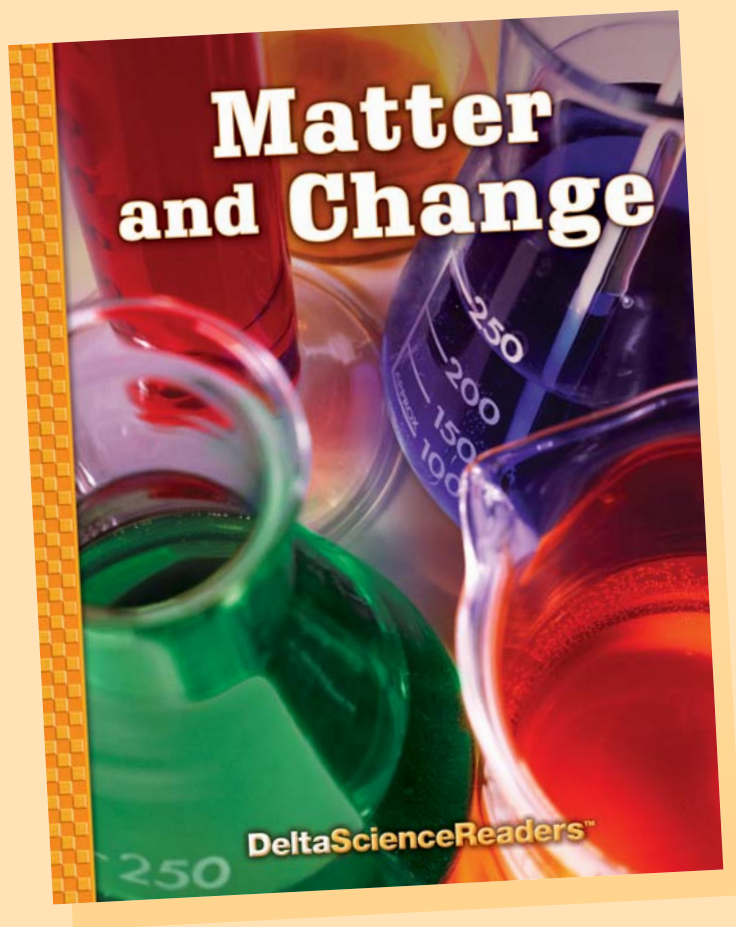


Delta Science Reader *Matter and Change* Teacher's Guide



In the Delta Science Reader *Matter and Change*, students find out about atomic structure, characteristics of subatomic particles, and different kinds of chemical bonds. They also read about elements and compounds and learn how elements are arranged in the periodic table. They trace changes of state between solid and liquid and between liquid and gas. Students also learn to distinguish physical properties and changes from chemical properties and changes. They read about activation energy, catalysts and inhibitors, and acids and bases. A biographical sketch introduces students to Marie Curie and radioactive elements. Finally, students find out about the history of the atomic model.

DELTA SCIENCE READERS for grades 6–8 are content-rich, 24-page informational texts that present key science concepts and vocabulary. They cover important science topics in an accessible, engaging format.

TEACHER'S GUIDES for Delta Science Readers for grades 6–8 contain general background information for linking science and literacy, assessment, and including all learners, as well as a comprehensive teaching plan. The teaching plan features three-step lessons and spotlight panels on science, literacy, and meeting individual needs.

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INTRODUCTION

Delta Science Readers for grades 6–8 are content-rich, 24-page informational texts. Based on key science standards for the topic, they are used in conjunction with hands-on kits or as stand-alone texts.

As students reach middle school, their reading abilities and knowledge of literacy skills and strategies greatly affect their success in understanding informational text. Middle school readers often need guidance in reading for information, especially as the content load of the text increases and becomes more complex. This guide provides the middle school teacher with both science and literacy support to help students learn.

Science and Literacy

Delta Science Readers are outstanding resources for building both science knowledge and literacy skills and strategies. Students interacting with informational text are exploring language fully, exercising all four aspects of literacy: reading, writing, speaking, and listening.

