Material B

In the *Teacher's Planning Guides*, the Assessing Prior Knowledge sections contain questions whose answers are intended to find out what students already know before instruction. The questions asked in lessons related to the kinetic molecular theory are mostly factual or else peripheral to the ideas examined—e.g., "What is the name given to the smallest pieces of matter? (answer: atoms)" (*Changes in Matter*, p. **6t**, p. **36t**). Sometimes there are relevant questions or tasks in other sections that could help identify students' ideas; however, these questions or tasks are not designated as being for the purpose of assisting teachers to ascertain their students' ideas—e.g., "Students list what they believe is matter and what they would classify as not matter" (*Changes in Matter*, p. **8t**, p. **12t**). Even then, no suggestions are made for probing further, and no examples are provided to help teachers interpret likely student responses. Furthermore, no recommendations are put forward for how teachers can elicit students' ideas about difficult topics such as the particulate nature of matter, the intrinsic motion of particles, the attributes of individual particles versus collections of particles, and the forces between particles.

Introduction pp. 6-11

At a Glance:

The *Introductory Lesson* introduces students to some of the basic building blocks of matter and their interactions.

Suggested pacing: one day

Assessing Prior Knowledge

Before you have students read page 6, ask them the following questions to assess their knowledge of matter.

What is the name given to the smallest pieces of matter? *(atoms)* **What does every object in the universe have in common?** *(All objects are made of atoms; they take up space and have mass and volume.)* **How do you know air is matter?** *(It takes up space, has mass and volume.)*

Theme Connection: Systems and Interactions

The theme linking the major concepts in this unit is Systems and Interactions. Matter is the basic material that makes up the universe. It is composed of elements, and each element has its own special chemical and physical properties and unique atomic structure. Matter can neither be created nor destroyed; only its form can be changed. Through observation, students can identify various types and structures of matter and examine how different kinds of matter interact with each other.

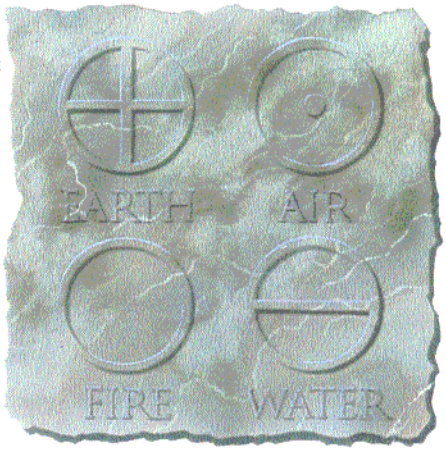
Display one-half cup of milk and one-quarter cup of lemon juice. Ask students to identify the properties of each. Ask them to predict what will happen if the milk and lemon juice interact. Pour the juice into the milk and let it sit for five minutes. Ask students to describe the properties of the resulting mixture. *(The milk changed from a white liquid into a thinner, more watery one with solid clumps.)* Point out that in this unit students will be observing the way many kinds of matter interact and change each other.

Changes In Matter

Every object in the universe—whatever its size, shape, color, or hardness—has one thing in common. Stars, planets, rocks, water, air, and all living things are made of the same fundamental material.

People have been curious about what things are made of for thousands of years. In fact, as far back as 2,500 years ago, the ancient Greeks tried to come up with a system that would help them classify all the matter in the world so they could understand the things around them. For a long time, most Greeks believed there was a simple explanation for all the different forms of matter, and that the four basic elements of soil, air, fire, and water made up the universe. According to this view, all matter consisted of one or more of these four elements.

However, the Greek philosopher Democritus (də mä' kri tus'), developed another theory of matter. He challenged the old concept of matter by asking a new question that no one had thought of before. What would happen, he wondered, if you should cut a piece of iron into smaller and smaller pieces until you could no longer see it? Democritus hypothesized that eventually you would end up cutting the iron into such a small piece (or particle) that it could no longer be cut. Democritus called these tiny particles "atoms" (from the Greek words *a*, meaning "not," and *temnein*, meaning "to divide"). Although Democritus was correct in determining that all matter is composed of atoms, he mistakenly believed that there were different kinds of atoms for each material.



