feel for the shape. You may find information about Jmol in many places, this is a good start: <http://en.wikipedia.org/wiki/Jmol>
- The collection on each of the first tabs will always be the same from the start of the sim or after **Reset Current Tab** (from the **Options** menu). There is no limit to the number of collections and the collections are randomly generated from a set of molecules, so molecules will show up in more than one collection.
- The last tab, **Larger Molecules**, has no collection windows. This tab could be used for inventive exploration.

### Important modeling notes / simplifications:

- If 2 atoms are bonded, like H<sub>2</sub>, and you want to add oxygen to make water, the oxygen cannot



be added because the H's are not located as they would be on the water. Use the  tool to separate the hydrogen or you can mouse between to atoms, the mouse will look like a pair of scissors



and you can cut just one bond.. Then position the H's like you would in Lewis structures, for



- The first tab has molecules with three or less atoms.
- The Kits that are provided can sometimes make more than one molecule. The kits are designed to provide constructive scaffold, but to allow exploration.
- The number, names, and types of molecules have been selected to optimize basic learning for students. For example, cyclic molecules or molecules with more than 4 atoms on any one atom are not included. Also, we chose a single name for structures that could have more than one name since as the molecule is being built, the bonding is not displayed.
- IUPAC naming is used <http://pubchem.ncbi.nlm.nih.gov/search/search.cgi> including using common organic molecule names like water.

### Insights into student use / thinking:

- Students figure out that where the atoms attach matters. For example: the hydrogen in water are attached to the oxygen not each other. The first tab has small molecules to help students learn how to use the separate and cut tools easily.

### Suggestions for sim use:

- For tips on using PhET sims with your students see: [Guidelines for Inquiry Contributions](#) and [Using PhET Sims](#)
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see [Teaching Physics using PhET Simulations](#)
- For activities and lesson plans written by the PhET team and other teachers, see: [Teacher Ideas & Activities](#)