Bohr Atomic Model

Introduction

Looking for an easy way to model the atom? Have students show a little of their right-brain creativity as they focus on the logic of this left-brain concept. The Bohr model of atomic and electron structure correctly predicts the existence of specific electron energy levels in atoms.

Concepts

- Atomic model
- Bohr model
- Energy levels
- Electron shells

Materials

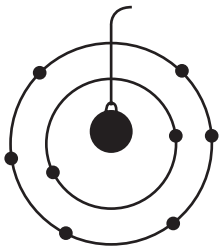
Aluminum or copper wire, 16 gauge, 10′
Fishing line, 25″
Modeling clay, 3 colors
Note card, 3″ × 5″
Paper clip, small
Periodic table
Ruler
Tape, cellophane
Wire cutters

Safety Precautions

Although the materials in this experiment are considered nonhazardous, please follow all normal laboratory safety guidelines. Use care when cutting wire and using cut wire.

Procedure

1. Using a periodic table, decide which element to model.
2. Identify the number of protons, electrons, neutrons in the predominant isotope of the element, and determine the energy levels required to model the atom. Write the information, along with the name, symbol, atomic number, and atomic mass of the element, on both sides of a 3″ × 5″ note card.
3. Using aluminum or copper wire, make as many concentric rings as necessary to represent the correct number of energy levels for the chosen element. The first ring should have an approximate diameter of 3″, the second 5″, the third 7″, the fourth 9″, and the fifth 11″.
4. Tie the small paper clip to one end of the fishing line.
5. Tie the first ring onto the fishing line approximately one inch from the paper clip so that, when suspended, the paper clip will hang in the center of the ring.
6. Repeat step 5 with each additional ring, securing the fishing line to the ring approximately one inch from the previous ring so that each smaller ring is centered within a larger ring.



Oxygen

7. Using two different colors of modeling clay, make a sphere approximately one inch in diameter. This represents the nucleus of the atom.
8. Push the paper clip through the nucleus so that it will hang in the center of the model.
9. Using a third color of modeling clay, make as many small pea-sized spheres as necessary to represent electrons. Place the electrons into the different size wires according to the following rules: only two electrons may exist in the first energy level, eight in the second, eighteen in the third, and thirty-two in both the fourth and fifth.
10. Press the wire into the clay to hold the electron in place.
11. Repeat step 10, as many times as needed to place all the electrons in the model.
12. Use the extra fishing line to hang the mobile from the ceiling or another object.
13. Attach the note card to the bottom of the outermost ring using a piece of cellophane tape.

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Publication No. 10738
061616

Tips

- Any stiff wire or coat hanger for making the rings works well in this activity.
- To bend the wire, wrap it around a can. A soup can for the smallest ring and a coffee can for the next ring, etc., should work well.
- The ends of the wire or coat hanger can be twisted together using a pair of pliers or taped using duct tape.

Discussion

Through the years, significant progress has been made in our knowledge of the atom. Atoms were originally described as the smallest particles of matter. The discoveries, in turn, of the electron, proton and neutron destroyed the notion of the indivisible atom. Knowledge of the subatomic particle makeup of the atom raised new questions—where are the electrons?

In 1913, the Danish scientist Niels Bohr (1885–1962) refined the existing atomic model to account for the locations of the electrons. According to the Bohr model, the electrons were restricted to certain specific orbits around the nucleus of the atom. These orbits differed in their distance from the nucleus and in their energy levels. Electrons that are closer to the nucleus are lower in energy than electrons that are further away from the nucleus. This idea is called the quantization of energy—electrons can only occupy specific energy levels, they may not have intermediate energy levels between these allowed states. The picture that is often used to describe this idea is the rungs on a ladder. An electron must always be on one of these energy rungs, not between them. An electron may be "excited" or promoted from a lower energy level to a higher energy level by absorbing energy of the appropriate wavelength. Conversely, an electron may "drop down" from a higher energy level to a lower energy level by releasing energy.

The idea that only certain energy levels are allowed has proved enduring, and Niels Bohr was awarded the Nobel Prize in Physics in 1922 for his model featuring quantized energy levels or electron shells. The Bohr model of atomic and electron structure successfully predicted the properties of the hydrogen atom, but does not work for atoms with more than one electron. The modern theory of electron structure states that although only certain energy levels are allowed, it is impossible to predict the exact locations of electrons in atoms. Electrons are not restricted to specific orbits. A system of atomic orbitals was defined to describe the probability of finding an electron in a particular region of space around the nucleus. Atomic orbitals differs in their size, shape, and orientation in space, and also in their energy levels. This model of electron structure is sometimes referred to as the electron cloud model.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Systems, order, and organization
Evidence, models, and explanation

Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter, understanding of motions and forces, transfer of energy

Content Standards: Grades 9–12
Content Standard B: Physical Science, structure of atoms, structure and properties of matter

Materials for *Bohr Atomic Model* are available from Flinn Scientific, Inc. This activity has also been developed into a model kit, *Atomic Mobile Kit*.

Catalog No.	Description
A0175	Aluminum Wire, 100 g
AP6938	Fishing Line, 1425 ft.
FB0600	Clay, Modeling, 5-lb Package
AP4240	Periodic Table, Notebook Size, 50
AP9254	Atomic Mobile Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

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