Atomic Structures: Mapping An Invisible World

AIMS
MULTIMEDIA

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Congratulations!

You have chosen a learning program that will actively motivate your students AND provide you with easily accessible and easily manageable instructional guidelines designed to make your teaching role efficient and rewarding.

The AIMS Teaching Module provides you with a video program keyed to your classroom curriculum, instructions and guidelines for use, plus a comprehensive teaching program containing a wide range of activities and ideas for interaction between all content areas. Our authors, educators, and consultants have written and reviewed the AIMS Teaching Modules to align with the Educate America Act: Goals 2000.

This ATM, with its clear definition of manageability, both in the classroom and beyond, allows you to tailor specific activities to meet all of your classroom needs.

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RATIONALE

In today's classrooms, educational pedagogy is often founded on Benjamin S. Bloom's "Six Levels of Cognitive Complexity." The practical application of Bloom's Taxonomy is to evaluate students' thinking skills on these levels, from the simple to the complex: Knowledge (rote memory skills), Comprehension (the ability to relate or retell), Application (the ability to apply knowledge outside its origin), Analysis (relating and differentiating parts of a whole), Synthesis (relating parts to a whole), and Evaluation (making a judgment or formulating an opinion).

The AIMS Teaching Module is designed to facilitate these intellectual capabilities, AND to integrate classroom experiences and assimilation of learning with the students' life experiences, realities, and expectations. AIMS' learner verification studies prove that our AIMS Teaching Modules help students to absorb, retain, and to demonstrate ability to use new knowledge in their world. Our educational materials are written and designed for today's classroom, which incorporates a wide range of intellectual, cultural, physical, and emotional diversities.

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ORGANIZATION AND MANAGEMENT

To facilitate ease in classroom manageability, the AIMS Teaching Module is organized in four sections. You are reading Section 1, Introduction to the Aims Teaching Module (ATM).

SECTION 2,

INTRODUCING THIS ATM

will give you the specific information you need to integrate the program into your classroom curriculum.

SECTION 3,

PREPARATION FOR VIEWING

provides suggestions and strategies for motivation, language preparedness, readiness, and focus prior to viewing the program with your students.

SECTION 4,

AFTER VIEWING THE PROGRAM

provides suggestions for additional activities plus an assortment of consumable assessment and extended activities, designed to broaden comprehension of the topic and to make connections to other curriculum content areas.

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FEATURES

INTRODUCING EACH ATM

SECTION 2

Your AIMS Teaching Module is designed to accompany a video program written and produced by some of the world's most credible and creative writers and producers of educational programming. To facilitate diversity and flexibility in your classroom, your AIMS Teaching Module features these components:

Themes

The Major Theme tells how this AIMS Teaching Module is keyed into the curriculum. Related Themes offer suggestions for interaction with other curriculum content areas, enabling teachers to use the teaching module to incorporate the topic into a variety of learning areas.

Overview

The Overview provides a synopsis of content covered in the video program. Its purpose is to give you a summary of the subject matter and to enhance your introductory preparation.

Objectives

The ATM learning objectives provide guidelines for teachers to assess what learners can be expected to gain from each program. After completion of the AIMS Teaching Module, your students will be able to demonstrate dynamic and applied comprehension of the topic.

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PREPARATION FOR VIEWING

SECTION 3

In preparation for viewing the video program, the AIMS Teaching Module offers activity and/or discussion ideas that you may use in any order or combination.

Introduction To The Program

Introduction to the Program is designed to enable students to recall or relate prior knowledge about the topic and to prepare them for what they are about to learn.

Introduction To Vocabulary

Introduction to Vocabulary is a review of language used in the program: words, phrases, usage. This vocabulary introduction is designed to ensure that all learners, including limited English proficiency learners, will have full understanding of the language usage in the content of the program.

Discussion Ideas

Discussion Ideas are designed to help you assess students' prior knowledge about the topic and to give students a preview of what they will learn. Active discussion stimulates interest in a subject and can motivate even the most reluctant learner. Listening, as well as speaking, is active participation. Encourage your students to participate at the rate they feel comfortable. Model sharing personal experiences when applicable, and model listening to students' ideas and opinions.

Focus

Help learners set a purpose for watching the program with Focus, designed to give students a focal point for comprehension continuity.

Jump Right In

Jump Right In provides abbreviated instructions for quick management of the program.

AFTER VIEWING THE PROGRAM

SECTION 4

After your students have viewed the program, you may introduce any or all of these activities to interact with other curriculum content areas, provide reinforcement, assess comprehension skills, or provide hands-on and in-depth extended study of the topic.

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SUGGESTED ACTIVITIES

The Suggested Activities offer ideas for activities you can direct in the classroom or have your students complete independently, in pairs, or in small work groups after they have viewed the program. To accommodate your range of classroom needs, the activities are organized into skills categories. Their labels will tell you how to identify each activity and help you correlate it into your classroom curriculum. To help you schedule your classroom lesson time, the AIMS hourglass gives you an estimate of the time each activity should require. Some of the activities fall into these categories:

Meeting Individual Needs

These activities are designed to aid in classroom continuity. Reluctant learners and learners acquiring English will benefit from these activities geared to enhance comprehension of language in order to fully grasp content meaning.

