Lesson 1.3

Made of Matter

Overview

Students are introduced to the nanoscale and think about the tiny bits of matter—atoms and molecules—that make up substances and mixtures all around them. Students see a demonstration of the digital Scale Tool that allows them to compare the relative size of different forms of matter. Students read the book *Made of Matter* to learn about atoms and molecules and their unique properties, and they apply what they learn to order a set of things by size. The teacher introduces the Matter chart on which to track students' growing understanding of atoms and molecules. The purpose of this lesson is to introduce students to the particulate nature of matter and to explore the crosscutting concept of Scale as they develop their understanding of the properties of all matter.

Unit Anchor Phenomenon: The food coloring from Good Food Production, Inc., is not exactly the same as Red Dye #75.
Chapter-level Anchor Phenomenon: Good Food Production, Inc.'s food coloring separated into different dyes.

Students learn:

- All matter is made of atoms, the smallest pieces of matter.
- Molecules are groups of atoms joined together.
- Atoms and molecules are tiny nanoscale particles that are too small to see at the observable scale.
- Diagrams, photos, and captions in informational text provide important information about key ideas.

Lesson at a Glance

ACTIVITY

1 **Introducing the Nanoscale** (10 min)
In order to connect students' understanding of the observable scale to the nanoscale, the teacher demonstrates the Scale Tool. Students are introduced to the idea that everything is made of matter and that the tiny bits of matter are called atoms and molecules.

SIM

2 **Previewing Made of Matter** (10 min)
Students are introduced to the book *Made of Matter* and discuss how the visual representations and captions are important in understanding the book's concepts.

STUDENT-TO-STUDENT DISCUSSION

3 **Partner Reading** (30 min)
Students read the book *Made of Matter* to become more familiar with the particulate nature of matter and to learn a number of key concepts about matter, molecules, and atoms as they continue developing ideas about the nanoscale. This activity provides an On-the-Fly Assessment to informally assess students' understanding of the crosscutting concept of Scale.

READING

4 **Discussing Models and Matter** (10 min)
The class thinks more deeply about the use of models in *Made of Matter* and summarizes the relationship between atoms and molecules. The Matter chart is introduced, which helps frame the unit and provides an ongoing and accessible visual reference of new terms and related concepts.

TEACHER-LED DISCUSSION

Materials & Preparation

Materials

For the Classroom Wall

- 4 vocabulary cards: *atom*, *matter*, *model*, *molecule*

For the Class

- 1 digital device, with Scale Tool
- 2 sheets of chart paper*
- marker*
- masking tape*

For Each Pair of Students

- 1 copy of *Made of Matter*

For Each Student

- *Modeling Matter* Investigation Notebook (pages 4–7)

*teacher provided

Preparation

Before the Day of the Lesson

1. Gather the following materials for the classroom wall:
    - 4 vocabulary cards: *atom*, *matter*, *model*, *molecule*
2. Create the Matter chart. On chart paper, write "Matter" at the top of the sheet. You will create this chart during this lesson and Lesson 1.4. Refer to the PDF file (in Digital Resources) to see what the completed chart will look like. You can print out the PDF file now so you can have it on hand during the lessons. (Note: The PDF file will also appear in Digital Resources for Lesson 1.4.) You will need to keep this chart posted throughout the unit.

VOCABULARY

- atom
- matter
- mixture
- model
- molecule
- substance

UNPLUGGED?

Digital Devices Not Required

A digital device is required in Activity 1 for the teacher demonstration of the Scale Tool. Students can complete this lesson without the use of digital devices.