Reading Informational Text

Reading to gain information is markedly different from reading for literary experience or to perform a task. Informational text is often read nonlinearly, or selectively. From section to section, the difficulty level, concentration of new vocabulary, structural pattern, and unfamiliarity of content may vary. Use the following guidelines to help your students get the most out of reading nonfiction text.

Prereading. Help students anticipate content and predict learning outcomes before they begin to read. Always preview informational text with students so that they can develop a focused purpose for reading and be able to answer the question, “Why am I reading this?”

Reading Strategically. A number of reading strategies support the comprehension of science text, in part because of the strong relationship between science and reading comprehension skills. The following comprehension skills are common to both reading and science:

- Identify main ideas and supporting details
- Compare and contrast
- Relate cause and effect
- Trace a sequence of events
- Draw conclusions based on evidence
- Demonstrate critical thinking
- Generate questions
- Summarize information
- Interpret graphics
- Recognize patterns and relationships
- Make predictions

Some of these skills are applied in the process of extracting and processing information. Others are applied in more demanding ways as students evaluate, analyze, interpret, and synthesize ideas.

Monitoring Comprehension. Help students read actively. Active readers think about the organization and presentation of information and monitor their own comprehension. Provide these tips: reread difficult passages; vary the pace of reading; stop and think about a passage; ask questions; think aloud while reading; take notes; make a prediction about what will come next; or paraphrase what has been read. Also, some students can process and share information better when paired with a reading partner.

Using Graphic Organizers. Graphic organizers are diagrams that show the relationships among ideas. Unlike traditional outlines, graphic organizers are visual representations. They show, rather than tell about, associations among important facts and supporting details. Encourage students to create their own graphic organizers. The most effective ones are those generated by students themselves as they interact with information. Useful formats include the KWL chart (see p. T1), concept web, T-chart, Venn diagram, flowchart, and cycle chart.

Keeping Science Notebooks. Responding to informational text in writing promotes higher levels of understanding. Students should use their notebooks for all writing related to the topic. This can include graphic organizers, vocabulary lists, predictions, questions, observations, labeled illustrations and diagrams, personal discoveries, activity sheets, and note taking.

Building Science Vocabulary

Studying science involves learning specialized vocabulary terms. It may also mean relearning familiar words that have different meanings in science. Help students acquire new science vocabulary through multiple activities. Examples include analyzing word parts, understanding word origins, identifying word families, crafting definitions in their own words, role-playing or illustrating definitions, connecting new words to known words, using context clues, and using science language as they write and talk about science topics.

Previewing Vocabulary. When previewing the boxed vocabulary words for each section, you may wish to focus on the terms most critical to your curriculum needs. You may also wish to have students work in pairs or in small groups to share their ideas about words and meanings.

It is important for students to keep written records of their growing science language in their science notebooks. You may begin this record during the vocabulary preview, using any of the following ideas or your own method:

- Have students sort the vocabulary words into lists of terms they know and don't know. As they read and learn, the "Know" list should grow and the "Don't Know" list should shrink.
- Ask a volunteer to read the words out loud so students can hear correct pronunciations.
- Group related words together in a chart.
- Identify words with familiar roots, prefixes, or suffixes.
- Note familiar words that have a special or different meaning in science.
- Let students select one vocabulary word they know and illustrate it or use it in an original sentence.

Reading and Vocabulary Growth. Support the natural link between science and literacy by making your science classroom a library as well as a laboratory. Make available other kinds of reading material about the topic in addition to the Delta Science Readers. Examples include nonfiction trade books, newspaper and journal articles, computer printouts from validated and reliable sources, textbooks, reference books such as almanacs and encyclopedias, posters, CD-ROMs, and so on. Seeing science concepts and vocabulary used in other contexts reinforces understanding.

See the **Glossary** pages, T23–T24, for many additional suggestions on building vocabulary.

Assessment Features

Students' knowledge and skills should be assessed in as many modalities as they are taught so that all students can show what they know. This Delta Science Reader teacher's guide offers a variety of tools and strategies for measuring student achievement throughout the learning process.

Preassessment Preassessments take place prior to learning and provide information on students' awareness and experience regarding the topics.

- **Access Prior Knowledge**—informal assessments of students' entry-level understanding.