Curriculum Connections

Many of the suggested activities are intended to integrate the content of the ATM program into other content areas of the classroom curriculum. These cross-connections turn the classroom teaching experience into a whole learning experience.

Critical Thinking

Critical Thinking activities are designed to stimulate learners' own opinions and ideas. These activities require students to use the thinking process to discern fact from opinion, consider their own problems and formulate possible solutions, draw conclusions, discuss cause and effect, or combine what they already know with what they have learned to make inferences.

Cultural Diversity

Each AIMS Teaching Module has an activity called Cultural Awareness, Cultural Diversity, or Cultural Exchange that encourages students to share their backgrounds, cultures, heritage, or knowledge of other countries, customs, and language.

Hands On

These are experimental or tactile activities that relate directly to the material taught in the program.Your students will have opportunities to make discoveries and formulate ideas on their own, based on what they learn in this unit.

Writing

Every AIMS Teaching Module will contain an activity designed for students to use the writing process to express their ideas about what they have learned. The writing activity may also help them to make the connection between what they are learning in this unit and how it applies to other content areas.

In The Newsroom

Each AIMS Teaching Module contains a newsroom activity designed to help students make the relationship between what they learn in the classroom and how it applies in their world. The purpose of In The Newsroom is to actively involve each class member in a whole learning experience. Each student will have an opportunity to perform all of the tasks involved in production: writing, researching, producing, directing, and interviewing as they create their own classroom news program.

Extended Activities

These activities provide opportunities for students to work separately or together to conduct further research, explore answers to their own questions, or apply what they have learned to other media or content areas.

Link to the World

These activities offer ideas for connecting learners' classroom activities to their community and the rest of the world.

Culminating Activity

To wrap up the unit, AIMS Teaching Modules offer suggestions for ways to reinforce what students have learned and how they can use their new knowledge to enhance their world view.

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VOCABULARY

Every ATM contains an activity that reinforces the meaning and usage of the vocabulary words introduced in the program content. Students will either read or find the definition of each vocabulary word, then use the word in a written sentence.

CHECKING COMPREHENSION

Checking Comprehension is designed to help you evaluate how well your students understand, retain, and recall the information presented in the AIMS Teaching Module. Depending on your students' needs, you may direct this activity to the whole group yourself, or you may want to have students work on the activity page independently, in pairs, or in small groups. Students can verify their written answers through discussion or by viewing the video a second time. If you choose, you can reproduce the answers from your Answer Key or write the answer choices in a Word Bank for students to use. Students can use this completed activity as a study guide to prepare for the test.

CONSUMABLE ACTIVITIES

The AIMS Teaching Module provides a selection of consumable activities, designed to specifically reinforce the content of this learning unit. Whenever applicable, they are arranged in order from low to high difficulty level, to allow a seamless facilitation of the learning process. You may choose to have students take these activities home or to work on them in the classroom independently, in pairs or in small groups.

CHECKING VOCABULARY

The Checking Vocabulary activity provides the opportunity for students to assess their knowledge of new vocabulary with this word game or puzzle. The format of this vocabulary activity allows students to use the related words and phrases in a different context.

TEST

The AIMS Teaching Module Test permits you to assess students' understanding of what they have learned. The test is formatted in one of several standard test formats to give your students a range of experiences in test-taking techniques. Be sure to read, or remind students to read, the directions carefully and to read each answer choice before making a selection. Use the Answer Key to check their answers.

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ADDITIONAL AIMS MULTIMEDIA PROGRAMS

After you have completed this AIMS Teaching Module you may be interested in more of the programs that AIMS offers. This list includes several related AIMS programs.

ADDITIONAL READING SUGGESTIONS

AIMS offers a carefully researched list of other resources that you and your students may find rewarding.

ANSWER KEY

Reproduces tests and work pages with answers marked.

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Atomic Structures: Mapping An Invisible World

THEMES

Atomic Structures: Mapping an Invisible World introduces students to various theories that have contributed to our understanding of atomic structure. These theories include the Dalton Model, the Rutherford Model and the Bohr Model. The modern model of the atom is also explained, including our knowledge of electron arrangement, protons, neutrons, and isotopes.

OVERVIEW

The atom is the building block of all matter in the universe. Since the time of the early Greeks, man has tried to understand how these building blocks work. The Greek philosopher Democritus was one of the first scientists to study the atom. Others followed, including John Dalton and Niels Bohr. Our modern understanding of the atom is based on scientific research involving the behavior of certain elements. From this research, we can learn more about electron configuration, atomic mass and weight, reactivity of certain atoms and radioactivity of various elements.

OBJECTIVES

- To learn about various early theories of atomic structure.
- To discuss the modern model of the atom, including electron arrangement, protons and neutrons.
- To examine the octet rule and its relationship to an element's reactivity.
- To explore isotopes and their effect on atomic mass.
- To discuss the aspects of radioactivity, half-life and dating.

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Use this page for your individual notes about planning and / or effective ways to manage this AIMS Teaching Module in your classroom.

Our AIMS Multimedia Educational Department welcomes your observations and comments.
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INTRODUCTION TO THE PROGRAM

Much of what we know about atomic structure today is the result of indirect observation of atoms and the particles that compose them. Democritus was the first to realize that the forces that hold together the atom cannot be divided except by the most powerful reactions. When the nucleus of an atom is split apart in a process called fission, tremendous energy is released. The English chemist John Dalton developed the first model of an atom in 1803. He believed that all atoms of the same element were alike in both shape and mass. Later, J.J. Thomson discovered a stream of negatively charged particles known as electrons. Lord Rutherford discovered that atoms were mostly comprised of empty space. He also indicated that the small, dense positively charged central portion of an atom was comprised of particles known as protons. Each of these discoveries has helped us to develop a modern model of the atom.

