

## Frequently Asked Questions and Teacher Tips

### Topics Include:

- |                         |                       |
|-------------------------|-----------------------|
| 1. Teacher Facilitation | 4. Kits               |
| 2. Tabs                 | 5. 3D View            |
| 3. Collection Boxes     | 6. Building Molecules |

### 1. Teacher Facilitation

#### How can I use this in my class?

Here are some ideas:

You can use the Build a Molecule sim:

- **In class** by having your students work individually or in pairs at computers. Check out the sample activities for this simulation available in the Teacher Resources section (below where you download the sim).
- **As a demo** by projecting the simulation onto a screen. You can manipulate the simulation, or you can select students to come up and build molecules for the class.
- **As homework** by asking students to complete a set number of collection boxes in preparation for a class, or as practice after an introduction to molecules.
- **With clicker questions** by asking students the name or geometry of a molecule with a clicker questions, and then build and visualize it to see if they were correct.

#### What can students learn from playing with this sim?

A lot! Students can learn:

- Molecules are made from atoms,
- What are molecular formulas,
- What are subscripts and coefficients,
- The same molecule can be represented in many different ways (with a name, formula, in 2D and 3D, in space filling and ball and stick view),

Students can also:

- Compare names for similar looking molecules to start learning about naming,
- Learn that molecules have a specific structure (a certain way the atoms go together) and begin asking questions about why do atoms go together in particular ways.
- And more...!

### 2. Tabs

#### What is the purpose of each tab?

Here's what we had in mind with each tab, but don't let that limit you! The tabs are designed to help teachers scaffold lessons or make lessons age appropriate by using only some of the tabs. If you find other learning goals that work for these tabs, let us know!

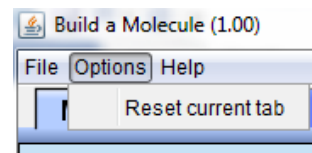
**Make Molecule** is useful for introducing: molecules are made from atoms, molecular formulas and chemical names, and different types of molecule representations (Lewis Dot-like structures, pseudo-3D and 3D).

**Make Many** can be used for the same purposes, and also to introduce coefficients. One thing we've seen work well with this tab is to challenge students to fill their collection box, and then give them ~ 5 minutes to figure it out. It's typically not necessary to describe what the coefficient means before letting them play. Students tend to try a couple of things, and then catch on pretty quick!

**Large Molecules** is a great challenge tab, or for just exploring. You can ask students to make the biggest molecule they can, to find patterns in names of similar compounds, compare the connectivity of different compounds, or to build large molecules and break them into smaller molecules (introduction to metabolism), or anything else that seems appropriate for your learning goals.

### Can I reset a tab back to the beginning?

Yes! You can "Reset current tab" by going under "Options" in the upper left-hand corner of the simulation. This can be useful if you want to have a class discussion with everyone looking at the same collection box, but keep in mind this will lose all of students work for that tab.



## 3. Collection Boxes

### What do I do with the collection boxes?

You collect molecules! The first two tabs have a built in challenge for students, to fill the collection boxes with the specified molecule. We've designed the first tab to help scaffold students naturally into figuring out how this works, so you likely won't need to explain this to students in detail. Once they make their first molecule that can be put in the collection box, there's an arrow that shows them where to put it, and they usually get the hang of it quickly.

### Can I reset just one collection box?

Sure! Just select "Reset Collection" at the bottom of the collection box to start that collection over, or you can select "Reset current tab" from the "Options" drop down menu in the upper left-hand corner of the simulation. Remember though, "Reset current tab" will undo all the students work on that tab and set the collection box back to the start.

### How many collection boxes are there?

Tons! The first collection box is always the same (that way you can have a discussion with your students with everyone looking at the same molecules at least once). After students fill that collection box, they'll each get a different, randomly selected collection box to fill. There's no limit to how many different collection boxes there are, but students will see some of the molecules to collect multiple times.

## 4. Kits

### How do I refill the atom buckets?

If you just want to refill your atom buckets, select “Reset Kit” in the corner of the kit box. If you want to refill your atom buckets and start over on the collection box you’re working on, select “Reset Collection” from the bottom of the collection box. This will refill your atom buckets and empty your current collection box, without undo-ing any previous collection boxes you’ve completed.