Ongoing Assessment Ongoing, formative assessments are integrated into the daily teaching and learning process. They not only measure ongoing student progress but also provide insights for reshaping and improving instruction.

- **Read to Understand Questions**—self-assessments or more formal evaluations of student mastery of key concepts. Suggested answers are provided.
- **Alternative Assessments**—additional choices, usually nonverbal, that provide other ways for students to demonstrate competencies.
- **Meeting Individual Needs**—teaching ideas that serve as assessments for students who have difficulty communicating fluently.
- **Answers to Caption Questions**—self-assessments related to student interpretation of graphic elements.
- **Notebooks**—student responses to science text and experiences that reveal growth in level of understanding and ability to organize ideas.

Postassessment Postassessments, or summative assessments, are opportunities for students to demonstrate what they have gained as a result of the learning experience.

- **Review and Reflect**—summative assessments that show the degree to which students can recognize patterns and understand relationships in the overall subject matter.
- **Writing Links**—writing assignments that require students to apply and communicate knowledge.
- **Cover to Cover**—opportunity for students to synthesize learning by comparing and contrasting front and back cover photographs.
- **Unit Test**—selected-response and short-answer questions (with answer key), provided with this teacher's guide, that measure comprehension of key science vocabulary and concepts.

Including All Learners

All students can be active participants in the scientific process and can become scientifically literate citizens. Further, all teachers can successfully guide students to learn and enjoy science. Making science content universally accessible may require implementing different instructional strategies and accommodating multiple intelligences. The guidelines listed below will help you meet the challenges of your diverse classroom.

Hands-on Science

The science classroom is an ideal environment for diverse learners because of its reliance on hands-on exploration of the world. Research has shown that all students are highly motivated to learn science when actively engaged in hands-on activities. Hands-on investigations are therefore an essential component of science education. Hands-on, inquiry-based science helps extend the reach of instruction to all students while enhancing and reinforcing student learning.

English Language Learners

When reading informational science text, English Language Learners (ELLs) are confronted with the challenge of learning content while becoming proficient in English. They may have the cognitive ability to perform in class and understand scientific meanings, but they may be unable to communicate, by reading, writing, speaking, or even listening, with proficiency and confidence. Using effective strategies, teachers can make content more accessible while language learners improve their English.

- Reinforce reader content with hands-on activities.
- Simplify vocabulary, not content.
- Allow multiple opportunities to practice new vocabulary.
- Present information orally and visually.
- Allow ELLs to demonstrate science learning nonverbally.
- Assess science comprehension, not English fluency.
- Promote a classroom environment in which students are comfortable sharing ideas and taking risks.

Learners with Special Needs

Individual student needs, abilities, and disabilities vary widely, and the accommodations appropriate for each classroom will be unique. Begin with a student's individual educational plan (IEP). Tailor the presentation, classroom setup, teaching strategy, and materials to ensure student safety and to enable each student to participate as fully as possible.

- Present instruction in the context of real-world situations.
- Pair students who have difficulty reading with friends who read fluently.
- Allow extra time for completing activities.
- Assign one task at a time and give instructions in different ways.
- Introduce new vocabulary in different, meaningful ways.
- Review material more often.
- Repeat other students' comments and questions for everyone to hear clearly.

Advanced Learners

Advanced learners benefit from meaningful assignments that extend and enrich their knowledge of science. Encourage students who readily grasp the basics of science concepts and processes to deepen their explorations. Students performing above grade level can cultivate high levels of science thinking through further research, investigation, or other guided or independent projects.

- Provide enrichment opportunities for students who can and wish to work on independent projects.
- Ask questions that encourage creative or imaginative answers.
- Model thinking that leads to problem solving, synthesizing, analyzing, and decision making.
- Make available more sophisticated resources for exploring the topic.
- Invite students to present their research to the class in a format of their choosing.

See the **Meeting Individual Needs** spotlight panels throughout this guide for specific suggestions for including English Language Learners, learners with special needs, and advanced learners.

About the Teaching Plan

The format and content of the three-step lesson plans and spotlight panels for each **Think About . . .** section in the student book are described below. Use the suggestions and strategies as appropriate for your teaching style and the needs of your students.