INTRODUCTION TO VOCABULARY

Before starting the program, write the word “atom” on the board. Ask students to look the word up in the dictionary or encyclopedia. Where did the word originate? What is the meaning of the word?

(Atom is a Greek word that means, “not cuttable.” It was given this name after Democritus developed his theory of atomism. Based on this theory, atoms were the smallest parts of an element that could not be broken down any further. Atom is defined as a tiny indivisible particle of which the universe is composed.)

DISCUSSION IDEAS

The study of atoms has led to many improvements in our daily lives. A good example of this can be found in the study of radioactivity. Not only did scientists discover naturally occurring radioactive atoms, they also devised ways to produce them. Ask students to think of some ways that this technology has been put to use.

(Radioisotopes are used as chemical tracers to detect illness in the body. They are also used to treat cancer. In addition, a radioisotope of carbon is used to date materials that are very old.)

FOCUS

Ask students to consider the intricate makeup of a tiny atom. It is sometimes difficult to imagine something that is too small to see. Explain that the science of atomic structure requires imagination and concentration. Ask students to keep this in mind as they begin the program.

JUMP RIGHT IN

HOW TO USE THE ATOMIC STRUCTURES: MAPPING AN INVISIBLE WORLD AIMS TEACHING MODULE

Preparation

- Read *Atomic Structures: Mapping an Invisible World* **Themes, Overview,** and **Objectives** to become familiar with program content and expectations.
- Use **Preparation for Viewing** suggestions to introduce the topic to students.

Viewing ATOMIC STRUCTURES: MAPPING AN INVISIBLE WORLD

- Set up viewing monitor so that all students have a clear view.
- Depending on your classroom size and learning range, you may choose to have students view *Atomic Structures: Mapping an Invisible World* together or in small groups.
- Some students may benefit from viewing the video more than one time.

After Viewing ATOMIC STRUCTURES: MAPPING AN INVISIBLE WORLD

- Select **Suggested Activities** that integrate into your classroom curriculum. If applicable, gather materials or resources.
- Choose the best way for students to work on each activity. Some activities work best for the whole group. Other activities are designed for students to work independently, in pairs, or in small groups. Whenever possible, encourage students to share their work with the rest of the group.
- Duplicate the appropriate number of **Vocabulary, Checking Comprehension**, and consumable activity pages for your students.
- You may choose to have students take consumable activities home, or complete them in the classroom, independently, or in groups.
- Administer the Test to assess students' comprehension of what they have learned, and to provide them with practice in test-taking procedures.
- Use the **Culminating Activity** as a forum for students to display, summarize, extend, or share what they have learned with each other, the rest of the school, or a local community organization.

SUGGESTED ACTIVITIES

Connection to History

60 Minutes

In about 400 B.C., a Greek philosopher named Democritus began to study matter. He was probably the first scientist to theorize that matter was made of tiny particles called atoms. Democritus believed that matter could be broken down into finer and finer pieces until it could no longer be divided. The particles left were called atoms. Followers of this theory were known as atomists.

In addition to Democritus, other famous atomists included Leucipus, Epicurus and Lucretius. Ask each student to learn more about one of these men using encyclopedias and library texts. What were their contributions to atomism? What other fields were the men involved with? Ask students to summarize their findings in a one-page report.

Meeting Individual Needs

20 Minutes

Ask students to write three short paragraphs, one describing each of the atomic particles: protons, electrons and neutrons. Remind them to include information about how each particle affects an atom's behavior and stability. Where is each particle found in an atom? What is the charge of each particle? Encourage them to find as many facts as they can about the atomic particles.

Hands On

20 Minutes

The following simple experiment will show students how atoms react with one another. To perform the experiment, students will need a few dull, old pennies, a teaspoon of table salt and a tablespoon of vinegar.

Have students place the pennies in a shallow dish. Explain that the film on the pennies is created when copper atoms combine with oxygen atoms. Tell them to sprinkle the salt on the pennies, than have them add the vinegar. What happens? What could be the reason?

(The film on the pennies breaks down and disappears as oxygen atoms in the film separate from the copper and join with atoms in the molecules of salt and vinegar.)

Critical Thinking

20 Minutes

Many early scientists believed that the atom was structured much like our solar system. In what ways did this theory turn out to be true?

(Almost everything in the solar system revolves around the sun, just as the particles of an atom revolve around the nucleus. The nucleus has a large mass compared to the other particles, just as the sun has the largest mass of anything in our solar system. Most of our solar system is composed of empty space, just as most of an atom is composed of space between particles. The planets that revolve around the sun are similar to electrons that revolve around the nucleus of an atom.)

Connection to Math

15 Minutes

Since we cannot see atoms, it is sometimes hard to imagine their size and appearance. A million hydrogen atoms, lined up side by side, would be thinner than a piece of paper. If an atom were the size of the period at the end of this sentence, all the atoms in a grain of salt would make a cube one mile long, one mile wide and one mile high. Even more amazing is the space between the nucleus of an atom and its electrons.