Greek symbols for air, Earth, fire, and water

Scientists in India had another understanding. While they accepted the idea that all matter was created from just a few elements, the Indian scientists developed an atomic theory of their own between A.D. 300 and A.D. 1000. These ancient scholars did not have advanced tools, such as microscopes, to study matter, but they suggested that each type of

More To Explore

Meeting Individual Needs

Modalities/Kinesthetic/Visual

Provide students with popped popcorn and glue or toothpicks. Ask them to use the popcorn as building blocks to create objects. Tell them they can make whatever they want but they cannot use other materials. At the end of the activity, ask students to compare the variety of objects they produced. Draw an analogy between the popcorn and atoms. Point out that atoms are the building blocks of the universe and that all matter consists of atoms.

Lesson 3

ENGAGE

pp. 36-37

At a Glance:

The *Engage* part of this lesson encourages students to compare the scale of outer space to the scale of atoms.

Suggested pacing: one day

Assessing Prior Knowledge

Before students begin reading this lesson ask the following questions to determine what they already know about atoms.

- **What are some things that contain atoms?** *(Answers will vary, but students may know that everything around them is made up of atoms.)*
- **Is it possible that your body contains atoms that are older than you are?** *(Yes. In fact all of them are much, much older. Atoms move constantly from substance to substance or from person to person. The atoms in your body are as old as the universe, and they have been part of many structures before this.)*
- **How can scientists prove atoms exist?** *(Atoms can be studied by indirect means, that is, by tracing their effects on things that can be measured or seen.)*

Theme Connection:

Scale and Structure

The theme linking some important concepts in this unit is Scale and Structure. In this lesson, the study of matter focuses on its basic building blocks—very small particles called *atoms* that cannot be observed directly. Ask the students how they know atoms exist if they cannot see them.

Anthology*

Introduce the lesson by discussing the poems "Elementary Decision" and "Dinosaur Air" on pages 6-7 in the ***Teacher's Anthology***.

Meet The Atom

The Basic Building Blocks of the Universe

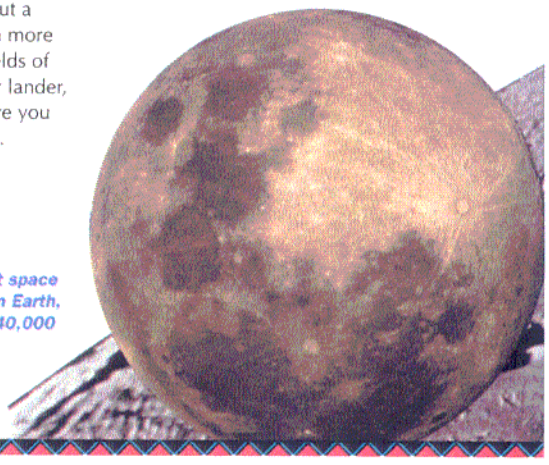
Much of our understanding of atoms has developed as a result of indirect observations, since we can't actually "see" atoms in action. This approach enables scientists to define the scale of atoms and describe their structure in a useful way, so that we can comprehend what atoms are, as well as how they make up matter.

Minds On! Have you ever looked closely at a full moon on a clear night? If you have, did you notice that some areas appeared bright while others were dark? Perhaps you saw the rough outline of a crater or two. If you could journey to the moon, how would the lunar surface look compared to the view you had from Earth?

Since the moon has no atmosphere to block your vision, you might be able to make out some details of its landscape by the time you are halfway there. You can recognize that the bright and dark regions are large mountains and vast plains marked by craters. When you are near enough to the moon to pick out a landing site, you can begin to see even more distinctive features. You can inspect fields of boulders that might damage your lunar lander, and you can see smoother places where you would be able to land with less danger.

As you start to land, you can observe the texture of the ground. You might notice that it appears to be covered with a grainy dust or that it seems to be composed of solid rock. When you step onto the surface of the moon, you can closely examine the soil and you can see the fineness of the dust and flecks of different minerals in the rocks.

Now let's take an imaginary trip in the opposite direction. Imagine standing outside. What would it be like to slowly become smaller and smaller? What do you think you would see as you shrank in size until you were the same size as the pores and pits in the sidewalk?



