Timeline for the Atom

Summary

Students will examine how significant scientific theories are developed, explore the work of scientists who contributed ideas to the atomic theory, and develop a timeline of key scientists to show how the work of each one built on the efforts of those who came before them.

Time Frame

1 class periods of 90 minutes each

Group Size

Small Groups

Materials

- *Elements of Chemistry: Atoms: The Building Blocks of Matter*
  video (or other video dealing with how our understanding of matter was developed)
  Computer with Internet access or
  Print resources about the history of the our understanding of the structure of the atom
  15 ft of Adding Machine Tape, Large piece construction paper.
  Colored pencils and markers

Instructional Procedures

Begin the lesson by asking students to consider the following questions: How are scientific ideas developed? Do you think one scientist comes up with the idea, or do scientists collaborate? Ask students to write their responses on a sheet of paper and put away their papers until the end of the

Tell students that the focus of today's lesson is how scientists learned about the structure of the atom. Their ideas culminated in what is called quantum mechanics, a set of discoveries that may be considered one of the biggest scientific accomplishments of the 20th century. To provide students with background information, have them watch the segment "Electron Behavior," in the program Elements of Chemistry: Atoms: The Building Blocks of Matter.

Explain that the class will develop a timeline illustrating what and when scientists contributed to the understanding of the atom's structure. Ask one or two volunteers to draw a timeline from 1900 to 1930 on butcher block paper. Then divide students into groups of three or four; each one to focus on one scientist and his contribution to the understanding of quantum mechanics.

Each student groups needs to produce the following information for each scientist:

Assign each group to one of the following scientists listed below; a brief explanation of each contribution is included.

Max Planck: In 1900 he put forth the idea that radiation is emitted in discrete quantities that he called quanta.

Albert Einstein: Building on Planck's ideas, in 1905 Einstein published the idea that the "quanta" was a bundle of light that behaved like a particle.

Ernest Rutherford: Working with colleagues Hans Geiger and Ernest Marsden in 1911, Rutherford was the first to hypothesize that the center of the atom, which he called the nucleus, is small, dense, and positively charged.

Niels Bohr: In 1913, he proposed a model of the atom with electrons orbiting the nucleus similar to the planets revolving around the sun. The orbits of electrons depend on their energy, and electrons can jump from one energy level to another; and energy travels in

discrete quantities.
James Chadwick and E.S. Bieler: They proposed in 1921 that a strong force held the nucleus together.
Louis de Broglie: He proposed in 1924 that electrons could behave as waves under some conditions, a finding that helped scientists understand that the atom didn't behave like the solar system because electrons do not move in regular orbits.
Erwin Schrodinger: Building on de Broglie's idea that electrons act like waves in some situations, he developed the basic equation of quantum mechanics in 1926.
Werner Heisenberg: In 1927 he proposed that it is impossible to know the position and velocity of an electron at the same time; this concept is called the uncertainty principle.
Max Born: Working with Heisenberg in 1927, Born modified Schrodinger's equation of quantum mechanics. His idea helped scientists develop the model of an atom with a nucleus surrounded by electrons at different locations when they are in different energy states.

Give students time in class to research their scientists. The following Web sites have useful information:

- An Introduction to the Electronic Structure of Atoms and Molecules
- Quantum Theory Timeline
- Brief History of Quantum Mechanics
- Atomic Structiure Timeline
- Timeline on Atomic Structure
- The Atomic Age Timeline

After students have conducted their research, have them fill in information on the construction paper and tape it to the timeline. Once the timeline is complete, ask each group to present a report about the scientist, identifying his contribution and how his work borrowed from that of other scientists. Students listening in the class should take notes on each scientist.
Conclude the lesson by asking students to look at the papers they completed at the beginning of the lesson. Ask what they have learned about this process. How would they modify their original ideas?

Assessment Plan

Scoring Guide:

3 points: Students demonstrated a deep understanding of how important scientific theories are developed; worked well with their group to conduct in-depth research; and were highly involved in the development of the class timeline.
2 points: Students demonstrated a satisfactory understanding of how important scientific theories are developed; worked satisfactorily with their group to conduct research; and were involved in the development of the class timeline.
1 point: Students demonstrated little or a poor understanding of how important scientific theories are developed; did not work well with their group to conduct research; and were barely or not involved in the development of the class timeline.

Bibliography

Lesson Design by Jordan School District Teachers and Staff.

Authors

Utah LessonPlans