In a typical atom, the nucleus is approximately one hundred thousandth (1/100,000) the size of the entire atom. With this in mind, imagine that the nucleus of an atom is the same size as a 1/2 inch coin. How large would the entire atom be? Can students think of anything with a similar size or distance?

(The entire atom would be approximately 500,000 inches, or 41,667 feet or almost 8 miles. In order to complete the analogy, ask students to think of a distance that is approximately 8 miles from their school.)

Link to the World

20 Minutes

Particle accelerators are an exciting new device used to change the movement of atomic particles. They accelerate particles such as electrons and protons, and give them extremely high energy levels. Ask students if they can think of some uses for particle accelerators, also known as atom smashers. Have they heard about any uses of particle accelerators on television or in other news mediums? If so, what did they hear?

(Particle accelerators are used to help scientists learn more about the structures of atoms. They are also used in powerful X-ray machines that can detect flaws in things such as aircraft parts. In addition, particle accelerators are used in medicine to detect and treat illnesses. Finally, particle accelerators are used to develop atomic weapons.)

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Writing

Extended Time

Each of the scientists listed below added their own contributions to our understanding of atomic structure. Ask students to choose one of the scientists listed. Have them investigate the theories proposed by their chosen person. After their research, ask students to imagine that they are their chosen person. They must summarize their theories in writing, using words and explanations that ordinary citizens can understand.

If time allows, ask for volunteers to present their summaries while taking on the roles of the historic scientists. Other students might voice opposition to the scientists' ideas or ask questions. Scientists might also debate with one another. Encourage the class to participate in a historical discussion on atomic structure as it might have actually occurred.

John Dalton
Sir Joseph John Thomson
Ernest Rutherford
Niels Bohr
Sir James Chadwick
Lise Meitner

Extended Activity

20 Minutes

An exciting new area in the study of atomic science is antimatter. Antimatter is matter composed of particles that are the opposite of ordinary particles. For instance, the electron's antiparticle is known as a positron because, unlike normal electrons, it has a positive charge. When these antiparticles combine, they release a tremendous amount of energy. In addition to positrons, scientists have produced antiprotons and antineutrons. They are now trying to combine these particles to form antimatter. How might antimatter be useful to humans? Do students think antimatter exists anywhere on Earth or in the universe?

(Antimatter, if it existed, would appear similar to regular matter. However, if antimatter combined with regular matter, both would disappear and produce a great amount of energy. This could be useful in the development of powerful new energy sources, perhaps for space travel. Antimatter does not exist on Earth, but some scientists believe that it exists in space. Astronomers have witnessed colliding galaxies which release huge amounts of energy. This energy could be the result of antimatter combining with matter.)

Culminating Activity

45 Minutes

Ask each student to choose an element from the periodic table. Using the information found there, including atomic mass (or number of protons) and electron configuration, have students draw a detailed diagram of the element's typical atom. Encourage students to use colored pencils to distinguish between atomic particles, and have them label the important parts of the atom.

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VOCABULARY

The following terms are from *Atomic Structures: Mapping an Invisible World*. Fill in the number of each term next to its closest definition.

1. alpha particles
2. atom
3. beta particles
4. electron
5. element
6. fission
7. fusion
8. half-life
9. isotopes
10. mass
11. neutron
12. proton

___ any substance that cannot be separated into different substances by ordinary chemical methods

___ positively charged, high-energy particles released by the nucleus of a radioactive atom when the atom undergoes a nuclear transformation

___ joining of the nuclei of two atoms to form the nucleus of a heavier element

___ smallest particle of an element that contains the properties of that element

___ uncharged elementary particle of an atom with the same mass as a proton

___ electrons given off by the nucleus of a radioactive atom when the atom undergoes a nuclear transformation

___ splitting of the nucleus of an atom into two nearly equal parts

___ atoms of an element that have more or less neutrons than normal

___ positively charged particle found in the nucleus of an atom which determines atomic number

___ elementary particle that orbits the nucleus of an atom

___ measurement of the rate at which radioactive isotopes decay

___ quantity of matter in a body as measured by its inertia

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CHECKING COMPREHENSION

Read the following sentences and circle the letter of the word that best fills each blank.

Much of what we know about atomic structure today is the result of indirect observation of atoms and the ___1___ that compose them. The Greek philosopher ___2___ was the first to propose that matter was composed of atoms. He realized that the forces that hold together the ___3___ cannot be divided except by the most powerful reactions. When the nucleus of an atom is split apart in a process called ___4___ , tremendous energy is released. ___5___ are one example of this tremendous energy. The English chemist ___6___ developed the first model of an atom in 1803. He believed that all atoms of the same ___7___ were alike in both shape and mass. Later, J.J. Thomson discovered a stream of negatively charged particles known as ___8___ . Lord Rutherford discovered that atoms were mostly comprised of ___9___ . He also indicated that the small, dense positively charged central portion of an atom was comprised of particles known as ___10___ .

