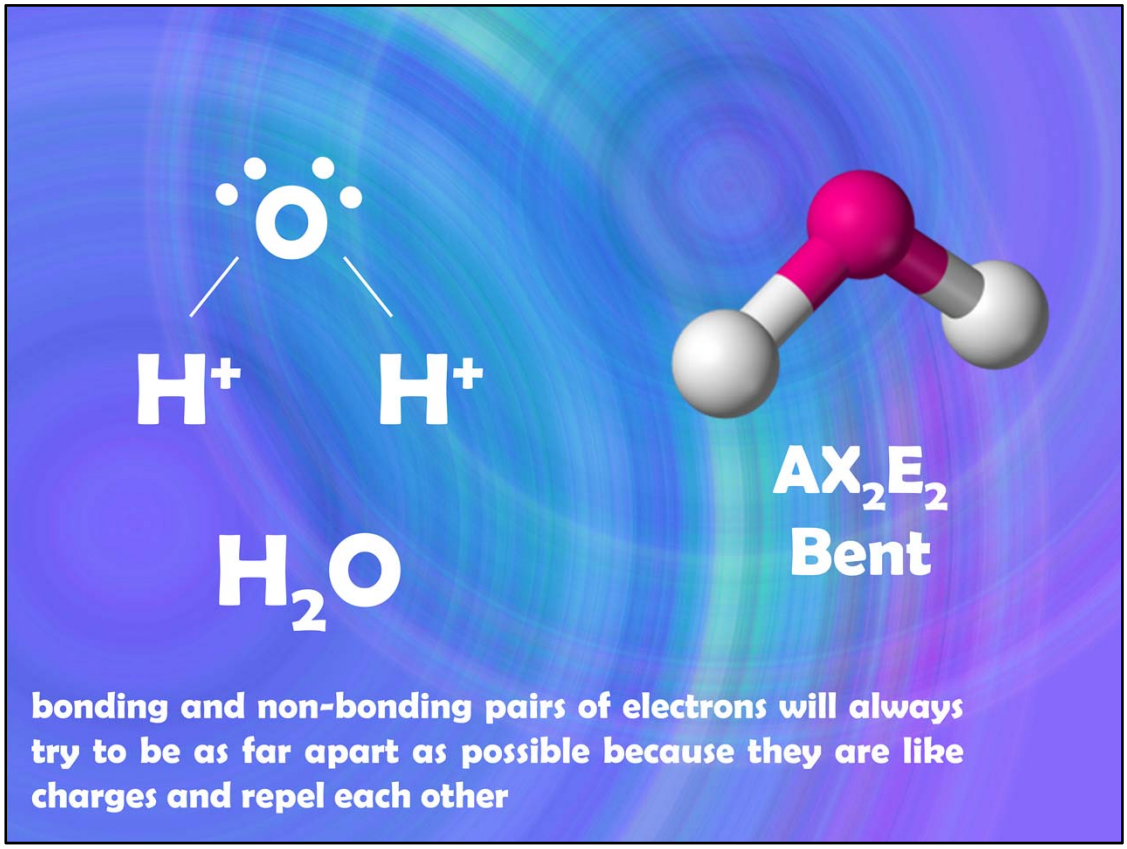
# Module 4: Bonding, Formula Writing, and Nomenclature
## Topic 6 Content: VSEPR Theory Presentation Notes


