

## Model Screen

In this screen students can build models of molecules by adding single, double, or triple bonded atoms or lone pairs of electrons to a central atom.

**MOVE** atoms or rotate the molecule to see the effect on molecule shape.

**SHOW** or hide molecule or electron geometry.

**ADD** or remove bonded atoms to see effect on shape.

**ADD** or remove lone electron pairs.

**SHOW** or hide lone electron pairs and bond angles.

Options:  Show Lone Pairs,  Show Bond Angles

Name:  Molecule Geometry (Trigonal Pyramidal),  Electron Geometry (Tetrahedral)

## Real Molecules Screen

Compare the shape and bond angles in real molecules to the values predicted using VSEPR theory.

**VIEW** real molecule or VSEPR model

**SELECT** real molecule to view.

Options:  Show Lone Pairs,  Show Bond Angles

Molecule: SO<sub>2</sub>

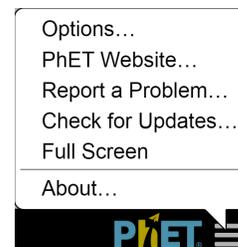
Name:  Molecule Geometry (Bent),  Electron Geometry (Trigonal Planar)

Real Molecules List:

- H<sub>2</sub>O
- CO<sub>2</sub>
- SO<sub>2</sub>
- XeF<sub>2</sub>
- BF<sub>3</sub>
- ClF<sub>3</sub>
- NH<sub>3</sub>
- CH<sub>4</sub>
- SF<sub>4</sub>
- XeF<sub>4</sub>
- BrF<sub>5</sub>
- PCl<sub>5</sub>
- SF<sub>6</sub>

## Complex Controls

- The play screen can be changed to a white background to facilitate projecting the simulation. To access this feature, select Options under the PhET tool bar menu.
- Lone pairs of electrons on the outer atoms can be shown in the Real Molecules screen. This feature can also be accessed under Options in the PhET tool bar menu.



## Model Simplifications

- The Valence Shell Electron Pair Repulsion (VSEPR) model was used to determine molecule shape for a given number of electron domains.
- On the Model screen, bond angles displayed are those predicted by the basic geometry using the VSEPR model. This screen is meant to provide a basic understanding of electron and molecule geometry.
- While the sim stops you from adding more than six electron domains to the central atom, it is possible to have coordination numbers larger than six.
- Students can build non-physical structures in the Model screen. As the goals of the sim are to support students making sense of trends in molecule and electron geometry, the building of non-physical structures is allowed to the extent that the learning goals are supported.

## Suggestions for Use

### Sample Challenge Prompts

- There are cases where atoms are as far apart as possible but the angles between atoms are not the same. What shapes are these, and why might this happen?
- Explain why the bond angle in a water molecule is  $104.5^\circ$ , not  $109.5^\circ$  as shown in the model view.
- Explain why the bond angles in some real molecules do not match the bond angle predicted by VSEPR theory – for example,  $\text{H}_2\text{O}$ ,  $\text{SO}_2$ ,  $\text{ClF}_3$ ,  $\text{NH}_3$ ,  $\text{SF}_4$ ,  $\text{BrF}_5$ .
- Build a molecule that has an octahedral electron geometry and a square planar molecule geometry.
- Describe the difference between electron and molecule geometry.
- Explain why some molecules have different electron geometries than molecule geometries.

See all published activities for Molecule Shapes [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).