1. A. elements
   B. isotopes
   C. alpha rays
   D. particles

2. A. Democritus
   B. Bohr
   C. Rutherford
   D. Thomson

3. A. beta rays of an atom
   B. octets of isotopes
   C. nucleus of an atom
   D. particles of a charged cloud

4. A. radiation
   B. fission
   C. gamma separation
   D. octet splitting

5. A. Nuclear weapons
   B. Solar panels
   C. Electrical generators
   D. Transformers

6. A. Lord Rutherford
   B. Niels Bohr
   C. John Dalton
   D. Albert Einstein

7. A. radiation level
   B. element
   C. half-life
   D. atomic mass

8. A. electrons
   B. protons
   C. neutrons
   D. isotopes

9. A. electrons
   B. octets
   C. gamma rays
   D. empty space

10. A. beta particles
    B. protons
    C. electrons
    D. plasmatrons

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Name

MATTER MATCH-UP

Match each term on the left with the best group of words on the right.

1. Niels Bohr
2. Sir William Crookes
3. John Dalton
4. Democritus
5. gamma rays
6. Lord Rutherford
7. orbit
8. particle
9. radiation
10. J.J. Thomson

form of energy that in nature comes from rocks, minerals, the sun and other objects in space

physicist who conducted experiments that indicated atoms were largely made up of space

scientist who proposed that electrons could orbit an atom without radiating energy

chemist who developed the first model of the atom in 1803

form of electromagnetic radiation similar to x-rays, but with a much shorter wavelength

piece of matter so small it has inertia and the force of attraction, but no magnitude

Greek philosopher who was the first to propose that matter is composed of atoms

English scientist who discovered electrons

developed a vacuum tube that was used to conduct particle experiments

path of an object that moves under the influence of a central force

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____
Name

TRUE OR FALSE

Place a T next to statements that are true and an F next to statements that are false.

1. ____ The charged cloud model represents electrons as being part of a diffused cloud of varying densities.
2. ____ The configuration of an atom's protons determines all of its chemical and physical properties.
3. ____ The noble gases are the most non-reactive elements in nature.
4. ____ The presence of an octet makes an atom very likely to react with other elements.
5. ____ The atomic number of an element is determined by its number of protons.
6. ____ The number of neutrons in the atom of a given element can change.
7. ____ Atoms of an element that have different numbers of electrons are known as isotopes.
8. ____ The AMU is used to measure how many electrons are present in the outer shell of an atom.
9. ____ Radioactive elements are those in which the atoms' nuclei disintegrate and emit energy.
10. ____ A beta particle is an electron or positron ejected from a nucleus at high speed.

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FILL IN THE BLANKS

Use the following words to fill in the blanks below.

AMU
fusion
half-life
isotopes
neutron
octet
protons
radioactive

1. The configuration of eight electrons in the outer level of an atom is called the __________________ .
2. __________________ determine the atomic number of an atom.
3. The number of __________________ in the atoms of a particular element can vary.
4. __________________ is a unit that measures the mass of at atom.
5. __________________ materials emit alpha particles, beta particles and gamma rays.
6. Atoms of an element that have different numbers of neutrons are called __________________ .
7. The joining together of atomic particles in a process called __________________ creates the energy that powers life on Earth.
8. The __________________ of an element is a measurement of the rate at which radioactive isotopes decay.

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PROTON, ELECTRON OR NEUTRON

For each clue below, write a P if the clue is describing a proton, an E if the clue is describing an electron, and an N if the clue is describing a neutron.

1. ____ Has a neutral charge
2. ____ Arranged in shells
3. ____ Has the same weight as a proton
4. ____ Lightest of the atomic particles
5. ____ Has a positive charge
6. ____ Atomic number is determined by these
7. ____ Has a negative charge
8. ____ Determines the stability and behavior of an element
9. ____ An extra one of these creates an isotope
10. ____ Has virtually no effect on an atom's mass

Name

WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally or backward.

electron
element
fission
fusion
half-life
isotope
mass
neutron
octet
proton

A	N	H	M	U	N	O	I	S	S	I	F
G	E	D	A	C	E	E	N	Q	H	S	S
L	L	K	S	G	U	P	A	H	D	O	B
O	E	O	S	P	T	K	G	A	L	T	Z
D	C	A	R	C	R	H	X	L	W	O	M
T	T	P	L	V	O	Q	O	F	K	P	S
P	R	O	T	O	N	A	W	L	B	E	Z
S	O	T	R	M	Z	J	Q	I	O	L	N
R	N	C	P	Q	L	Y	D	F	R	C	Y
B	N	V	T	E	L	E	M	E	N	T	W
T	R	E	B	E	B	F	U	S	I	O	N
Q	M	C	R	J	T	C	N	Y	C	Z	J

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TEST

Circle the phrase which best answers each question.

1. Since direct observation of atoms is almost impossible, scientists rely on:

    - microscopes.
    - proton beams.
    - models.
    - x-rays.

2. Dalton and Thomson theorized that atoms were:

    - divisible.
    - indivisible.
    - unstable.
    - highly reactive.

3. Lord Rutherford found that atoms contain dense central portions called:

    - neutrons.
    - electrons.
    - nuclei.
    - protons.

4. The Charged Cloud model describes _______ as being part of a diffused cloud of varying densities.

    - atoms
    - protons
    - neutrons
    - electrons

5. The configuration of eight electrons in the outer orbit of an atom is:

    - an atomic number.
    - an isotope.
    - an octet.
    - an atomic mass.

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TEST (CONTINUED)

6. Atoms of an element with different numbers of neutrons are:

   - isotopes.
   - gamma rays.
   - ground level states.
   - noble atoms.