Valence Shell Electron Pair Repulsion Theory

# Module 4: Bonding, Formula Writing, and Nomenclature
## Topic 6 Content: VSEPR Theory Presentation Notes

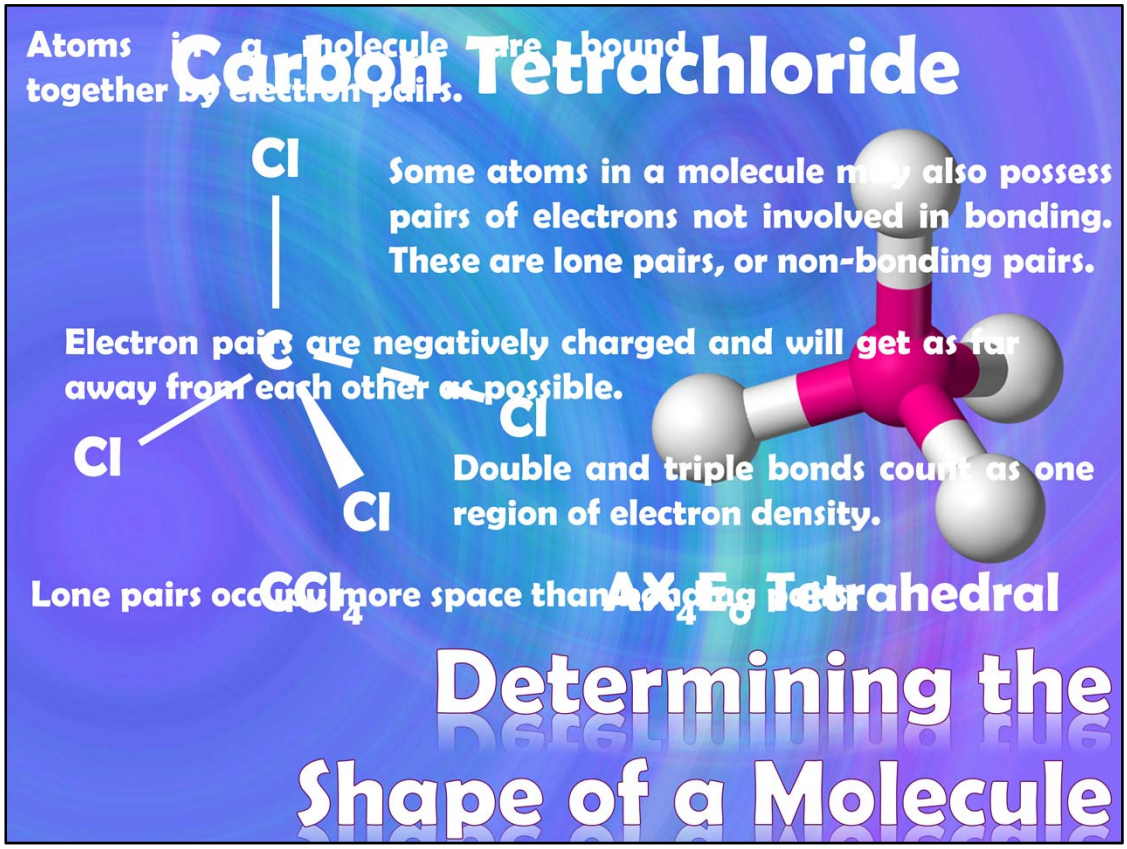

The structure of a molecule is very important in determining its properties. Although there are now very advanced experimental methods for determining a molecule's structure, a simple model called valence shell electron pair repulsion theory, or VSEPR theory, is a great way to predict the structure.

# Module 4: Bonding, Formula Writing, and Nomenclature
## Topic 6 Content: VSEPR Theory Presentation Notes




The main idea of the VSEPR model is that the bonding and non-bonding pairs of electrons will always try to be as far apart as possible because they are like charges and repel each other. Although there are many complicated types of structures, your focus will remain on two atom molecules and molecules with two, three, and four pairs of electrons around the central atom. Shown here is a water molecule, or $H_2O$. Through its bent shape, the atoms are attempting to be as far from each other as possible.