Three-step Lesson Plan

The lesson plan for each section begins with a list of **learning objectives**. The final objective in each list highlights one reading skill that promotes science comprehension.

1 Before Reading Before-reading strategies set the stage for reading each section. Prereading efforts are particularly important with informational text because the reader will encounter new and complex ideas, different text forms and structures, and unfamiliar vocabulary. Make the process less daunting by accessing prior knowledge and previewing the section.

Access Prior Knowledge. These discussion prompts help you engage and motivate students by linking the main ideas students will read about to their existing knowledge and experiences. In some cases, it may be appropriate to identify and address common misconceptions about the topic at this point.

Preview the Section. This is a “walk-through” of the section content and vocabulary. Point out or discuss the boxed Read to Understand questions and vocabulary words. These indicate the main topics and key terms covered in the section. Also, look together at the section title and subheads. Based on the preview, students can generate questions, make predictions, and set a purpose for reading this section.

2 Guide the Learning Help students interact with the text, monitor comprehension, and integrate new ideas with existing knowledge as they read. A variety of grouping strategies is suggested so that students may benefit from collaborative learning.

Discuss and Explore. These questions elicit student responses that demonstrate comprehension of facts and concepts. The science and literacy skills developed during reading include

- relate cause and effect
- identify the main idea and supporting details
- trace a sequence of events

- compare and contrast
- describe
- predict

Critical Thinking. These questions challenge students to dig deeper and exercise higher-order thinking skills, such as

- infer
- draw conclusions
- interpret
- summarize
- generate questions

3 Assess After-reading assessments for each **Think About . . .** section include

Read to Understand Answers. Sample answers to the Read to Understand questions are provided. The questions can function either as informal self-assessments for students or as part of an ongoing written or oral assessment of student progress.

Alternative Assessment. These assessment opportunities, such as hands-on demonstrations or visual presentations, accommodate multiple learning and communication modes.

*This teacher’s guide offers opportunities for multiple measures of student progress. See **Assessment Features**, p. Tiii, for additional tools.*

Spotlight Panels

Special feature boxes appear on each page to provide additional support.

Science. Additional science background information, historical perspectives, and facts and figures of interest that support science instruction and can be shared with students as appropriate.

Literacy. Ideas for strengthening literacy skills in the areas of reading comprehension, vocabulary, notebooking, organizing ideas, and using the visuals.

Meeting Individual Needs. Suggestions for making science content and vocabulary accessible to English Language Learners and students with special needs and for including and challenging advanced learners.

*Teaching pages for **People in Science** and **Did You Know?** also offer suggestions for activating prior knowledge and building comprehension and include science spotlight panels. The Glossary pages provide many helpful vocabulary-building strategies.*

TEACHING *Matter and Change*

The Delta Science Reader ***Matter and Change*** presents the key science concepts related to matter, physical properties, and chemical properties. The book provides opportunities for students to engage in science inquiry by applying literacy skills and strategies to informational text. Students explore science as they develop informational literacy.

Build Background

Front Cover. Assess students' prior knowledge of matter and change by displaying the front cover and discussing the title. *What do you observe in this photograph?* (Possible answer: laboratory equipment and colored liquids) Students may recognize the containers as beakers, a flask, and a graduated cylinder. *What do you think the colored liquids are?* (possibly different kinds of chemicals) *What "matter" is shown on the cover?* (the liquids, the glass containers, the table top) *What is the purpose of the numbers on the containers?* (They show units of measurement, such as milliliters.) *Would you drink the liquids pictured?* (Students should know *never* to taste an unknown substance.)

Encourage students to share what they know about matter and change from their personal experiences and from previous hands-on explorations in science. Stimulate discussion with questions such as *What is matter? Point to some matter in the classroom. What are some ways that matter can change? When and why does matter change? Can we make some matter change right now? What do you recall from other science investigations of matter and change?*

Such discussions help students make connections between what they already know and new information that will be presented in the book.

Matter and Change

DeltaScienceReaders™

Based on the title and cover, have students predict what they might learn in this book.

Preview the Book

In a preview, students scan the book quickly to see the structure and to find the main topics and most important text features. Have students preview *Matter and Change* before reading.