7. The atoms of radioactive elements emit energy after their:

   - nuclei disintegrate.
   - protons split.
   - electrons disperse.
   - neutrons become positively charged.

8. The joining together of atomic particles is a process called:

   - conduction.
   - fusion.
   - particle assimilation.
   - fission.

9. Half-life is the amount of time it takes one half of _______ to decay.

   - an atom
   - a charged particle
   - a neutron
   - a radioactive substance

10. If heat or electrical energy is added to an atom, the electrons in the atom will:

    - be absorbed.
    - increase in number.
    - remain stable.
    - move to a higher energy level.

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ANSWER KEY for page 18

VOCABULARY

The following terms are from *Atomic Structures: Mapping an Invisible World*. Fill in the number of each term next to its closest definition.

1. alpha particles
2. atom
3. beta particles
4. electron
5. element
6. fission
7. fusion
8. half-life
9. isotopes
10. mass
11. neutron
12. proton

5 any substance that cannot be separated into different substances by ordinary chemical methods

1 positively charged, high-energy particles released by the nucleus of a radioactive atom when the atom undergoes a nuclear transformation

7 joining of the nuclei of two atoms to form the nucleus of a heavier element

2 smallest particle of an element that contains the properties of that element

11 uncharged elementary particle of an atom with the same mass as a proton

3 electrons given off by the nucleus of a radioactive atom when the atom undergoes a nuclear transformation

6 splitting of the nucleus of an atom into two nearly equal parts

9 atoms of an element that have more or less neutrons than normal

12 positively charged particle found in the nucleus of an atom which determines atomic number

4 elementary particle that orbits the nucleus of an atom

8 measurement of the rate at which radioactive isotopes decay

10 quantity of matter in a body as measured by its inertia

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ANSWER KEY for page 19

CHECKING COMPREHENSION

Read the following sentences and circle the letter of the word that best fills each blank.

Much of what we know about atomic structure today is the result of indirect observation of atoms and the ___1___ that compose them. The Greek philosopher ___2___ was the first to propose that matter was composed of atoms. He realized that the forces that hold together the ___3___ cannot be divided except by the most powerful reactions. When the nucleus of an atom is split apart in a process called ___4___ , tremendous energy is released. ___5___ are one example of this tremendous energy. The English chemist ___6___ developed the first model of an atom in 1803. He believed that all atoms of the same ___7___ were alike in both shape and mass. Later, J.J. Thomson discovered a stream of negatively charged particles known as ___8___ . Lord Rutherford discovered that atoms were mostly comprised of ___9___ . He also indicated that the small, dense positively charged central portion of an atom was comprised of particles known as ___10___ .

1. A. elements
   B. isotopes
   C. alpha rays
   [✓ D.] particles

2. [✓ A.] Democritus
   B. Bohr
   C. Rutherford
   D. Thomson

3. A. beta rays of an atom
   B. octets of isotopes
   [✓ C.] nucleus of an atom
   D. particles of a charged cloud

4. A. radiation
   [✓ B.] fission
   C. gamma separation
   D. octet splitting

5. [✓ A.] Nuclear weapons
   B. Solar panels
   C. Electrical generators
   D. Transformers