# Module 4: Bonding, Formula Writing, and Nomenclature
## Topic 6 Content: VSEPR Theory Presentation Notes



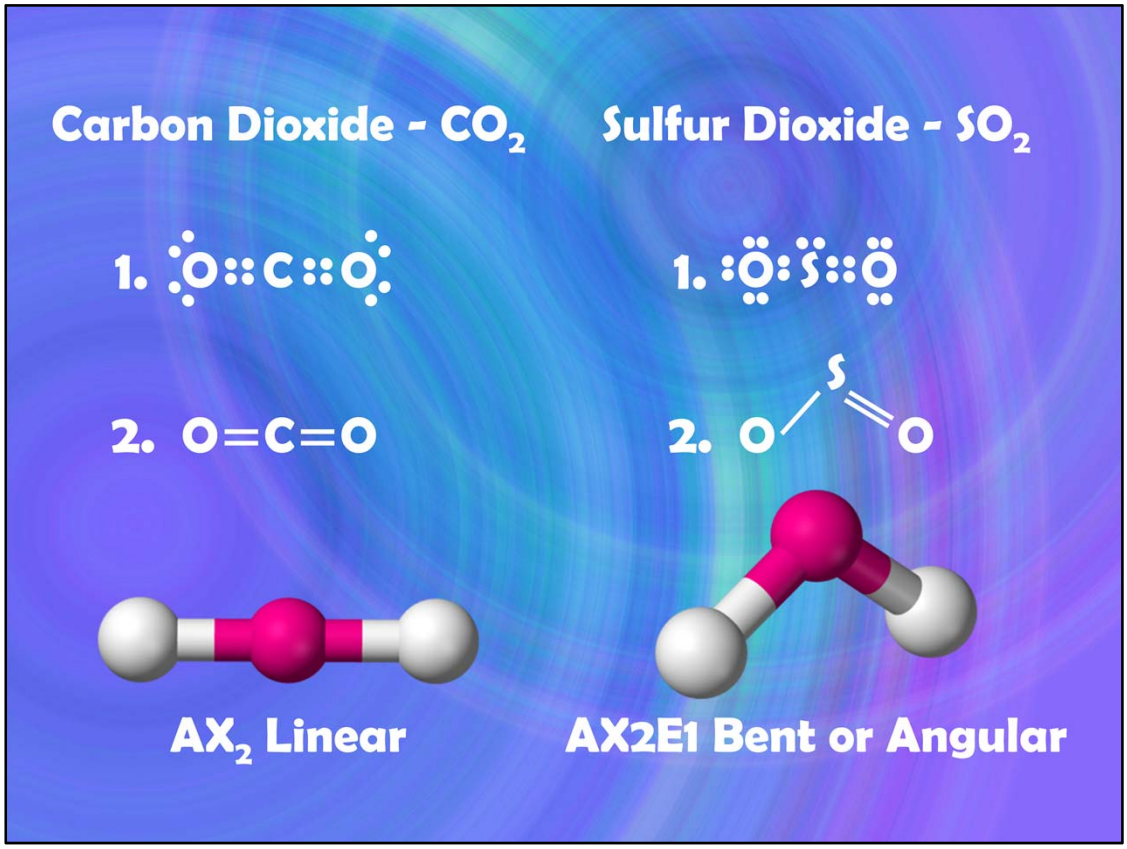

In order to define the shape of a molecule, it is important to remember how chemical bonding occurs. When determining the shape of a molecule, you should remember the following:

- Atoms in a molecule are bound together by electron pairs.
- Some atoms in a molecule may also possess pairs of electrons not involved in bonding. These are lone pairs, or non-bonding pairs.
- Electron pairs are negatively charged and will get as far away from each other as possible.
- Double and triple bonds count as one region of electron density.
- Lone pairs occupy more space than bonding pairs.

What shape is the compound carbon tetrachloride? Before you answer this, you must ask yourself the following question: How would these atoms bond? Drawing the Lewis dot structure of carbon tetrachloride first helps you determine the bonding formation. Next, you need to count the number of bonds and non-bonding pairs connected to the central atom, carbon. After this is completed, you will find that carbon tetrachloride, $CCl_4$, is tetrahedral in shape. In the image, you can view the tetrahedral shape of carbon tetrachloride.

