PhET Tips for Teachers

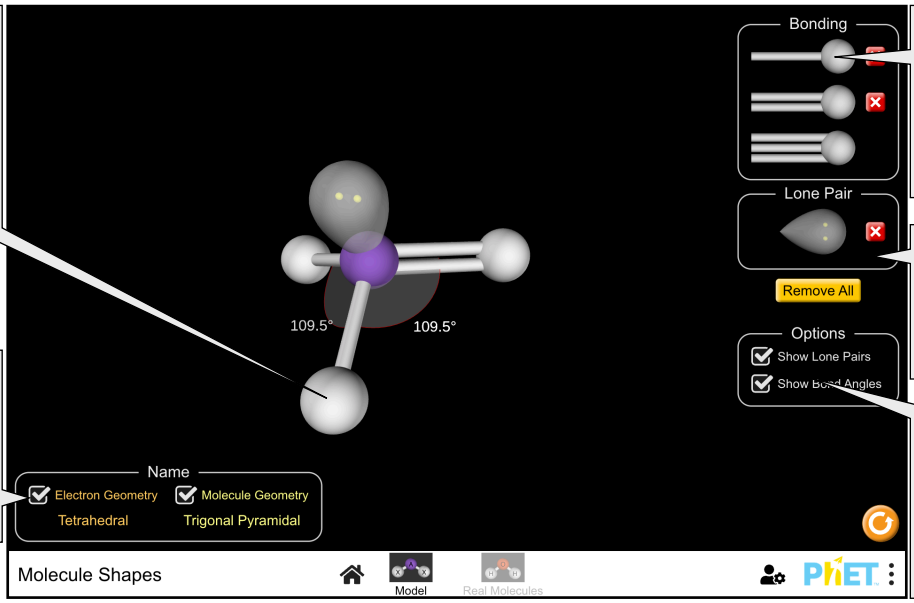
Molecule Shapes

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.

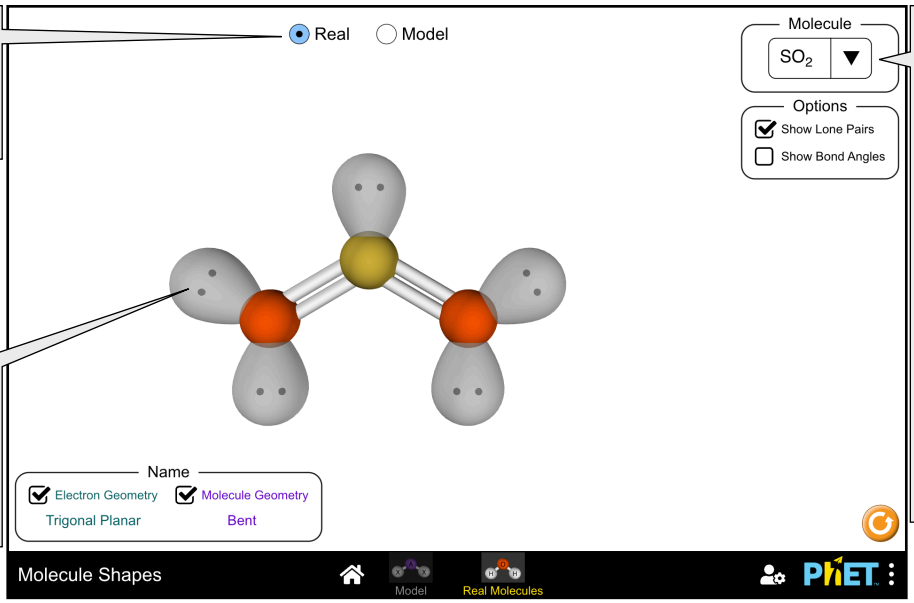
SHOW or hide lone electron pairs and bond angles.

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

ENABLE outer lone pairs in the Preferences dialog



SELECT real molecule to view.

- H_2O
- CO_2
- SO_2
- XeF_2
- BF_3
- ClF_3
- NH_3
- CH_4
- SF_4
- XeF_4
- BrF_5
- PCl_5
- SF_6

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Customization Options

Query parameters allow for customization of the simulation, and can be added by appending a '?' to the sim URL, and separating each query parameter with a '&'. The general URL pattern is:
…html?queryParameter1&queryParameter2&queryParameter3

For example, in Molecule Shapes, if you want to start the sim with a white background (colorProfile=projector), with the 2nd screen open by default (initialScreen=2) use:
https://phet.colorado.edu/sims/html/molecule-shapes/latest/molecule-shapes_all.html?colorProfile=projector&initialScreen=2

To run this in Spanish (locale=es), the URL would become:
https://phet.colorado.edu/sims/html/molecule-shapes/latest/molecule-shapes_all.html?locale=es&colorProfile=projector&initialScreen=2

⚙ Indicates this customization can be accessed from the Preferences menu within the simulation.

Query Parameter and Description	Example Links
maxConnections - limits the number of atoms (1-6) that can be connected to the central atom on the Model screen, independent of bond order.	maxConnections=4
⚙ showOuterLonePairs - displays the lone pairs on outer atoms.	showOuterLonePairs
⚙ colorProfile - changes the simulation colors for better contrast when projecting.	colorProfile=projector
screens - specifies which screens are included in the sim and their order. Each screen should be separated by a comma. For more information, visit the Help Center.	screens=1 screens=2,1
initialScreen - opens the sim directly to the specified screen, bypassing the home screen.	initialScreen=1 initialScreen=2
⚙ locale - specify the language of the simulation using ISO 639-1 codes. Available locales can be found on the simulation page on the Translations tab. Note: this only works if the simulation URL ends in "_all.html".	locale=es (Spanish) locale=fr (French)
allowLinks - when false, disables links that take students to an external URL. Default is true.	allowLinks=false
supportsPanAndZoom - when false, disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is true.	supportsPanAndZoom=false

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 104.5^0, not 109.5^0 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, H_2O, SO_2, ClF_3, NH_3, SF_4, 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.