Building Molecules Laboratory: Sharon Walton

Teacher's Guide

Goals

- To build a model showing molecular geometry using balloons
- To visualize shapes of the orbitals by the VSEPR theory

The Activity

The students build models of molecules from balloons, compare it to structures depicted by the VSEPR theory, and learn to make predictions about molecular structure.

Materials for Each Group

- Balloons
- String and scissors
- Worksheet

SAFETY

No special safety considerations are required.

Instructions

Inflate a number of balloons, according to the numbers of electron pairs, as described in the table. Tie the balloons together as tightly as you can using piece of string.

Fill in the geometric figures for all possible structures in the table by altering the number of non-bonding electron pairs for each electron configuration.

Draw, in the "configuration of bonds" column, the shape of the molecules you get from your balloons, including the central atom, the bonded atoms, and non-bonding pairs.

Give examples of molecules that fit into each category.

# of e-pairs	Config. of e- pairs	# of nonbonding e-pairs	Class of molecule	Config. of bonds	Examples of molec.	Predicted bond angle
2	Linear	0	AX_2	X-A-X	BeH_2, $BeCl_2$	180°

For full table, see a chapter about the VSEPR theory in any chemistry book or in the references on the following page.

Lecture Notes

Today we're doing molecular geometry. We'll learn the VSEPR theory and we'll see the structure of molecules in 3D as opposed to the usual 2D.

Balloons model atoms well and you get real shapes that we see in the books.

You should tie the balloons as tight as you can with a piece of string, where each balloon represents a pair of electrons.

Fill in the geometric figures for all possible structures in the table by altering the number of non-bonding electron pairs for each electron configuration. Try to predict structures of molecules.

Fill out the worksheet to learn which shapes go with which atoms, and then you will be able to predict the shapes of other molecules.

Start with molecules of two atoms connected to the central atom. The type of molecule is denoted:

A—central atom

B—for bonding pairs

So a linear molecule is AB_2—we have two bonding pairs.

Do all the ones with no lone pairs, first.

See the triangular shape—see how it's flat, that's why they call it planar. Watch a ball and stick model, too.

Octahedron: It has six pairs of bonding electrons. It's shaped like a square, with two atoms going out on both sides. It has eight faces—thus, it is called an octahedron.

Summary

Why do we learn this? We learned about polar covalent and non-polar covalent molecules. Now, we can see how they share their electron pairs.

If we have AB_2, do the atoms share the electrons equally?

It's like a tug of war: similar atoms pull the electrons with the same amount of force. This bond is non-polar covalent. If the atoms are not the same, the bonds are polar covalent.

Teaching Tips From Ms. Walton

You can use different colors/sizes of balloons for bonding/non-bonding electron pairs. Get some extra balloons.

Balloons are cheap and available, and when they are tied together, one can really grasp the shapes, which are predicted by the VSEPR theory.

Try to show the students what basic shapes you can get and how it fits with the patterns of bonding/nonbonding electrons.

As you go on teaching, this activity is something you can refer to because the students remember it.

With balloons, it takes more imagination to see the central atom than with the ball and stick model.

The balloons make class interesting and the students understand.

References: Links

http://www.shef.ac.uk/chemistry/vsepr/
An excellent illustrated tutorial on VSEPR theory.

References: Readings

Jones, M.B. (2001) "Molecular Modeling in the Undergraduate Chemistry Curriculum," *Journal of Chemical Education,* Vol. 78, No. 8, pp: 867-868.

Parker, J. (1997) "VSEPR Theory Demo," *Journal of Chemical Education,* Vol. 74, No. 7, p: 776.

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