

# LESSON 3

## OVERVIEW

# What's the Matter? Defining Matter



### Lesson Type

**Activity:**  
**Groups of 4**

## Key Ideas

Chemistry is the study of matter—what it is composed of and how it can be transformed. Matter can be defined as anything that has substance and takes up space. Scientists refer to substance as mass, and to taking up space as volume. They define matter as anything that has mass and volume. Almost everything in the universe is matter, with a few exceptions—such as ideas, feelings, and energy, which have no substance and do not take up space. Chemists might study almost anything in the universe, even things such as energy and pressure, which aren't themselves matter but require matter.

*As a result of this lesson, students will be able to*

- define matter as anything that has mass and volume
- classify an item as matter or not matter

## Focus on Understanding

- Many students confuse mass with volume. They might also think gases are not matter because they often appear to have no mass and often can't be seen.
- Students may be unclear on the distinction between matter and energy; e.g., hot air is matter, but heat is not.
- Students may think of chemists as working only with synthetic “chemicals.” In fact, chemists study all kinds of matter, both natural and synthetic.

## Key Terms

matter  
mass  
volume  
meniscus

## What Takes Place

Students work in groups to determine whether items on a list are matter. Students identify a list of properties common to all the items they classify as matter in order to construct a definition of matter. The reading in the student text introduces the measurement of mass and volume in preparation for the next lesson.

## Materials

- student worksheet
- poster paper and markers (optional)

**LESSON****3****LESSON  
GUIDE**

# What's the Matter?

## Defining Matter

### Engage (5 minutes)

**Key Question:** What is matter?

#### ChemCatalyst

Modern chemistry is defined as the study of matter.

1. What do you think matter is?
2. Name two things that are matter and two things that are not matter.

**Sample Answers:** 1. Matter is different kinds of substances. 2. Answers will vary.

### Discuss the ChemCatalyst

➡ Sample students' ideas.

#### Sample Questions

- What do you think chemists study? (Everything, from food and paper to polymers and pharmaceuticals.)
- What do you think matter is?

### Explore (15 minutes)

#### Guide the Activity

- ➡ Walk around the room and assist students as they discuss the topic. If they seem lost, let them know that matter is another word for “substance.”
- ➡ The “correct” answers are not as important as the process of constructing the definition.

**LESSON**  
**3**

ACTIVITY

# What's the Matter?

## Defining Matter

Name \_\_\_\_\_

Date \_\_\_\_\_ Period \_\_\_\_\_



### Purpose

To decide what is and what isn't matter and to define matter.

### Questions

- Discuss the items listed with your group. Decide which things in the list are matter. Use the table to divide the items into three categories.

batteries	heat	electricity	fear	dust
DNA	helium	bacteria	wind	atoms
sound	clouds	car exhaust	wisdom	fire

Matter	Unsure	Not matter
batteries, dust, clouds, DNA, helium, bacteria, atoms, car exhaust	wind, sound, fire	heat, electricity, fear, wisdom

- In your group, discuss the common properties, or characteristics, of the items in the matter category. Below, create a list of those properties that apply to *all* items that are matter.

*Sample answers: They are all heavy, they have a size, they are all "things." You can touch matter, you can see matter, etc.*

- In your group, examine your list of properties. Use them to write a definition of matter.

*Sample answer: Matter is anything you can see and touch.*

- Making Sense** Pick one of the items you consider to be "not matter." Explain why you believe that item is not matter by showing how it doesn't fit your definition of matter.

*Answers will vary but should make some arguments relevant to the group's definition of matter.*

- If You Finish Early** Some of the items on the list, such as wind, can be categorized as the movement of matter. List some other things that describe the movement of matter.

*Sample answers: tornadoes, sounds, music, earthquakes*

## Explain and Elaborate (20 minutes)

### Discuss What Constitutes Matter

- ➡ Write the categories Matter, Unsure, and Not Matter on the board. As the class reaches consensus on each item, write it on the board in the chosen category.