Roadmap for Reading. Tell students that previewing is like looking at a map before taking a trip. It helps us know where we are going! Using a preview to anticipate content increases student interest in the material to be studied. For that reason, a preview is a vital part of reading for information, or nonfiction reading. Use the preview to activate prior knowledge, make predictions about what the text will present, and set a purpose for reading.

Matter and Change

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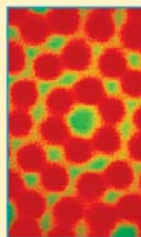
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For each new feature students identify, have them ask questions: Why are these [boxes] here? What are the purposes of [map keys]? How do these [boldface words] help us understand the topic? What if the book did not have [labels]?

Start a KWL Chart

Have students make a four-column KWL chart in their science notebooks. Based on the book's title and their preview, have them fill in the first two columns—What I Know (K) and What I Want to Know (W). Have students fill in the third column, What I Learned (L), as they work through the book. After students have finished reading about each topic, they can fill in the last column with questions they still have about the topic.

Conceptual Framework

Help students make meaning of the content covered in *Matter and Change* by building a conceptual framework—a theme around which they can organize ideas and information. For this topic, such a framework might be **The chemical nature of matter affects its behavior.**

Table of Contents. Begin the preview with the table of contents. Think of the table of contents as an outline of the book. It lists the different parts of the book and the topics covered in each part. Page numbers are given for the main section headings. After students have skimmed the table of contents, ask if they have ever studied any of these topics before. Look at the photographs on the contents page. Can students guess where in the book they might find out about the objects pictured?

Text Features. Next, have students “walk through” the book. Ask them to look at the headings, subheadings, and graphics (photographs, diagrams, captions, illustrations, labels, graphs, and tables) and tell why they are helpful. Focus their attention on organizational features such as the boxed Read to Understand questions, boxed Vocabulary lists, boldface words, and Glossary.

All matter is made up of tiny building blocks called atoms. Atoms bond in different ways to form elements and compounds that have different characteristics. The arrangement and movement of particles of matter determine all of a substance's physical and chemical attributes.

Begin by discussing students' common experiences of observing differences between objects and materials—size, shape, texture, color, weight, and so on. Help students develop thoughtful and thorough descriptions of physical properties, beyond the obvious size, shape, and color distinctions. What do the physical properties reveal about the chemical makeup? How is this matter interacting with other matter? Is the interaction physical or chemical? As students read, they can relate their learning about matter and change to the framework.

OBJECTIVES

(pages 2–8)

- Understand the structure of the atom, and describe the three main types of subatomic particles.
- Explain how the elements are arranged in the periodic table.
- Contrast elements and compounds, and describe the characteristics of a compound.
- Identify the three ways atoms can form chemical bonds.
- Use reading skills such as comparing and contrasting to achieve science comprehension.

1 Before Reading

Access Prior Knowledge

Ask students questions to elicit their ideas about what makes up matter. *What is the smallest object you can think of?* (Students may suggest a grain of salt or speck of dust.) *Is that tiny object made up of anything smaller?* (Accept all ideas.)

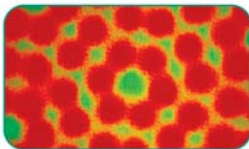
Supply students with colored comics from the Sunday newspaper and hand lenses. Have them look at the comics using the lenses. Ask, *What do the comics look like “close up”?* (lots of tiny dots) Elicit that things we can see and touch are made up of other things too small to see or touch.

Preview the Section

Use the Read to Understand questions to set a purpose for reading (answers on p. T8). Preview the Vocabulary words using one of the methods described on p. Tiii. Remind students that these important words appear in boldface type and are defined in the Glossary. (See pp. T23–T24 for more vocabulary-building ideas.)

Think About . . .

What Makes Up Matter?



▲ **Figure 1** This image of silicon atoms was made by a scanning tunneling microscope.

READ TO UNDERSTAND

- Describe the three kinds of subatomic particles.
- Why is an element's atomic number important?
- How is the periodic table organized?
- What are three ways that atoms can form bonds with one another?

