Orbitals

Teacher's Guide

1.0 Summary

"Orbitals" is the first activity to be done after the pre-test. This activity should take approximately one class period.

2.0 Learning Goals

Driving Question: Where do we expect to find electrons in an atom?

This activity provides a brief history of the development of the atomic model. The model is then used to reinforce the current understanding of atomic orbitals. Electrons move in random patterns around the nucleus. The electrons are moving so quickly that we map their location as clouds instead of actual points. These clouds are negatively charged and are important because they are responsible for the formation of bonds between atoms in the formation of molecules.

Learning Goals

- Students will review the development of the atomic model.
- Students will understand that electrons are negatively charged.
- Students will understand that electrons exist as clouds around the nucleus.
- Students will understand why Dalton's model does not adequately explain our current understanding of the atomic model.
- Students will understand that electron clouds are negatively charged.

Additional Teacher Background

Electrons behave according to laws of quantum mechanics. These laws are very difficult for most people to understand because they do not map well within the macroscopic world. It is important that students move away from the belief that electrons orbit the nucleus like the Earth orbits the Sun. There are some similarities; electrostatic force pulls the electron to the nucleus such as gravity pulls the Earth toward the sun. Although the forces are different, the role of mathematics is similar.

However, the electrons move so quickly that they behave very differently from planets. These electrons follow apparently random patterns around the nucleus of an atom that are unlike a planet's elliptical orbit. The electrons' position in space can be determined by using probability models that treat the electrons like waves as opposed to particles.

3.0 Standards Alignment

Alignment to National Math and Science Standards (NCTM or NSES)

Objective	Standards
Students will understand the development of the atomic model.	• Varies by state.
Students will understand that electrons exist as negative clouds around the nucleus.	• Varies by state.

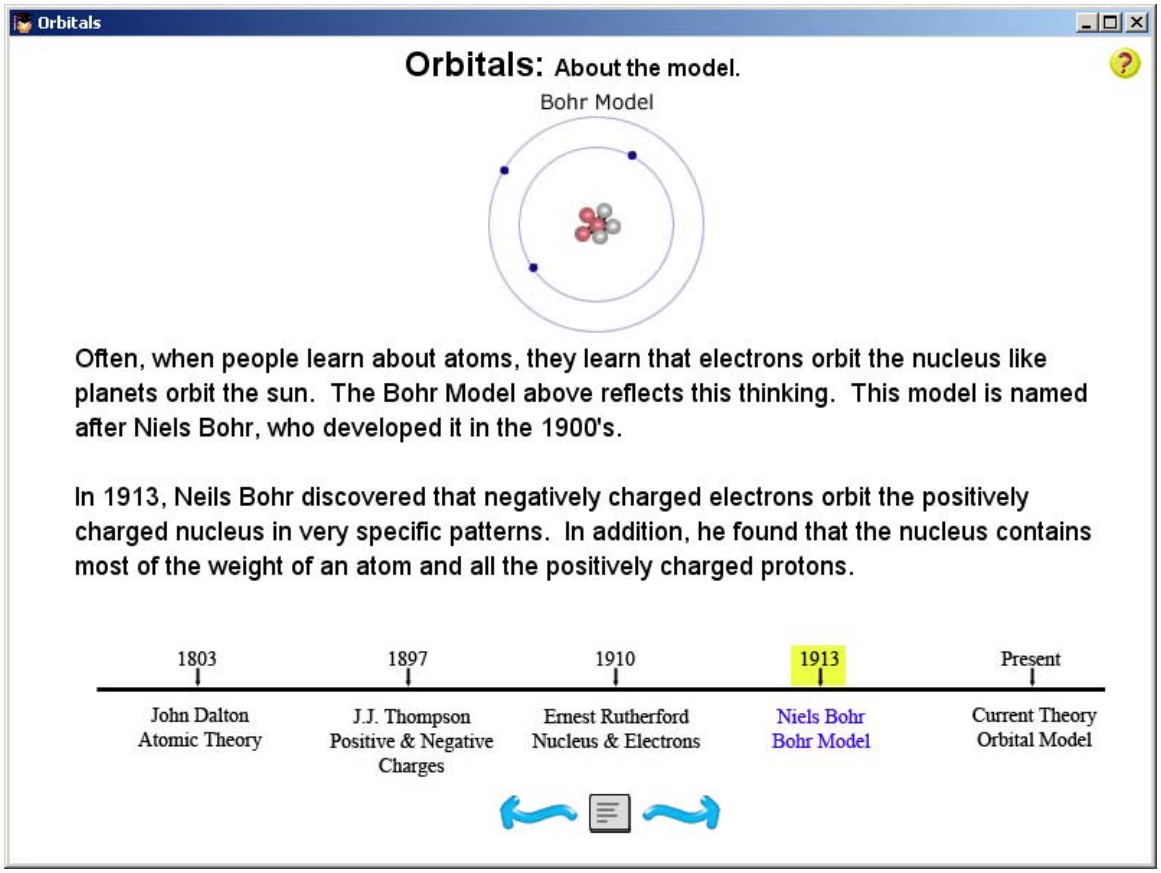
4.0 Activity Sections

4.1 Table of Contents

This activity has 4 sections.