#### Sample Questions

- Which items are clearly matter? Not matter? Up for discussion?
- If an item is not matter, what is it? (energy, an idea, a feeling)

#### Key Points

**The items that are clearly matter are all objects, or things, that are tangible.**

Gases are matter, too. For example, you do not always see or feel air; however, you can inflate a balloon with it, which indicates something is there.

**Energy and ideas are not matter, but they involve matter.** Wind, for instance, could be considered the movement of matter. Experiencing a thought would be impossible without matter in the brain. We experience heat only when matter is around, such as a log burning or warm air from a heater.

### Discuss the Properties of Matter

- ➡ As the groups share, make a list on the board. Assist the class in reaching consensus about the list.

#### Sample Questions

- What is one property that all matter has in common?
- Does everything in the “matter” column have this property?
- Does anything in the “not matter” column have this property?
- Can you always see and feel matter?

#### Key Point

**Matter has some sort of dimension and substance to it.** These are two properties of matter. Some might say that most matter can be seen or touched, although there are exceptions. And just because you can feel or sense something, that does not always mean it is made of matter. For example, an earthquake is sensed, but it is not matter.

### Define Matter as a Class

- ➡ Ask each group to share or display its definition of matter on the board.
- ➡ Ask the class to imagine that they are at a science convention and their task is to create the most accurate definition of matter. They must give evidence to support their claims. Have the class refine the definition until they more or less reach consensus on it. Challenge incomplete definitions with counterexamples.

#### Sample Questions

- Based on what we've discussed, what is matter?
- Which of these is the best definition of matter? Why? Can it be improved?
- Does everyone agree a hundred percent with this definition?
- Does our definition of matter help us sort out items in the “unsure” column?

### **Key Point**

**A good definition should work 100% of the time.** Modify the definition until it applies to everything in the “matter” column and nothing in the “not matter” column. Incomplete definitions must be fleshed out.

### **Share Some Formal Definitions of Matter**

- Share the definitions of matter given below. Compare the class’s definition to the formal ones, looking for similarities and differences. Make sure students do not get the impression that their definition is inferior or wrong.

Here are some textbook definitions of matter:

**Matter:** Anything that has substance and takes up space.

**Matter:** Anything that has mass and volume.

### **Sample Questions**

- How does our class definition compare with these?
- Do you have any criticisms of these other definitions? (They each require that you define other things—mass, volume, substance, space—before you can define matter.)
- What made it difficult to define a term like *matter*?

### **Briefly Define Energy (optional)**

#### **Sample Questions**

- Which items on our list do you think would belong to a category called “energy”?
- What do you think energy is?
- Do coffee and candy contain energy? Explain your thinking.
- Is energy matter?
- Can you detect energy with your senses?

### **Key Point**

**Energy is the ability to do work or make reactions happen.** There are many different forms of energy, such as heat, light, and electricity. Although we all have an idea of what energy is, it is difficult to define. Students may think of energy as something “contained” in food, caffeine, batteries, and so on. But energy does not take up space or have mass. For instance, a cup of tea doesn’t have more mass when it’s hot. However, it may lose mass due to evaporation, which is a loss of matter.

### **Wrap-up**

**Key Question:** What is matter?

- Matter is everything that has substance and takes up space, or that has mass and volume.
- Ideas and energy are examples of things that are not matter.
- Chemists study all kinds of matter.

## Evaluate (5 minutes)

### Check-in

Which of the following can be classified as matter?

- a. a beam of sunlight
- b. an automobile
- c. an idea
- d. your breath
- e. rain
- f. sadness

**Sample Answer:** Parts b, d, and e are matter; c and f are not matter; a, a beam of sunlight, is ambiguous. If we think of a beam of sunlight as light that bounces off dust particles, then matter is involved.

## Homework

Assign the reading and exercises for Alchemy Lesson 3 in the student text.