VOCABULARY

matter	nonmetal
atom	metalloid
nucleus	compound
subatomic	chemical formula
proton	chemical bond
neutron	ion
electron	ionic bond
atomic number	metallic bond
mass number	covalent bond
isotope	molecule
valence electron	polar molecule
element	organic compounds
periodic table	hydrocarbon
noble gas	isomer
metal	

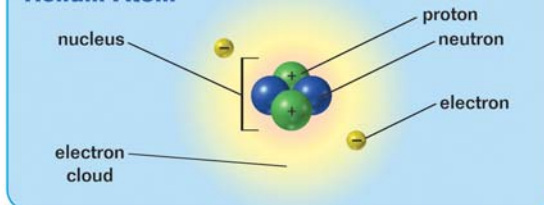
Atoms

Everything around us—water, air, land, and even living things—is made of matter. **Matter** is anything that has mass and takes up space. All matter is made of tiny building blocks called **atoms**. Atoms are so small that we cannot see them, except with powerful microscopes (Figure 1). Scientists have gathered evidence about the structure of atoms by experimenting with how substances behave.

Scientists have found that most of an atom's mass is located in its center, called the **nucleus**. An atom's nucleus is made of smaller, **subatomic** particles called protons and neutrons (Figure 2). A **proton** is a subatomic particle with a positive (+) electric charge. Every atom has at least one proton in its nucleus. The nuclei of most atoms also contain neutrons. **Neutrons** are subatomic particles with no electric charge. They are neutral. A proton and a neutron have about the same mass.

The size of an atom's nucleus is very tiny compared to the size of the whole atom. Most of the area around the nucleus is empty space. An atom's electrons move around in this space. **Electrons** are a third kind of subatomic particle. An electron has a negative (–) electric charge. Imagine that the nucleus of an atom is the size of the period at the end of this sentence. The closest electrons would be moving around it about 50 meters (about 164 feet) away. Electrons have very little mass. An electron is 1,836 times lighter than a proton.

Helium Atom

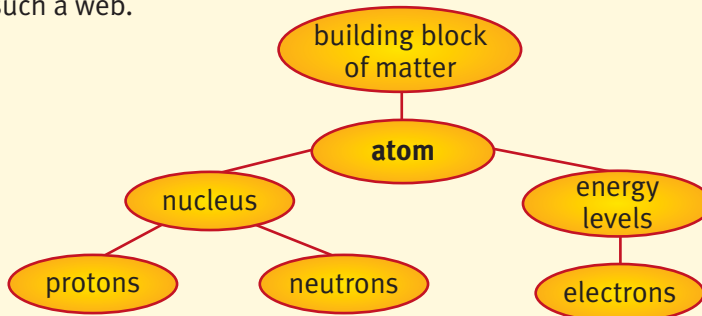


▲ **Figure 2** A helium atom contains two protons, two neutrons, and two electrons. In the model shown, the electron cloud is the region where the electrons are most likely to be located.

2

LITERACY

Organizing Ideas Have students create a concept web to organize the information they learn about atoms. They can begin with **atom** as the key concept. As they read about the structure and properties of atoms, they can add other cells and linking lines to the web to show how these supporting details are related. See the sample below for one way to begin such a web.



When the number of electrons in an atom is equal to the number of protons, the atom as a whole is neutral. The electric charges of the subatomic particles are balanced.

Scientists used to think that electrons revolved around the nucleus in predictable paths, like planets revolving around the Sun. Now we know that this is not true. Instead, electrons move quickly throughout all the space around the nucleus. Scientists show this using a model called the electron cloud model. We cannot know exactly where the electrons are at any given time, but the cloud represents the area where electrons are most likely to be found.

An atom can be identified by the number of protons in its nucleus. This number is called the atom's **atomic number**. For example, a hydrogen (H) atom has one proton in its nucleus, so hydrogen's atomic number is 1. Any atom with only one proton is a hydrogen atom. Helium (He) has two protons, so its atomic number is 2. Lithium (Li) has three protons, so its atomic number is 3, and so on.

The atom's **mass number** of an atom is equal to the number of protons *plus* the number of neutrons in its nucleus. The number of electrons is not included in the mass number because the mass of an electron is so small.