DIGITAL RESOURCES

Matter Chart: Completed

Partner Reading Guidelines

Modeling Matter Investigation Notebook, pages 4–7

3. Create the Partner Reading Guidelines. On chart paper, create these guidelines. (See Digital Resources for what this should look like.) You will keep this posted throughout the unit. If you don't have enough wall space, you'll need to take it down and repost it during the reading lessons.
4. Preview the Scale Tool. Familiarize yourself with the content and functionality of the Scale Tool and review the instructional sequence in Activity 1 so you are prepared to model the Scale Tool for students during the lesson. (Note: The Scale Tool will take a few moments to load. Once it does, you should see the image of the astronaut.) Check your equipment to ensure that you are able to project easily in your classroom.
5. Read *Made of Matter*. Familiarize yourself with the content of this book and the visual representations it features: diagrams, photos, and illustrations.
6. Assign reading partners. Throughout the unit, we recommend that students read with partners. You may choose to assign the same reading partners throughout the unit or switch reading partners with each book. (See the Differentiation section for more recommendations about reading partners.)
7. Prepare for On-the-Fly Assessment. Included in Activity 3 of this lesson is an On-the-Fly Assessment that provides an opportunity to informally assess students' understanding of the crosscutting concept of scale. Press the hummingbird icon and select ON-THE-FLY ASSESSMENT for details about what to look for and how you can use the information to maximize learning by all students.

Immediately Before the Lesson

1. Write the Investigation Questions on the board: "How are different kinds of molecules different? How are molecules similar?"
2. Post the Partner Reading Guidelines. Post this in a place that will be easily visible to all students.
3. Have on hand the following materials:
    - materials for the classroom wall
    - copies of *Made of Matter*
    - Matter chart (blank)
    - marker
    - masking tape

Differentiation

Embedded Supports for Diverse Learners

Partner Reading. Reading with a partner provides opportunities for students to assist each other with reading—with using the reading strategy modeled by the teacher, with decoding, and with comprehension. Partner Reading encourages discussion of the text during reading, which aids comprehension and engagement.

Matter chart to organize information. The Matter chart, which is introduced in this lesson, helps to clearly organize new concepts about matter with key vocabulary words (*atom*, *matter*, *mixture*, *molecule*, *substance*) and simple illustrations that the teacher draws. This chart provides an ongoing and accessible visual reference of bits of information recorded in an organized manner. By creating this chart, the teacher is modeling a way to organize data. The end result is a class reference tool that helps solidify, in students' minds, new terms and related concepts.

Visual representations. The demonstration of the Scale Tool and the multitude of models, diagrams, and other images in *Made of Matter* help students see and understand the vast differences between the nanoscale and the observable scale. All these visual representations help support students' learning of important science concepts. Visual representations are especially helpful for English learners and students who need support with processing oral or written language.

Potential Challenges in This Lesson

Partner Reading. There are numerous benefits to the practice of Partner Reading, even for fifth graders. By choosing partners carefully, and taking some time beforehand to explain the process and benefits of this strategy, students will have a better understanding of what is expected of them. Briefly discuss the Partner Reading Guidelines with the class.

Reading-centered. Reading science texts may be new for many students, and it can be challenging for anyone. Consider if any of your students would benefit from extra reading instruction or pre-teaching in order to be successful with the activities in this lesson.

Several new vocabulary words. In this lesson, the words *atom*, *matter*, *model*, and *molecule* are introduced as well as the concept of the nanoscale. It may be challenging for some students to make sense of so many new words, especially since the words represent concepts that are likely unfamiliar. Of course, students will have many other opportunities to read, write, hear, and say these words throughout the unit, but you might want to consider spending extra time discussing these new words if you think this will be a challenge for your students.

Specific Differentiation Strategies for English Learners

Bilingual Spanish glossary. Having access to translations and definitions of new science terms in Spanish is helpful for English learners for whom Spanish is their primary language. Have students turn to pages 84–85, Glossary, in the *Modeling Matter* Investigation Notebook to see Spanish translations and definitions. Encourage students to refer to this glossary as needed throughout the unit.

Cognates. Many of the academic words that students will be learning over the course of this lesson and unit are Spanish cognates. Cognates are words in two or more different languages that sound and/or look the same or very nearly the same, and that have similar or identical meanings. You may decide to support students by keeping a running list on chart paper of cognates that students encounter in this unit, or by encouraging students to keep their own lists that they can refer to as needed. Cognates are especially rich linguistic resources to exploit for academic English language development and for biliteracy development.

