Exploration

TEACHER guide

Atomic Split

Exploration Summary

Students will sequence events to show how atoms split to produce nuclear energy.

Student Learning Objectives

- Explain the process of nuclear fission.
- Recognize the formula to calculate nuclear energy.

Student Worksheet

The student worksheet includes questions to check understanding, instructions for how to use the Exploration, and a section for recording Exploration data. Why do the questions come first? In following best practices for teaching science, students are asked to review questions before participating in an activity. When the questions come first, students are more focused on the intended content of the activity. Then they can respond to the questions during the activity or after completion of the activity.

Exploration Procedure

Explain that the purpose of this Exploration is to learn how splitting the nucleus of an atom produces energy. Follow the appropriate procedure below.

Student Performs Exploration

1. Tell students how much time they will have to complete the Exploration and the student worksheet.
2. Explain how students should proceed:
   - Read the questions before starting the Exploration.
   - Follow the instructions on the worksheet to perform the Exploration.
   - Take notes or record data as necessary.
   - Respond to the questions in writing.
3. Explain that you will be available to help any students who raise their hands.
4. Tell students to begin the Exploration.
5. When time is up, ask students to share their answers.
6. Talk about the Discussion Question below.

Exploration

TEACHER guide Atomic Split

Teacher Performs Exploration

1. Display the questions from the student worksheet and ask students to tell you what they think they will learn from the Exploration based on its questions. Highlight key words.
2. Read the Introduction and click the Continue button.
3. Roll the mouse over each label to reveal the hints. Drag each to the correct place on the diagram.
4. Control the animation with the Stop and Play buttons. Read the outcome explanations as they appear and discuss.
5. Read the concluding text, discuss, and close.
6. Pose each of the questions below and ask for answers from the class. Replay parts of the Exploration as necessary to illustrate the answers.
7. Talk about the Discussion Question below.

Optional: Use this Exploration as a small-group activity at a computer station. Assign it to students who need specific reinforcement of the concept.

Questions

1. How is the uranium isotope U236 created? How does it differ from uranium 235?
   Answer: It's created when a free neutron collides with the nucleus of uranium 235. The nucleus of U236 has one more neutron than U235.
2. How can the splitting of a single U236 nucleus lead to a chain reaction?
   Answer: When the uranium nucleus splits, it releases several free neutrons that can collide with nearby U235 atoms, splitting them and releasing more free neutrons to continue the process.
3. Explain the formula $e = mc^2$.
   Answer: This says the amount of energy produced (E) is equal to the amount of mass (m) multiplied by the speed of light squared (c^2).

Discussion Questions

Review the structure of atoms and isotopes

- All atoms of an element contain the same number of protons. This number, called the atomic number, identifies the element. For example, carbon's atomic number is 6 and it has six protons.
- Because atoms are electrically neutral, they have the same number of electrons as protons.
- When atoms of the same element have a different number of neutrons, they are called isotopes.
- Some elements have isotopes that exist in nature but are unstable. These are called radioactive isotopes.
- They are unstable because the structure of their nucleus may change suddenly.
- Scientists have learned how to create an unstable isotope by crashing a free neutron into the nucleus of U235, creating U236, which is so unstable that its nucleus immediately splits into several smaller nuclei.