# Module 4: Bonding, Formula Writing, and Nomenclature

## Topic 6 Content: VSEPR Theory Presentation Notes



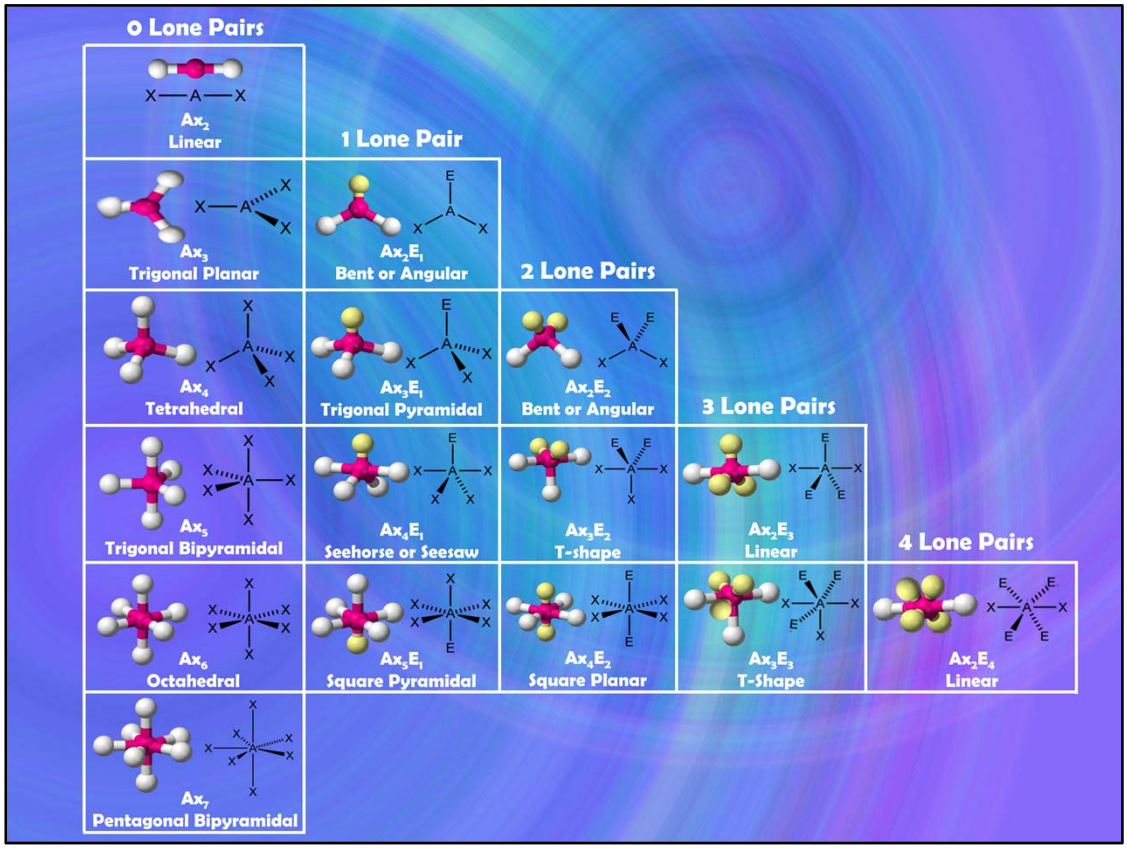

You can use the following steps in order to determine the shape of a molecule.

1. First, draw the Lewis dot structure. Show each bond as a line and show unshared electrons on the central atom with dots.
2. Next, count the number of bonds and non-bonding pairs attached to the central atom.

This example shows carbon dioxide creating two double bonds. The resulting shape is linear. The other example shows sulfur dioxide with a single bond, a double bond, and a non-bonding pair. The resulting shape is bent, or angular.

# Module 4: Bonding, Formula Writing, and Nomenclature

## Topic 6 Content: VSEPR Theory Presentation Notes




What other shapes exist for molecules? In order to determine the name of the shape of the molecule, it is helpful to use the VSEPR Geometries chart shown here. You can download a printable version of this chart in the Resources area.

| Electron Pairs Around Central Atoms | Shared Pairs | Unshared Pairs | Shape Name |
|---|---|---|---|
| 2 | 2 | 0 | Linear |
| 3 | 3 | 0 | Trigonal Planar |
| | 2 | 1 | Angular or Bent |
| 4 | 4 | 0 | Tetrahedral |
| | 3 | 1 | Pyramid |
| | 2 | 2 | Angular or Bent |

The table shown here is also a guide for naming the shapes of molecules. This table shows the electron pairs around the central atoms, shared pairs of electrons, unshared pairs of electrons, and the shape that will form. You can download a printable version of this table in the Resources area.