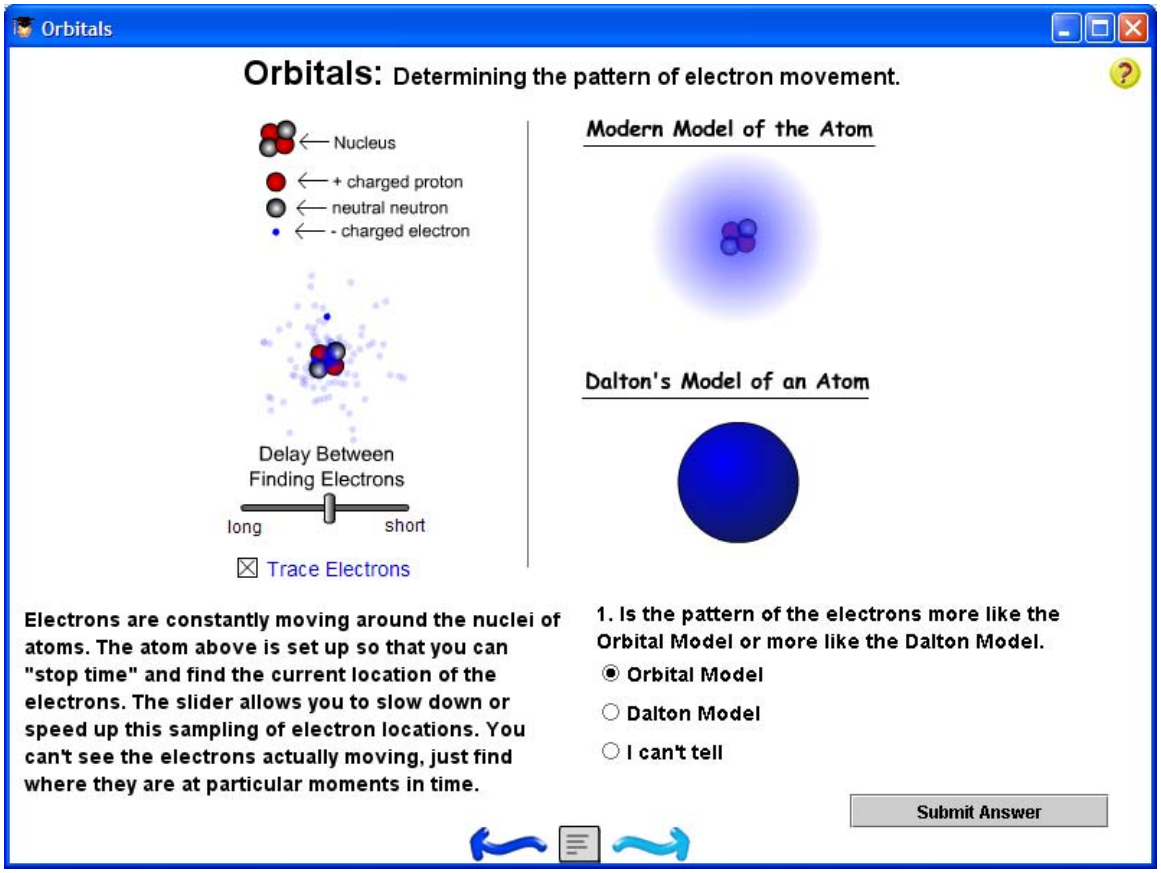
4.2 About the model

The first step provides students with a brief history of the atomic model.



4.3 Exploring the Model

This section introduces the student to the simulation that promotes an understanding of orbitals.



Notice that the slider on the left can be moved to adjust the frequency at which electrons are seen. The simulation will move faster if students push the slider toward "short." It is also important to make sure that the "trace electrons" button is checked. This insures that the last position of the electron remains on the screen.

As the simulation continues it should begin to look more and more like the modern model (orbital model) of the atom.

Question 2 in this activity asks students how electrons move around the nucleus. You may need to suggest the quick random movements of the electrons.

4.4 Questions for understanding

This section asks the students questions to help assess their understanding of the concepts.

The first question asks how only two electrons can make up a cloud. You may need to remind students that only one electron is needed to make up a cloud. Two electrons would actually make the cloud even faster.

The second question in this section asks about the charge on the cloud. Since the cloud is made up of electrons, it carries a negative charge.

The final question asks why the solid ball or Dalton model is not a good representation of the atom. You may need to remind students that the cloud is not solid matter.

4.5 Summary

This section shows the answers to all the questions. There is an icon on the lower left that will print each student's answers. After the student clicks on the icon, s/he will be asked to type in her/his name. This is only for the printout; the names are not saved in our database. Then, a web page is generated with the answers. This process may take a few moments. The standard print dialog box will open and the student can select the appropriate printer.

5.0 Student Reports

Your students' work with the Orbital activity is logged and viewable on the MAC Project Web Portal at http://mac.concord.org. For each student, you can view a report containing questions and answers.

"Finding the Nucleus" is the next activity in the Chemica sequence.