Most oxygen (O) atoms have eight protons and eight neutrons, giving them a mass number of 16. However, not all oxygen atoms have eight neutrons. Atoms of the same type that have different numbers of neutrons are called **isotopes**. Oxygen in the air is a mixture of three different oxygen isotopes.

Recall that electrons are always moving around the nucleus. Their distance from the nucleus depends on how much energy they have. The various positions that electrons can occupy in an atom are called *shells* or *energy levels*. Electrons in the energy levels that are closest to the nucleus have low energy. Electrons in the energy levels that are farther away from the nucleus have higher energy. Each energy level can hold only a certain number of electrons. The electrons in the outermost energy level are called **valence electrons** (Figure 3). The number of valence electrons that an atom has is an important property. It determines the way the atom will join with other atoms.

An atom will gain, lose, or share electrons with other atoms in order to fill its outermost energy level. Most atoms need eight valence electrons to fill their outer level. Hydrogen and helium are two exceptions. They need only two valence electrons to fill their outer level.

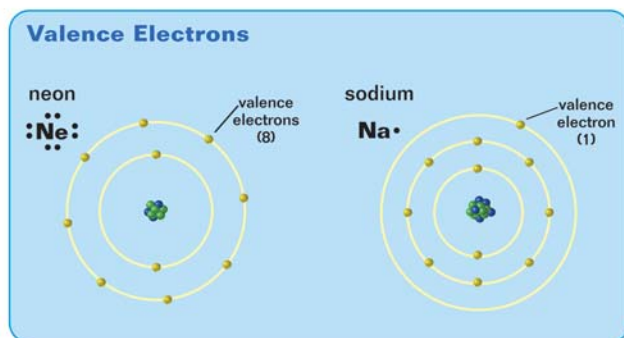


Figure 3
Dot diagrams show the number of valence electrons in an atom. A neon atom has eight valence electrons. To show this, eight dots are positioned, two per side, around neon's chemical symbol, Ne. A sodium atom has only one valence electron. Which kind of atom, neon or sodium, is more likely to join with other atoms in order to have a full outermost energy level?

ADDRESSING MISCONCEPTIONS

Some students may associate the term *matter* only with solids because they can see and hold solid materials. Some students may have difficulty recognizing liquids and gases as matter. Remind students that matter is anything that has mass and takes up space. Blow up a balloon to show that exhaled carbon dioxide gas, though invisible, takes up space. Display a container of water and vegetable oil to show liquids taking up space. Use a balance to measure the mass of liquids and gases by subtracting the mass of the containers.

Answer to Caption Question

Figure 3. sodium

2 Guide the Learning

Discuss and Explore

Vocabulary Have students use a dictionary to find the origin of the word *atom*. (It comes from the Greek word *atomos*, which means “indivisible.”) Be sure students understand that something that is indivisible cannot be broken down into smaller parts. After reading pp. 2–3, do students think that *atom* is an accurate name? Help them see that because an atom is made up of subatomic particles—protons, neutrons, and electrons—it is not “indivisible.” Can they guess why it received that name originally? (See p. 22. The atom was named about 400 B.C.E. by the Greek philosopher Democritus, who reasoned that bits of matter could be broken down into smaller and smaller particles until an “indivisible” particle was reached.)

Visualize Help students try to imagine the size of an atom. Have students draw a line 1 cm long in their science notebooks. How many atoms do they think could “line up” on that line? (50 million)

SCIENCE

History Physicist Ernest Rutherford (1871–1937) performed a series of experiments about 100 years ago that help us understand atomic structure. Rutherford aimed a beam of positively charged particles at a thick sheet of gold foil. Based on earlier models, he predicted that the particles should pass straight through the foil. Most did, but a few particles were deflected. Rutherford realized that an atom must have a concentrated positive charge at its center, which he called the “nucleus.” Since like charges repel each other, the deflected particles had been repelled by a gold atom’s nucleus. Rutherford came up with a model of an atom that was mainly empty space in which electrons move around a nucleus. This concept of the nucleus, containing almost all the mass and all of the positive charge of an atom, was Rutherford’s greatest contribution to science. (On p. 22 students will read about the history of the atomic model.)