Increase wait time. English learners benefit from increased time to process oral questions. In addition to considering the content of a question, English learners can use a few extra seconds to make sense of unfamiliar words or phrases and/or to mentally translate questions into their primary languages. Increasing your wait time to 10 seconds before calling on students will likely increase the participation of English learners in class discussions (e.g., in the class discussion about the nanoscale and the new vocabulary).

Specific Differentiation Strategies for Students Who Need More Support

Strategic partnering. Thinking in advance about reading partners can help ensure that all students are successful during reading. You may want to pair a reader who might benefit from more support with a partner who is a slightly more fluent reader. You may also want to provide partners with more time to read.

Anticipation Guide. For each book, we provide an optional Anticipation Guide in the Investigation Notebook. Anticipation Guides can help support students by activating prior knowledge before reading, promoting engaged reading, and encouraging students to monitor their comprehension. If you choose to use this optional activity, have students turn to page 5, Getting Ready to Read: *Made of Matter*, in the Investigation Notebook. To use this activity, explain that students should work with a partner to decide if they agree or disagree with each statement. After reading, ask partners to revisit the statements and discuss whether they want to change any responses based on their reading. Encourage students to refer to the text as they discuss.

Specific Differentiation Strategies for Students Who Need More Challenge

Create models of molecules. Challenge students to create diagrams or three-dimensional models of various molecules, such as water, calcium carbonate, oxygen, or even some of the more complex molecules depicted in *Made of Matter* or some they research on the Internet. Students can use colored pencils and markers or various colors of clay to represent each type of atom within a molecule. To recreate the arrangement of various atoms by using clay, shape the clay into small balls to represent the atoms; the atoms can be joined with toothpicks to create a three-dimensional model of a molecule.

Reading Reflection. A Reading Reflection activity for each book is included in the Investigation Notebook. These are optional written activities designed to reinforce concepts in the books and provide prompts to encourage further thinking about the text. These activities are designed for early finishers to use during Partner Reading and can also be used in a variety of other ways, such as to reinforce concepts on a second read of the book or as homework. The Reading Reflection for this book (on page 7, Reading Reflection: *Made of Matter*, in the Investigation Notebook) asks students to think about how various kinds of molecules differ from one another.

Standards

Key
Practices Disciplinary Core Ideas Crosscutting Concepts

3-D Statement

Students read the book *Made of Matter* and explore with the digital Scale Tool to obtain and evaluate information about the particulate nature of matter (energy and matter).

Louisiana Student Standards for Science

Science & Engineering Practices

- Practice 2: Developing and using models
- Practice 5: Using mathematics and computational thinking
- Practice 8: Obtaining, evaluating, and communicating information

Crosscutting Concepts

- 3: Scale, Proportion, and Quantity
- 5: Energy and Matter

Disciplinary Core Ideas

- PS1.A: Structure and Properties of Matter: Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations, including boiling water, the inflation and shape of a balloon, and the effects of air on larger particles or objects. (UE.PS1A.a)
- ETS1.B: Developing Possible Solutions: At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (ETS.UE.1B.b)

Louisiana Student Standards for English Language Arts

- RI.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from the text.
- RI.5.3: Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
- RI.5.4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

- RI.5.7: Utilize information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
- SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

Louisiana Student Standards for Mathematics

Standards for Mathematical Practice

- 1: Make sense of problems and persevere in solving them.
- 2: Reason abstractly and quantitatively.

Standards for Mathematical Content

- 5.NBT.A.2: Understand the place value system. Explain and apply patterns in the number of zeros of the product when multiplying a number by powers of 10. Explain and apply patterns in the values of the digits in the product or the quotient, when a decimal is multiplied or divided by a power of 10. Use whole-number exponents to denote powers of 10.
- 5.NBT.A.3.a: Read and write decimals to thousandths using base-ten numerals, number names, and expanded form.

1
SIM
Introducing the Nanoscale

Introducing the Nanoscale

10
MIN

Teacher introduces nanoscale by demonstrating the Scale Tool. Students preview diagrams, photos, and captions before reading *Made of Matter*.

