

ATOMS AND ISOTOPES

Purpose:

The purpose of this introductory lesson is to acquaint students with concepts about atoms and isotopes and to begin exploration of radioactivity and its relation to radiation, the chemical elements, and the nature of atoms.

Concepts:

1. There are 92 naturally occurring chemical elements, some of which are radioactive.
2. An atom is the smallest part of a chemical element that has all the chemical properties of the element.
3. Each atom has a nucleus that determines its chemical properties.
4. The nucleus of a radioactive atom spontaneously emits a particle, which changes the atom into a different chemical element.

Duration of Lesson:

One 50-minute class period

Objectives:

As a result of participation in this lesson, the learner will be able to:

1. define atom, atomic number, atomic weight, and isotopes;
2. name the parts of an atom;
3. discuss everyday applications and uses of radioactive materials; and
4. use the Periodic Table.

Skills:

Analyzing, discussing, drawing (optional), expressing opinions, interpreting/using charts (optional), reading comprehension

Vocabulary:

Atom, atomic number, atomic weight, electron, isotope, molecule, neutron, nucleus, proton, radiation, radioactive decay

Materials:

Reading Lesson

Atoms and Isotopes Review, p. SR-17

Activity Sheets

Atoms and Isotopes Review, p. 109

The Chemical Elements and Isotopes, p. 111

Periodic Table, p. 115

Chemical Element Worktable, p. 117

Suggested Procedure:

1. Assign the reading lesson entitled *Atoms and Isotopes Review*.

It may be helpful to begin by explaining to students that the reading lesson and activities in which they will participate cover concepts about atoms and isotopes. Discuss why the number of naturally occurring elements is smaller than the number of elements on the periodic table.

(We know for certain that 92 elements exist in nature. Physical evidence indicates that at least two others are present from time to time because they are part of the decay chain of some naturally occurring elements. Students may become confused because the periodic table indicates 103 elements. The reason for the discrepancy is that scientists have produced small amounts of very heavy elements in the laboratory.)

2. Engage students in a class discussion upon completion of the reading lesson.

Sample Discussion Questions:

1. If atoms are so small that we can't see them, how do we know they really exist?

(Scientists learn about atoms through indirect observation. They study the properties of atoms that can be measured in some way. We study other phenomena the same way. For example, we can't see the wind, but we can see it blow leaves about, and therefore we know it exists. We know its properties and its effects.)

2. If an atom is considered the smallest unit of matter, how can we say that atoms are made of smaller particles such as protons, electrons, and neutrons?

(The atom is the smallest part of matter which retains all of the chemical characteristics of an element. Electrons, protons, and neutrons are fundamental particles which make up the atoms of all elements.)

3. Why are protons used to identify elements?

(The number of protons in an atom is used to identify an element because all isotopes of an element have the same number of protons.)

4. What is the difference between an atom and a molecule?

(A molecule can be a combination of several atoms of the same element or of different elements. For example, a molecule of hydrogen gas is made of 2 hydrogen atoms combined with 1 oxygen atom, H_2O . A molecule is always made of atoms; atoms are not made of molecules.)

5. How do isotopes differ from one another?

(Isotopes of a specific element differ from one another in the number of neutrons in their nuclei. They have the same number of protons in their nuclei and therefore, they have

the same chemical properties but not the same atomic weight. They are all atoms.)

6. Why is the atomic weight sometimes a fraction?

(The atomic weight is the average of the weights of the isotopes of an atom.)

3. Assign the reading review *Atoms and Isotopes* and the activities entitled *Chemical Element Worktable* to be completed in class.

You may wish to review rounding off numbers with the class and do the first example as a group to assure understanding.

Additionally, it may be helpful to discuss the steps involved in filling in the names of isotopes. Be sure that students know they must use the list of elements and their symbol to find the isotope symbol. They must also know that they use the symbol to find the correct box for the element on the periodic table, and that they add the number of protons and neutrons to identify the isotopes.

4. Assign the following for homework:

- (a) Have students write a 1 or 2 sentence description of the difference between radiation and radioactivity.

(Students should be aware that radiation is energy that moves through space in the form of wave particles. Radioactivity is the property of some chemical elements that spontaneously emit radiation.)

- (b) Ask students to list as many everyday uses of radiation as they can. They may look these up, or ask friends and family members to help them, etc.

(Answers will vary. However, you should be looking for such responses as:

Radioactive materials have many different uses. They are used in medicine, scientific research, industry, and to help generate electricity.

Doctors have learned many different ways to use radioactive materials in the treatment and diagnosis of various diseases, including cancer.

We also use radiation to label things. When substances are labeled with radioactive elements, we can trace the path these substances take through living plants or animals.

Industry uses radiography to check the quality of many different products. In addition, radioactive elements are used in thickness gauges, for analyzing evidence from the scene of a crime, for preserving foods, for dating art and antiques, and for generating electricity.)

Teacher Evaluation of Learner Performance:

Student completion of activities and participation in discussion will indicate level of comprehension.