6. A. Lord Rutherford
   B. Niels Bohr
   [✓ C.] John Dalton
   D. Albert Einstein

7. A. radiation level
   [✓ B.] element
   C. half-life
   D. atomic mass

8. [✓ A.] electrons
   B. protons
   C. neutrons
   D. isotopes

9. A. electrons
   B. octets
   C. gamma rays
   [✓ D.] empty space

10. A. beta particles
    [✓ B.] protons
    C. electrons
    D. plasmatrons

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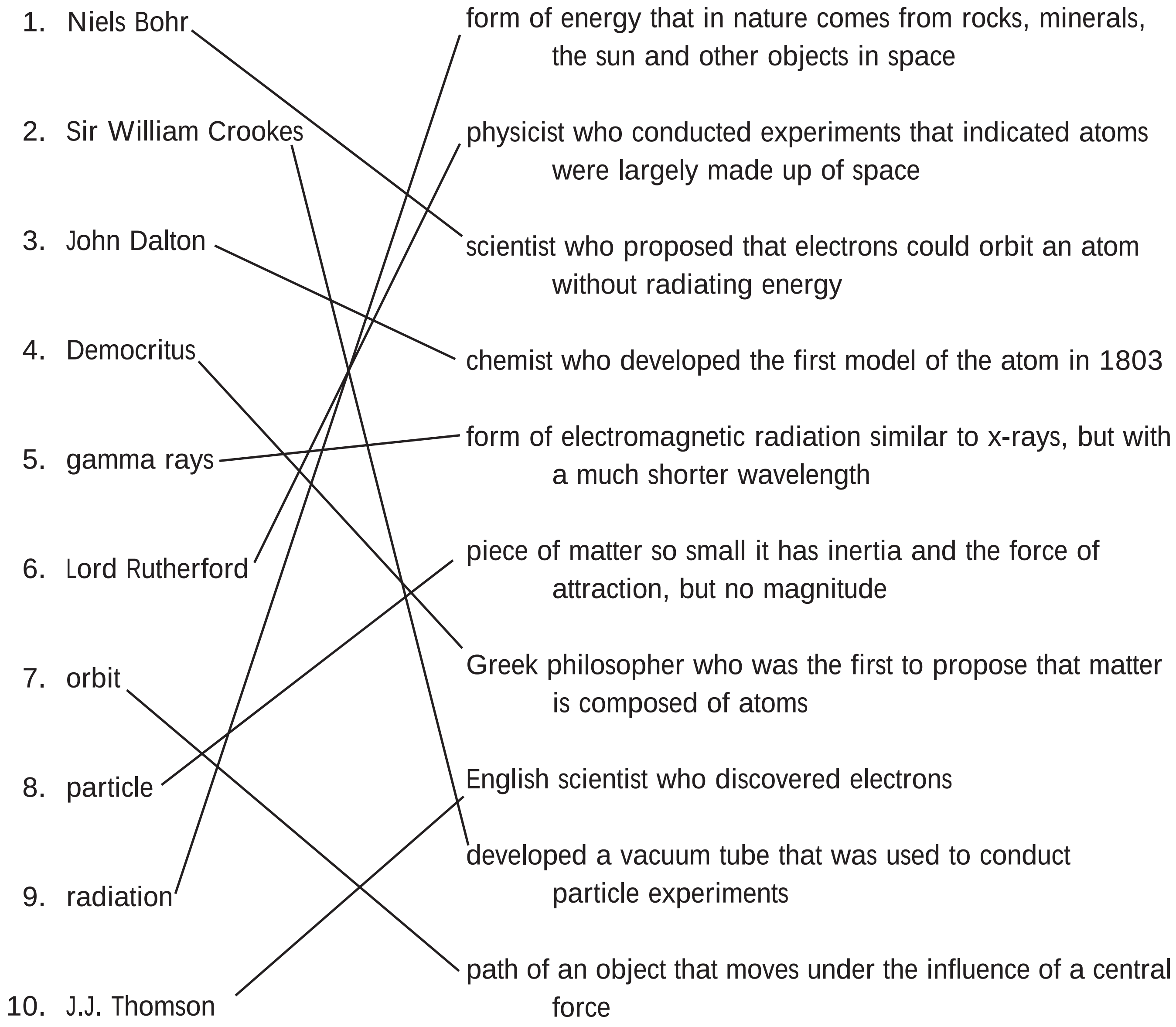
ANSWER KEY for page 20

MATTER MATCH-UP

Match each term on the left with the best group of words on the right.



1. Niels Bohr	form of energy that in nature comes from rocks, minerals, the sun and other objects in space
2. Sir William Crookes	physicist who conducted experiments that indicated atoms were largely made up of space
3. John Dalton	scientist who proposed that electrons could orbit an atom without radiating energy
4. Democritus	chemist who developed the first model of the atom in 1803
5. gamma rays	form of electromagnetic radiation similar to x-rays, but with a much shorter wavelength
6. Lord Rutherford	piece of matter so small it has inertia and the force of attraction, but no magnitude
7. orbit	Greek philosopher who was the first to propose that matter is composed of atoms
8. particle	English scientist who discovered electrons
9. radiation	developed a vacuum tube that was used to conduct particle experiments
10. J.J. Thomson	path of an object that moves under the influence of a central force

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ANSWER KEY for page 21

TRUE OR FALSE

Place a T next to statements that are true and an F next to statements that are false.

1. __T__ The charged cloud model represents electrons as being part of a diffused cloud of varying densities.
2. __F__ The configuration of an atom's protons determines all of its chemical and physical properties.
3. __T__ The noble gases are the most non-reactive elements in nature.
4. __F__ The presence of an octet makes an atom very likely to react with other elements.
5. __T__ The atomic number of an element is determined by its number of protons.
6. __T__ The number of neutrons in the atom of a given element can change.
7. __F__ Atoms of an element that have different numbers of electrons are known as isotopes.
8. __F__ The AMU is used to measure how many electrons are present in the outer shell of an atom.
9. __T__ Radioactive elements are those in which the atoms' nuclei disintegrate and emit energy.
10. __T__ A beta particle is an electron or positron ejected from a nucleus at high speed.

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ANSWER KEY for page 22

FILL IN THE BLANKS

Use the following words to fill in the blanks below.

AMU
fusion
half-life
isotopes
neutron
octet
protons
radioactive

1. The configuration of eight electrons in the outer level of an atom is called the **octet** .
2. **Protons** determine the atomic number of an atom.
3. The number of **neutrons** in the atoms of a particular element can vary.
4. **AMU** is a unit that measures the mass of at atom.
5. **Radioactive** materials emit alpha particles, beta particles and gamma rays.
6. Atoms of an element that have different numbers of neutrons are called **isotopes** .
7. The joining together of atomic particles in a process called **fusion** creates the energy that powers life on Earth.
8. The **half-life** of an element is a measurement of the rate at which radioactive isotopes decay.

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ANSWER KEY for page 23

PROTON, ELECTRON OR NEUTRON

For each clue below, write a P if the clue is describing a proton, an E if the clue is describing an electron, and an N if the clue is describing a neutron.