Instructional Guide

1. Introduce *matter*. Let students know that they will be learning more about matter in today's lesson.

In the previous lesson, we looked at food mixtures and discussed their properties that we could see with our eyes at the observable level. Today, we're going to zoom way in to see the tiny bits of matter—the stuff that makes up everything around us.

Post the *matter* vocabulary card to the Vocabulary section of the classroom wall.

2. Project the Scale Tool. Explain that this Scale Tool helps us see how tiny these tiniest bits of matter are. The Scale Tool begins at the scale at which you can see everything—shown here with an image of an astronaut. Point out that the scale of a human is measured in meters, as shown by the green box with the 1 meter label.

This is the observable scale, or the size that we can see.

This tool shows things from the very small to the immensely large.

3. Use slider to view different objects. Move the slider at the bottom of the Scale Tool slowly to the left. Students will likely recognize many of the objects they see. Make sure all students notice that each time the color of the background changes, the size of the objects also changes. Ask students to identify and discuss the size of the following objects by demonstrating the size with their hands:

- human heart
- grain of salt
- grain of sand
- human hair
- red blood cell

Point out that a red blood cell is too small to see with our eyes. When you reach the brown box with 1 nanometer label, let students know that they are now looking at objects that are even smaller than objects that can be seen through a microscope.

This is the nanoscale. It is the scale of particles. The nanoscale is so small that we can't see anything at this scale, even with most microscopes. This shows some different kinds of particles—atoms and molecules, which are the tiniest bits of matter.

Point out the drawings of an atom and a molecule at the nanoscale. Emphasize that all matter is made of atoms and molecules.

4. Thinking at the nanoscale. Let students know that they will be thinking at the nanoscale often during this science unit and that they are going to need to use their imaginations and think creatively to picture what all the substances around them might look like at that tiny scale.

5. Show large scale objects. Move the slider at the bottom of the Scale Tool slowly to the right to show objects larger than a human.

In this unit, we will focus on the observable scale and the nanoscale, but some scientists—especially Earth and space scientists—investigate things and processes at huge scales.

Teacher Support

Rationale

Providing More Experience: Daily Written Reflections
Daily Written Reflections are open-ended, optional prompts that you can use with students to jump-start each lesson. You can ask students to write their responses, or you can use the prompts as the basis for a discussion. Daily Written Reflections can also be used at other times in the day or as homework. The prompts encourage students to reflect on what they've been learning, activate prior knowledge, make connections, and practice using science vocabulary. Responses can also be a good window into students' thinking. Let students know that for this kind of writing, it is more important to focus on recording their ideas rather than on perfect spelling or punctuation. Daily Written Reflections are meant to be brief—allow about 5–10 minutes for students to respond.

Instructional Suggestion

Providing More Experience: Today's Daily Written Reflection
How are different substances different? Think about the food-mixture investigations you did in the previous lesson. Write about two different substances you investigated. This prompt (on page 4 in the Investigation Notebook) allows students to express both previously held conceptions and new information they gathered in the previous lesson. It will provide you with a window into students' early ideas about substances.

Instructional Suggestion

Science Practice: Linear Measurement in Metric
Scientists around the world primarily use metric units when measuring. The metric system is based on units of 10. Each unit is 10 times smaller or larger than the next unit. This means that you can convert a measurement from one unit to another by multiplying or dividing by 10. For example, centimeters and meters are common units of linear measurement that students will encounter in science text. Depending on where your students and their families have lived to date, they may be more familiar with either the metric system (using meters, centimeters, etc.) or the standard system (using yards, inches, etc.). Either way, it may be helpful to have students relate 1 meter to something concrete, such as their bodies. They can determine how many centimeters/meters tall they are. They can measure the distance from the floor up to their hips or the distance from one fingertip to the opposite shoulder. Showing 1 centimeter on a meterstick or comparing a yardstick to a meterstick can help students visualize these conversions.

