Build An Atom

Throughout the guide, teaching tips are in red.

Activity Description & Estimated Class Time

Students build models of common elements. This exercise is intended to expose students to the structure of atoms in terms of the protons, electrons, and neutrons using the location, charges, and comparative size of these subatomic particles. This lesson takes one 50-minute period.

Correlations to NC Science Standards

PS.8.1.2 Use models to illustrate the structure of atoms in terms of the protons, electrons, and neutrons (using the location, charges, and comparative size of these subatomic particles), without consideration of isotopes, ions, and energy levels.

Learning Target

Students will demonstrate knowledge and understanding of the following ideas and content:

- Atoms are made of protons, neutrons, and electrons.
- The periodic table an be used to determine the number of protons, neutrons, and electrons in a particular atom.

Brief Science Background

In 1897, British physicist J.J Thompson proved that atoms were not the simplest form of matter. Using a cathode ray tube, he showed that all atoms contain a small negatively charged subatomic particle or electron. Thompson knew that atoms had an overall neutral charge. Therefore, he reasoned that there must be a source of positive charge in the atom. In his plum pudding model, he proposed that atoms were negative particles embedded within a positively charged "soup."

In 1911, Ernest Rutherford performed his famous gold foil experiment. Through this experiment, he concluded that the positive charge was localized over a small area and contained most of the atom's mass, which would be known as the nucleus. He also discovered that the atom was made up of mostly empty space. Twenty-one years later, Rutherford's colleague James Chadwick announced the existence of a third subatomic particle, the neutron. This particle does not have any charge and is located in the nucleus with the proton. From there, scientists discovered that only protons and neutrons contribute to the atomic mass. They also found that all atoms have an overall charge of zero, indicating that the number of protons is equivalent to the number of electrons.

Part 1 — Building an Atom

Materials

Materials for the whole class

- red blocks (These represent protons.)
- yellow blocks (These represent neutrons.)
- white beads (These represent electrons.)
- pipe cleaners (These represent electron shells.)
- student activity sheet (SD 1)

Materials for groups of 2 students

- sandwich zip bags (to place materials in)
- 2 red blocks
- 2 yellow blocks
- 2 white beads
- 2 pipe cleaners
- Periodic Table (supplied by the teacher)

Procedure

1. Give each student a student activity sheet (SD 1).
2. Project the Helium periodic table square from SD 1 and ask students, "What information can this periodic square give us?"
   Answers include: name of the element, symbol, # of protons, # of electrons, atomic mass, # of neutrons (atomic mass = # of protons + # of neutrons)
3. As a class fill in the information for Helium.

Name: **Helium**
Symbol: **He**
Atomic Mass: **4.00**

# of Protons: **2**
# of Electrons: **2**
# of Neutrons: **2**

4. Handout a bag of materials to each pair of students. Students will work in pairs to put together a model of a Helium atom. As a class, take two red blocks and two yellow blocks and snap them together. Explain to students that they have created the nucleus of the atom. The nucleus is the center of the atom. It is made of protons and neutrons. The red blocks represent protons and the yellow blocks represent neutrons.
5. Instruct students to take two pipe cleaners and attach ends together. Place two white beads on the pipe cleaners and attach the other end of the pipe cleaners to create a circle. Explain to students that they have created the first electron shell of the atom. The first electron shell can only hold 2 electrons. The white beads represent electrons.
6. Place the nucleus inside the electron shell. Explain to students that they have created a model of the Helium atom.
7. Review all the components of the atom, and have students complete SD 1 through #5.

Part 2 — Which Atom Do You Have?

Materials

Materials for the whole class

- Red Blocks (These represent protons.)
- Yellow Blocks (These represent neutrons.)
- White Beads (These represent electrons.)
- Pipe Cleaners (These represent electron shells.)
- Student Activity Sheet (SD 1)

Materials for groups of 2 students

- 1 Atom Bag (made by teacher)
- Periodic Table (supplied by teacher)

Preparation

Allow for approx. 30 min.

Create the following atom bags using a quart size zip bag:

- 4 Lithium bags labeled bag #1: each should have 3 red blocks, 4 yellow blocks, 3 white beads, 5 pipe cleaners
- 4 Beryllium bags labeled bag #2: each should have 4 red blocks, 5 yellow blocks, 4 white beads, 5 pipe cleaners
- 4 Boron bag labeled bag #3: each should have 5 red blocks, 6 yellow blocks, 5 white beads, 5 pipe cleaners
- 3 Carbon bags labeled bag #4: each should have 6 red blocks, 6 yellow blocks, 6 white beads, 5 pipe cleaners
- 3 Nitrogen bags labeled bag #5: each should have 7 red blocks, 7 yellow blocks 7 white beads, 5 pipe cleaners

Procedure

1. Tell students, "Your challenge is to identify an atom based on its structure. You must build the atom and then identify the atom."
2. Give each pair of students an atom bag. Students should build their atom and fill out the information on SD 1.
3. After students finish building their model, have them rotate to another student's model. Students will determine which atom the model represents based on its structure.
   Have students locate atom bag numbers that are different from theirs.

Formative Assessment/ Guided Practice

Guided Practices are similar to typical tests, but require students to reveal their thinking about content. They serve as a practice before a test and should not be graded. They are intended to expose misconceptions before an assessment and to provide opportunities for discussion, re-teaching, and for students to justify answers. They are best given as individual assignments without the manipulatives used in the activity. In that context, pose the following "test items" to the class. Ask them to write responses in notebooks.

If an element with 300 electrons and a mass of 600 was discovered, how many neutrons and protons would you expect it to have? Explain your answers. Where would each particle be located in an atom of this element?

SD 1

Name:

1. Fill in the information with your class.

Name: # of Protons:

Symbol: # of Electrons:

Atomic Mass: # of Neutrons:

2. Draw a sketch of the Helium atom. Label the subatomic particles and their charges.

3. Where are the protons and neutrons found in an atom? In our model what represent the proton? What represents the neutron?

4. Where are the electrons found in an atom?

5. What do you notice about the sizes of protons, neutrons, and electrons? In our model what represents the electron?

6. Look at the contents of your atom bag. Complete the information below before building your atom.

# of Protons: # of Electrons: # of Neutrons:

7. Now build your atom, being sure to place each part in the correct position. Draw a sketch of your model below.

8. Based on your model compete the following information. You may use a Periodic Table.

Element Name: Element Symbol: Atomic Mass:

9. When your teacher instructs you to, rotate to a different groups' model and complete the chart below.

Atom Bag #	# of Protons	# of Neutrons	# of Electrons	Element Name	Symbol