### I’m out of atoms, but haven’t filled my collection box yet. What do I do?

You can either refill your atom buckets, by selecting the “Reset Kit” in the left corner of the kit, or if you need different atoms, use the arrow buttons in the upper right-hand corner of the kit box to cycle through all of the kits available.


### Can I make only one molecule with each collection box?

No, you can typically make more than one, and for some kits you can make hundreds of different molecules! The kits in the first and second tabs are designed to scaffold students into more complicated kits, so they start with fewer options (so they can get the hang of building molecules), with the number of molecules possible increasing as they go along. In the third tab, the kits are designed to allow for maximum number of molecules possible.

In the third tab there are kits that allow you to make a biological molecule (glycine or aminoacetic acid) along with other organic compounds, and kits for more exotic building, like comparing silane, borane and methane. Don’t worry though, if your learning goals don’t call for focusing on any special kits, students still get a lot out of coming up with their own comparisons, and just exploring.

## 5. 3D View

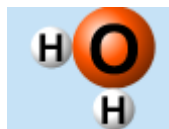
### What can I do with the molecules in 3D view?

Once you’ve made a molecule, the option to see in 3D will appear as a green button.  Press this button and the molecule will show in 3D in it’s own Jmol window. This molecule is grab-able, students can rotate it and change the view (from space filling to ball and stick). To learn more about Jmol, this is a good starting place: <http://en.wikipedia.org/wiki/Jmol>

## 6. Building Molecules

### I tried to put some atoms together that should go together, but it didn’t work. What do I do?

The connectivity of the atoms is important in real life and in the sim. When you build atoms, think of starting with the central atoms and adding the outer atoms one at a time. So for water, you start with oxygen, and add a single hydrogen to each side. Since you can build atoms using a Lewis-like structure, it doesn’t matter which side you add the hydrogens to. For example, both of these are water:



But, if you try to put oxygen and a hydrogen molecule together like this:





they won't make a molecule. That's because in water, the two hydrogens aren't attached to each other, they're attached to the oxygen so you need to attach each hydrogen to the oxygen individually.

We've found from interviews and classroom observations, if students don't get it right the first time, they just try a couple different ways until they get it. That's why we start the first tab and first kit with only three atoms, that way students can figure out how to rearrange and put things together really quickly.


We've even seen 5<sup>th</sup> grade students build Lewis Dot structures intentionally to look more like the 3D model after using the Build a Molecule sim. For example, when making water, we've seen students intentionally add the hydrogens to the right and left side rather than one on top and one on the right (or left) after seeing the molecule in 3D.

### Can I break apart a molecule back into individual atoms?

Yes! There are two options, you can break apart all the atoms in a molecule by using the blue 'break apart' button,  that appears above each molecule.

If you just want to break a single atom off your molecule, hover your mouse right where the two atoms touch that you want to break apart. A pair of scissors will appear  (if you don't see it, just wiggle your mouse around that area and look for the scissors to appear). Click when your mouse looks like scissors and just those two atoms will be separated.

### Can I break just a single bond, without breaking apart the entire molecule?

Sure! If you just want to break apart two atoms only, not your entire molecule, mouse over the area where the two atoms touch. A pair of scissors will appear  (if you don't see it right away, just wiggle your mouse around, when you hit the right spot, the scissors will appear). Click when your mouse looks like scissors and just those two atoms will be separated.

### What molecules can I build?

Any molecule you have the atoms for you can build, with the exclusion of cyclic molecules and those that result in atoms overlapping as you build them.

For the third tab, which has the most atoms available, you can build ~ 9,000 molecules!

### I found a molecule with the wrong name. What's going on?

We don't show bonding in the atoms as you build them (you can see bonding in 3D view) because this sim is for middle school students and we didn't want to focus on that topic. This means that some structures you build may have multiple names depending on the bonding (and if it is a radical).

For structures that could correspond to more than one molecule, only one name and 3D structure are used, so if you built it many times it will always be given the same name and show the same structure with bonding in 3D, but it may not always be the most commonly found molecule of the possible options.

For each molecule, we give the IUPAC Traditional name, from the PubChem database <http://pubchem.ncbi.nlm.nih.gov/search/search.cgi> for all molecules, (so that water will be called 'water' and not 'dihydrogen oxide'). This means, for example, that organic compounds with common names will show with their common name, but organic compounds without a common name will be shown with the systematic name.