Instructional Suggestion

Going Further: Mathematical Thinking
Students can create a table showing the pattern of decimal and fractional equivalents of the numbers in the Scale Tool. Before creating the table, demonstrate the connections between a meterstick and the Scale Tool. Hold up a meterstick and point out that one row of the green box (1 m) on the Scale Tool represents the length of 1 meterstick, which is close to the size of a human. As you move the slider on the Scale Tool toward the human heart, point out how the yellow box (10 cm), which is close to the size of the heart, is 1/10 of the meterstick, or 10 cm. Continue to compare the marks on the meterstick for 1 cm and 1 mm, comparing them to the grain of salt and the human hair on the Scale Tool, respectively. Pout out that each smaller measurement is made by dividing each length in tenths.

Write “Observable Scale” at the top of the table and write the headers for each of four columns: “Scale Tool object,” “Fraction,” “Decimal,” and “Unit of measure.” As you guide students through the Scale Tool, have them record the equivalents in each row as listed below:

- Object: Human Fraction: 1/1 Decimal: 1 m Unit of measure: 1 meter (m)
- Object: Human heart Fraction: 1/10 Decimal: .1 m Unit of measure: 10 centimeters (cm)
- Object: Grain of salt Fraction: 1/100 Decimal: .01 m Unit of measure: 1 centimeter (cm)
- Object: Human hair/grain of sand Fraction: 1/1,000 m Decimal: .001 m Unit of measure: 1 millimeter (mm)
- Object: Blood cell Fraction: 1/10,000 m Decimal: .0001 m Unit of measure: 100 micrometers

Background

Technology Note: Scale Tool
The Scale Tool is a digital tool that allows students to more clearly see the relative differences in size and scale of a wide variety of objects ranging from the solar system to subatomic particles. In this lesson, you start with the observable scale of a human and continue to the nanoscale of the atom. Scale Tool usage is fairly straightforward. The slider allows you to zoom in or out, and the numbers on the slider and in the grids provide an indication of the scale at which the viewer is currently observing. Selecting an object brings up a dialog box containing the name of the object, the measurements of the object, and some interesting facts.

Instructional Suggestion

Technology Note: Modeling with the Scale Tool
Demonstrating the Scale Tool in real time on a digital device hooked up to a projector may benefit students as they start to understand the relationship of the concepts of scale. It also helps students see how you interact with the tool. Additionally, it lets you model how you can ask questions and wonder aloud as you explore and utilize the Scale Tool features, such as the dialog boxes and numbers.

Rationale

Pedagogical Goals: *Particles* vs. *Molecules*
The *Modeling Matter* unit focuses on the term *molecules* rather than using the more general term *particles*. By focusing on the term *molecules*, the unit enables students to begin developing a more precise understanding of matter at the nanoscale—differentiating between different kinds of molecules gives students the ability to explain why different substances have different properties, and it lays the groundwork for understanding chemical reactions at the nanoscale. However, students are not expected to develop understanding of the specific arrangement of atoms within the molecules of each substance, the chemical formulas of molecules, the chemical bonds that hold atoms together, nor the difference between molecules and ionic compounds.

2 STUDENT-TO-STUDENT DISCUSSION
Previewing Made of Matter

Previewing Made of Matter

10 MIN

Students preview the book by looking at and discussing the visual representations and captions before they read.

Instructional Guide

1. Introduce *Made of Matter*. Hold up the book, read the title aloud, and let students know that they are going to read a book today that is about what all things are made of at the nanoscale.

2. Introduce the Partner Reading Guidelines. Let students know that they will read the book with a partner. Point out the guidelines that you posted on the wall and review them with the class. If Partner Reading is an unfamiliar activity for your students, let them know they can refer to the guidelines as they read.

3. Distribute and preview books. Distribute one copy of *Made of Matter* to each pair of students. Discuss visual representations in the book and their importance in helping students understand what they read.

Visual representations, such as diagrams and photographs, tell us useful information that help us understand science text better. Captions are the words underneath a diagram or photograph that explain what is shown. Visual representations, along with their captions, help us understand what's in the text.

You'll have a few minutes to preview the book with your partner. Let's see what you can find out in that time.

4. Partners look through book and share with the class. After a few minutes, call on a few students to share their ideas about illustrations, diagrams, and/or captions they found in the book. Have them point out the page numbers so their classmates can turn to those pages. Let them know that these visual representations will help them make sense of the book as they read.