The moon—our nearest space neighbor—as seen from Earth, 384,000 kilometers (240,000 miles) away

MORE TO EXPLORE

CURRICULUM CONNECTION

Literature

Read to the class excerpts from the *Borrower* books by Mary Norton to help students imagine what it would be like to live in a shrunken world.

CURRICULUM CONNECTION

Language Arts**

If any of your students have seen the movie *Honey, I Shrunk the Kids,* ask them to share the plot with the other students. The film deals with the accidental shrinking of several children and the dangers they encounter while in miniature form. Have students write their own story or screenplay featuring themselves as characters who have been shrunk.

* Available in Unit Box

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Minds On!

After students read pages 6-7, have them do the ***Minds On*** Activity.

Critical Thinking Process

- Concept formation

Developing Critical Thinking Processes: Concept Formation

- Students list what they believe is "Matter" and what they would classify as "Not Matter." Through the process of concept formation, they begin to understand that matter has physical properties.

Assessing Student Results

Examples of "Matter" might include the students themselves, desks, floor, air, and any other object that has mass and takes up space. Examples of "Not Matter" may include heat, electricity, light, sound, magnetism, motion, wind, and other forms of energy or force.

Discussion Strategies

After students complete the ***Minds On*** Activity, you may need to point out that the forces and kinds of energy listed in the "Not Matter" column do not have mass and do not take up space. Ask students to read the remainder of the text on pages 8 and 9. After students discuss the properties of burning wood, ask them what patterns of change occur when the following substances are burned: marshmallows, meat, cookies, paper, and oil.

Minds On! You may have a good idea of what matter is already. Draw a line down the center of a piece of paper in your ***Activity Log*** on page 1. Label one column "Matter" and the other column "Not Matter." Take a few minutes to look around you. List what you observe in the classroom in one column or the other.

Think about what all the things you listed as matter have in common. For example, they have mass and take up space. Desks, books, chalk, the teacher, fellow students, light fixtures, clothes, and a clock on the wall all are objects around you that take up space.

What did you list under the heading "Not Matter" in the Minds On? Did you list sounds you heard? Did you include time on your list? A shadow? What about sunlight? Did you list the chill or warmth you may have felt near a window? Are these things matter, or are they caused by matter? What about things like dust and clouds? Think about the composition of these objects.

What about air? You can't see, smell, or taste it. But we know it's there when we feel a breeze or see flags flying. In the following Try This Activity, you will determine if air can be classified as matter.

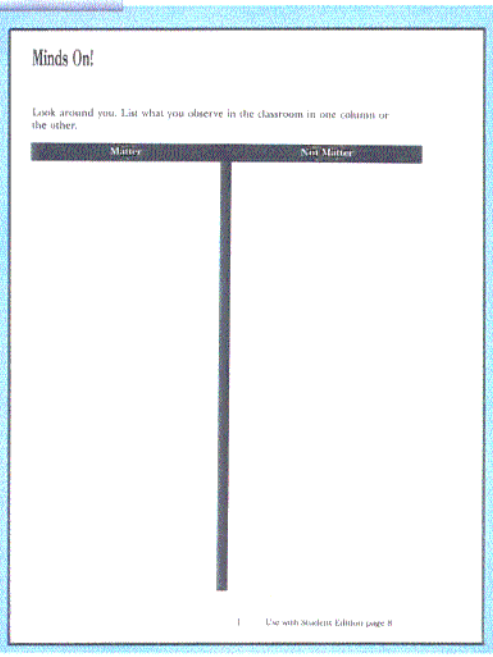
Wood is still wood when it is cut.

Activity Log**

On ***Activity Log*** page 1, students list their observations under the headings "Matter" and "Not Matter."

Assessing Student Results

Assessment tips are provided in the vertical column.



Minds On!

Look around you. List what you observe in the classroom in one column or the other.

Matter	Not Matter

1 Use with Student Edition page 8

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Lesson 1

ENGAGE pp. 12-13

At a Glance:

The *Engage* section of this lesson encourages students to compare the three forms of water and to identify physical properties of other kinds of matter.