1. N Has a neutral charge
2. E Arranged in shells
3. N Has the same weight as a proton
4. E Lightest of the atomic particles
5. P Has a positive charge
6. P Atomic number is determined by these
7. E Has a negative charge
8. E Determines the stability and behavior of an element
9. N An extra one of these creates an isotope
10. E Has virtually no effect on an atom's mass

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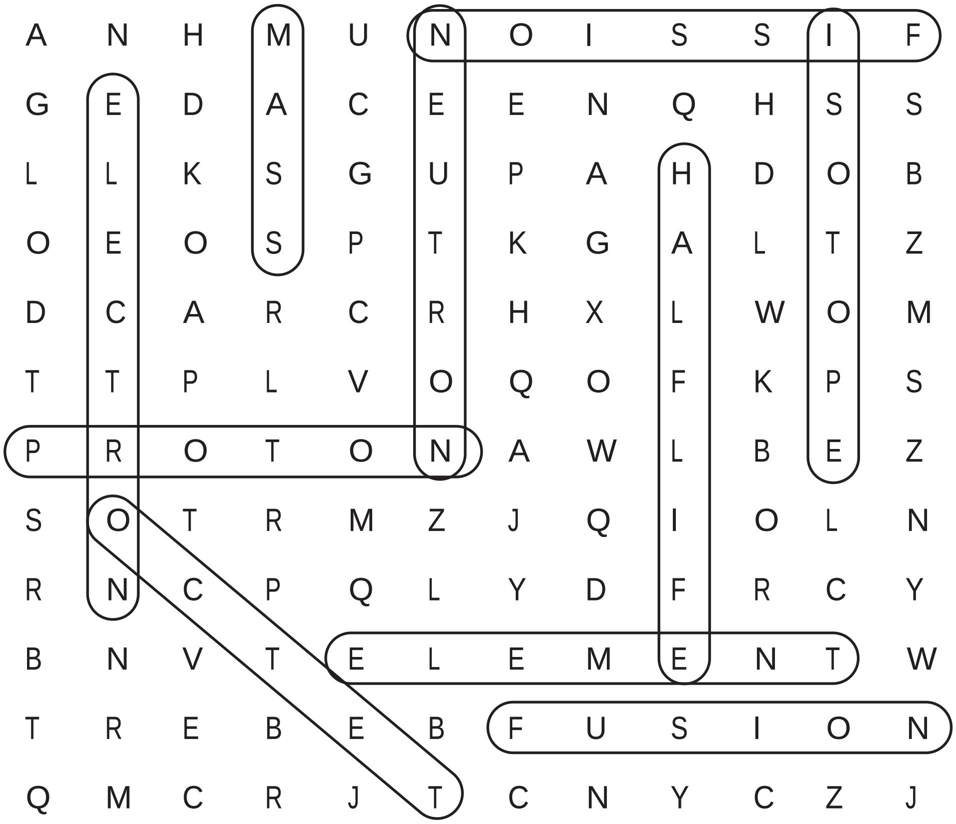
ANSWER KEY for page 24

WORD SEARCH

The following words can be found in the maze below. The letters may be arranged horizontally, vertically, diagonally or backward.

electron
element
fission
fusion
half-life
isotope
mass
neutron
octet
proton



A	N	H	M	U	N	O	I	S	S	I	F
G	E	D	A	C	E	E	N	Q	H	S	S
L	L	K	S	G	U	P	A	H	D	O	B
O	E	O	S	P	T	K	G	A	L	T	Z
D	C	A	R	C	R	H	X	L	W	O	M
T	T	P	L	V	O	Q	O	F	K	P	S
P	R	O	T	O	N	A	W	L	B	E	Z
S	O	T	R	M	Z	J	Q	I	O	L	N
R	N	C	P	Q	L	Y	D	F	R	C	Y
B	N	V	T	E	L	E	M	E	N	T	W
T	R	E	B	E	B	F	U	S	I	O	N
Q	M	C	R	J	T	C	N	Y	C	Z	J

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ANSWER KEY for page 25

TEST

Circle the phrase which best answers each question.

1. Since direct observation of atoms is almost impossible, scientists rely on:

   - microscopes.
   - proton beams.
   - [✓ models.]
   - x-rays.

2. Dalton and Thomson theorized that atoms were:

   - divisible.
   - [✓ indivisible.]
   - unstable.
   - highly reactive.

3. Lord Rutherford found that atoms contain dense central portions called:

   - neutrons.
   - electrons.
   - [✓ nuclei.]
   - protons.

4. The Charged Cloud model describes _______ as being part of a diffused cloud of varying densities.

   - atoms
   - protons
   - neutrons
   - [✓ electrons]

5. The configuration of eight electrons in the outer orbit of an atom is:

   - an atomic number.
   - an isotope.
   - [✓ an octet.]
   - an atomic mass.

ANSWER KEY for page 26

TEST (CONTINUED)

6. Atoms of an element with different numbers of neutrons are:

- [✓ isotopes.]
- gamma rays.
- ground level states.
- noble atoms.

7. The atoms of radioactive elements emit energy after their:

- [✓ nuclei disintegrate.]
- protons split.
- electrons disperse.
- neutrons become positively charged.

8. The joining together of atomic particles is a process called:

- conduction.
- [✓ fusion.]
- particle assimilation.
- fission.

9. Half-life is the amount of time it takes one half of ______ to decay.

- an atom
- a charged particle
- a neutron
- [✓ a radioactive substance]

10. If heat or electrical energy is added to an atom, the electrons in the atom will:

- be absorbed.
- increase in number.
- remain stable.
- [✓ move to a higher energy level.]

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