Teacher Support

Rationale

Literacy Note: Partner Reading
Throughout this unit, we suggest that students read the books with a partner. This allows students time to apply and practice the reading strategies they're learning, keeps them focused on the task at hand, and provides opportunities for

them to assist each other with reading. Of course, you can use any effective reading procedures you've already established with your class. Before reading this first book in the unit, you may need to provide instruction on how to read with a partner by using the Partner Reading Guidelines provided or your own guidelines. Establishing procedures takes time at first, but will pay off in terms of student learning and management of the lessons. Over time, students gain practice working together and will need fewer reminders about reading together effectively.

Rationale

Literacy Note: Visual Representations in Science Text
Studies show that adult and student readers alike often ignore visual representations, such as diagrams, as they read informational text. Yet, science text relies heavily on using visual representations to convey information. Drawing explicit attention to the diagrams in *Made of Matter* will help students see how much information is contained in each diagram. As you model, using both the text and a diagram to make sense of the reading, you will help students see that often the most powerful understanding comes from neither the text nor the diagram alone, but from connecting the two.

3 READING
Partner Reading

Partner Reading

30 MIN

Partners read *Made of Matter* to learn about molecules. Then, they apply what they learn to order a set of objects from smallest to largest.

Instructional Guide

1. Read page 3 aloud and review *matter*.

Matter is the stuff that things are made of.

2. Read pages 4–7 aloud together. Call on volunteers to read one or two paragraphs at a time while the rest of the class follows along. Reinforce stopping to look at the visual representations and reading the captions.

3. Pairs read. Provide students with time to read the rest of the book with their partners. Remind them to examine the visual representations as they read.

4. Project notebook. When most students have finished reading, regain students' attention. Select page 6 in the table of contents. Have students turn to page 6, Thinking at the Nanoscale, in their notebooks. Review the directions.

We know that atoms and molecules are very tiny. How tiny is tiny? Use what you read in the book to put these things in order from smallest to largest. Remember to look at the text *and* the visual representations in the book to help you understand how tiny the nanoscale is.

5. On-the-Fly Assessment: Thinking at the nanoscale. As you circulate, check to see students' progress in ordering items from the smallest to largest. Provide assistance as necessary.

6. Discuss students' responses on the notebook page. Call on partners to share their responses. [Smallest to biggest: 1 atom, 1 water molecule, 1,000,000 water molecules, 1 drop of water, 1 glass of water.]

7. Point out that students have been making inferences. Explain that when students used the text and visual representations in the book to determine in which order to place the objects, they were making inferences.

When you use what you have read and observed to figure something out, you are making an inference. The book did not say that one atom is smaller than one drop of water, but you were able to figure that out from what you read. You will make many inferences as you study atoms and molecules, since they are too small to observe directly.

Embedded Formative Assessment

On-the-Fly Assessment 2: Thinking About Objects at the Nanoscale

Look for: Throughout the unit, students will be using inferences about nanoscale interactions to explain phenomena at the observable scale. Make note if students are able to identify that atoms are smaller than molecules and that both of those are smaller than a drop of water or a glass of water. At this point, even if students have little experience with ideas of nanoscale, they should be using the supportive features of the text in order to put the items in order, from smallest to largest. Note what evidence students are using to complete this task. Are they using prior knowledge, the text, and/or discussing with their partners to make their decisions?

Now what? If students have switched atoms and molecules, you may want to have them reread the caption under the molecule on page 9 of *Made of Matter* and see if that clarifies their thinking. If students have atoms or molecules as larger in size than the water, we suggest a review of the Scale Tool, relating a drop of water to something close to a bread crumb, and then identifying the smaller molecules and atoms. This might help students order items from largest to smallest, going from top to bottom. Additionally, you can make a copy of the photographs on pages 6 and 7, cut them apart, and have students put them in order on their desks—either from largest to smallest or from smallest to largest—before they revise the notebook page (page 6, Thinking at the Nanoscale).