Suggested pacing: one day

Assessing Prior Knowledge

Before you have students read pages 12-13, ask them to describe the characteristics of water to determine what they know about the three states of matter. *(Water can exist in three forms. Ice is the solid form, water is the liquid form, and water vapor is the gaseous form. If water is heated to a boil, it can turn to steam; if it is placed in a cold place, such as a freezer, it can turn to ice.)*

Theme Connection:

Scale and Structure

The theme linking some important concepts in this unit is Scale and Structure. Every object in the universe is composed of matter. The scale of these objects ranges from very large to very small. In this lesson, the study of matter focuses on the structure of substances large enough to be observed with the unaided eye. Students observe and identify the physical properties of different materials and describe the effect of temperature changes on the three states of matter.

To make students more aware of the concepts of scale and structure, choose several objects in the room and have the students compare their size and structure.

Theme T SCALE and STRUCTURE

Physical Properties

Ice melts in the warmth of sunlight. The melted water boils on the stove and turns to steam. It also freezes into ice again in the freezer. That same ice can be melted again. Does all matter exist in three forms? What causes matter to change from one form to another form?

Matter can exist in the form of a solid, liquid, or gas, depending on the temperature and pressure. Water exists in these three forms at normal Earth temperatures and pressures. Specific temperatures help us identify and classify water as a type of matter that is different from other types of matter. Let's think about some other physical properties of matter.

Minds On! Imagine that you have just met a friendly, and hungry, little alien who came to your classroom from another solar system. You invite her to the cafeteria with you for a bowl of ice cream, but she has never heard of ice cream and asks you to describe it for her. What would you say? Write the answer in your ***Activity Log*** on page 3, carefully describing the properties of color, texture, taste, and temperature.

The way an object looks, feels, smells, tastes, melts, or freezes makes it different from every other object. We can use these properties to distinguish one type of matter from another.

The properties of an object, such as its structure and composition, also determine its use. That's why bridges are built with concrete and steel instead of glass and rubber. Can you imagine what would happen if a bridge trestle made of rubber began to melt and change shape on a hot summer day? Other materials have properties that make them practical to use in building aircraft. The airline industry wants to use aircraft with reduced weight to save energy. It uses lightweight metals in the construction of airplanes and helicopters, which reduces the amount of fuel required to fly them. At other times the odor of a substance is a desirable property. For example, chemists use the fragrance of lilacs to make some perfumes and air fresheners because that scent is pleasant to our noses.

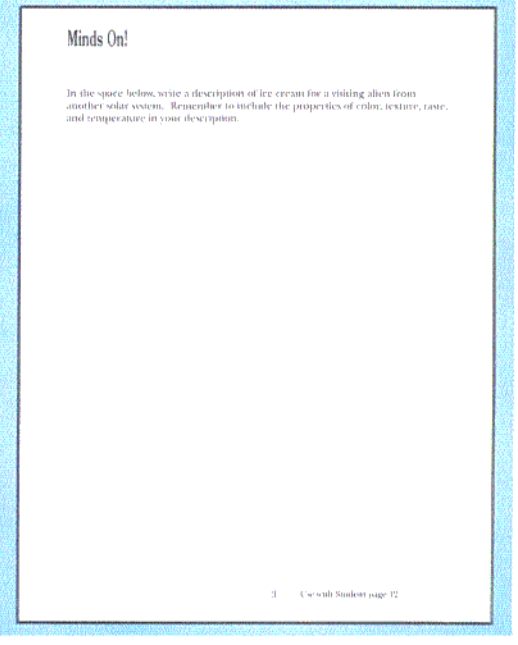
All matter has certain properties that allow us to distinguish one type of material from another. In the following Explore Activity, we will investigate one of these properties.

ACTIVITY LOG**

On ***Activity Log*** page 3, students should describe the properties of ice cream, as requested in the ***Minds On*** Activity.

Assessing Student Results

Assessment tips are provided in the vertical column.


Minds On!

In the space below, write a description of ice cream for a visiting alien from another solar system. Remember to include the properties of color, texture, taste, and temperature in your description.

3 Use with Student page 12

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