Teacher Support

Background

About the Book: *Made of Matter*
Made of Matter introduces students to several important concepts about matter. Students learn that everything around them is made of tiny particles called atoms and that atoms joined together are called molecules. By comparing different amounts of everyday materials, students get a sense of just how tiny atoms and molecules are. Students are introduced to models as representations of atoms and molecules and learn that all molecules of one kind are exactly the same. Students learn the difference between a substance and a mixture and that most matter is made of many different kinds of substances mixed together. They also learn that molecules can have different properties, which helps build the foundation for understanding why substances have different observable properties.

Rationale

Pedagogical Goals: Informational Text

A major goal of this curriculum program is to deepen students' awareness of and experience with the genres of science writing they are likely to encounter in school and in their lives outside of school. This curriculum program is designed to address the Louisiana Student Standards for English Language Arts related to reading and writing informational text, with a specific focus on science text. Learning effective strategies and approaches for comprehension of informational text is extremely important for success in school, yet reading and writing these texts can be challenging for many students. The student books and related investigations in this curriculum provide explicit, supportive instruction around how to tackle informational text.

Possible Responses

Investigation Notebook
Thinking at the Nanoscale (page 6)

Smallest to biggest
1 atom
1 water molecule
1,000,000 water molecules
1 drop of water
1 glass of water

4 TEACHER-LED DISCUSSION
Discussing Models and Matter

Discussing Models and Matter

10 MIN

The class discusses models and their purpose. The teacher introduces the Matter chart.

Instructional Guide

1. Have students turn to page 9 in *Made of Matter* and discuss the model. Ask students about the models of atoms and molecules—or the pictures on the page—and what they show and don't show.

What does the image on this page show?
[Atoms, molecules, places where they join together.]

These are models of atoms and molecules—drawings that make it easier to see atoms and molecules so we can study them and figure them out. Do you think atoms and molecules actually look like this?
[No.]

Why not?
[Atoms and molecules don't have a color. They are not shaped like a ball. They are not joined together with sticks.]

These models make it easier to see how atoms and molecules are arranged. Scientists often use models to show things that are too small, or even too large, to see all around us.

2. Review *model* and post the vocabulary card.

A model is something scientists make to answer questions about the real world.

3. Introduce and post the blank Matter chart. Point to the title of the chart.

Remember that everything around us is made of matter. Matter is the stuff that things are made of.

4. Define *atom*, write "atom" at the bottom of the Matter chart, and draw a circle (to the right of the word) to represent an atom. Ask students what an atom is, based on their reading. Refer to pages 4–5 of *Made of Matter* if necessary. [Tiny pieces that make up matter, building blocks of matter, atoms joined together to make molecules.]

An atom is a tiny piece of matter that is too small to see. My drawing represents one atom—even though, of course, atoms are much too small to see!

5. Define *molecule*, write "molecule" above the word *atom* (leaving room to insert an arrow between the two words), and draw a simple water molecule to the right of the word. Explain how the two concepts are related.

Atoms are smaller than molecules. A group of atoms joined together in a particular way forms a molecule. My drawing is not what molecules really look like; it's just a representation—another model—of a molecule.

Post the vocabulary cards for *atom* and *molecule*.

6. Discuss the relationship between atoms and molecules. Draw an arrow going from the word *atom* to the word *molecule* to show that an atom is part of a molecule. Ask students questions to check their emerging understanding of atoms and molecules.

How many atoms are in this molecule?
[Three.]

How many different types of atoms are in this molecule?
[Two.]

How can you tell?
[There are two different representations of atoms: one large circle and two small circles.]

7. Conclude the lesson by reviewing the Investigation Questions.

How are different kinds of molecules different? How are molecules similar? Now that we've seen some models of different molecules in *Made of Matter*, we will keep thinking about ways that different molecules can be the same or different. We will keep these questions in mind as we continue to investigate molecules over the next few lessons.

Teacher Support

Background

Science Note: Molecular Models
Scientists make models to represent important information about molecules, such as the types of atoms of which they are composed or the way those atoms are arranged and connected. These models are not meant to represent what the molecules actually look like. This type of model is helpful for thinking about atoms as distinct entities and for understanding molecules as groups of atoms joined together in particular ways.

Rationale

Literacy Note: Creating the Matter Chart
In this lesson, you begin to create the Matter chart by adding the words *atom* and *molecule* and drawing a simple diagram of each. This shows the relationship between atoms and molecules. In Lesson 1.4, you will add the words *substance* and *mixture* and draw a simple diagram for each. Use the Matter chart in this lesson as a reference to help students remember the difference between atoms and molecules; use the chart in Lesson 1.4 to help students understand the relationship among atoms, molecules, substances, and mixtures. Over time, as students gain more experience with these concepts, they will begin to use the words accurately in their speech and writing to explain the ideas they are learning.

Background

Science Practices: What Is Meant by Developing and Using Models?
When people think of models in the everyday sense, they often think of the miniature replica vehicles built by hobbyists. In science, models have a different meaning, and they play a crucial role in scientists' developing knowledge about the natural world. In science, models are the approximations of aspects of the natural world that scientists create and use to figure out and explain the phenomena they are investigating. Typically, models are used to try and understand aspects of the natural world that are difficult or impossible to directly observe because they are too small, too large, took place in the past, happen too quickly, or take place over extended periods of time. Models can take a number of forms including diagrams, physical objects, or computer programs. As scientists develop new ideas about the nature and workings of the natural world, they evaluate current models and revise how they represent those ideas in models to reflect those new understandings. For the *Modeling Matter* unit, the focal practice is developing initial tentative models of how a particular phenomenon works and returning to those models to revise them to reflect new thinking and ideas. The unit provides multiple opportunities for students to revisit and revise their models of how a phenomenon works, in order to represent new ideas or new understanding.

Background

Science Practices: Developing and Using Models Across the Unit
In Chapter 1, students are introduced to the idea that a model is something scientists make to answer questions about the real world and that models can help you understand something by making it simpler or easier to see. Students use models to figure out what happens with molecules in a chromatography test and then go on to develop their own nanovision models to explain chromatography. Students have their first opportunity to revise their models in the digital Modeling Tool after discussing their initial models with a partner. Students later evaluate three new models of chromatography and discuss how each one is accurate in some ways but also how each could be revised and improved. This prepares students to revise their own models of chromatography again, incorporating the new ideas they've learned about molecules and separating mixtures. In Chapter 2, students are introduced to the *Modeling Matter* Simulation. They use the Simulation to figure out what can happen to the molecules of a solid and the molecules of a liquid when they are mixed together. Students gather more information about dissolving and then create digital nanovision models that show how dissolving happens. Students then use their conceptual models of the relationship between molecular interactions and solubility to make inferences about what a mixture would look like at the observable scale. In Chapter 3, students use physical models and the Simulation to learn about attraction and mixing. After learning that emulsifiers will keep salad dressing mixed, students draw initial nanovision models of how they think emulsifiers work. They use the Simulation to learn more about how emulsifiers work and, based on their new ideas, they revise their initial models of emulsifiers in the digital Modeling Tool. Students then have the opportunity to evaluate one another's models for what they do and do not show well and to think about how they would revise their models again.

Background

Science Practices: Developing and Using Models Across Chapter 1
In Chapter 1, students are introduced to the idea that a model is something scientists make to answer questions about the real world and that models can help you understand something by making it simpler or easier to see. They are also introduced to the Models chart where they will keep a record of the different models they will encounter in the unit. Students first look at diagrammatic models of molecules and atoms as they reflect on matter. They then use the Pasta Model to make sense of what's happening with the molecules in their chromatography tests. Next, students use the Fan Model to figure out that different molecules can have different properties that can help explain why the dyes traveled different distances in the chromatography test. Students go on to develop their own nanovision models to explain chromatography and then discuss with a partner in order to revise their models in the digital Modeling Tool. Students evaluate three new models of chromatography and discuss how each one is accurate in some ways but also how each could be revised and improved. This prepares students to revise their own models of chromatography, incorporating the new ideas they've learned about molecules and separating mixtures.