

LESSON 9

The Mystery Object

Inquiries 1
Periods 1

CONCEPTS

Density can be used to help identify matter.

STUDENT OBJECTIVES

Measure the volume of an irregular object by displacement.

Measure the mass of an object.

Calculate density.

Use density to identify the material from which an object is made.

Use knowledge and skills acquired to solve problems related to the characteristic properties of matter.

OVERVIEW

This lesson serves as an assessment for the first part of the module, Characteristic Properties of Matter. It consists of two parts: a performance assessment in which students individually complete an inquiry and a written assessment. The performance assessment tests students' ability to apply the concepts of mass and volume to calculate density. Students use this characteristic property of matter to help identify the material from which an object is made. The written component consists of objective test questions that students answer using recall and higher-level interpretive skills. The emphasis of this part of the assessment is on students' direct experience and their ability to apply what they have done in class to new scenarios. Assessment rubrics are provided.

BACKGROUND

This lesson is the first assessment of the module. The performance assessment may be the first your students have done in science. Some may find it rather daunting. Although many of the other lessons have informal assessments, this assessment is a formal test in which students work alone and do not exchange information. This approach allows for more accurate assessment of each individual's skills and knowledge. It also emphasizes to students the importance of lab work and careful recording of observations as components of the module.

Although students are asked to outline their procedure for the performance assessment, they do not design the inquiry. To perform the inquiry, students must use a combination of skills recalled from previous lessons. (It is suggested that students be allowed to refer to their

notebooks, student sheets, and Student Guides during the performance assessment.) Some items of apparatus are provided to distract students. Students may design their own results table. Do not penalize them for not doing so, provided their results are clearly presented.

The homework reader “Choosing Materials for Pedal-Powered Flight” looks at how materials are selected for an engineering project on the basis of their characteristic properties. The reader and the homework activity present the concepts in the Anchor Activity, which is introduced in Lesson 10.

MATERIALS FOR LESSON 9

For each student

- 1 copy of Student Sheet 9: Assessment
- 1 100-mL graduated cylinder
- 1 250-mL beaker
- 1 ruler
- 1 magnifying loupe
- 1 mystery object

For the class

- 4 electronic balances
- Access to water

PREPARATION

1. Make one copy of Student Sheet 9: Assessment for each student.

NOTE To reduce duplicating costs, you may want to make only one class set of Section B. Students can write their one-letter responses to the questions in Section B on plain paper.

2. Set out the student apparatus. Place the sets of apparatus as far apart as possible.
3. If you have not already done so, with a thin felt-tip pen, number the mystery objects as follows: aluminum nails, 1–8; steel nails,

9–16; and so on up to 32. Measure the mass and volume of each mystery object and record them on a sheet of paper. Table 9.1 lists approximate densities and volumes for the objects.

4. Place one mystery object next to each set of apparatus (see Table 9.1 for descriptions of the mystery objects). Make sure adjacent students do not have the same object.

Table 9.1 The Mystery Objects

Description	Composition	Density (g/cm ³)	Volume (mL)
Nail	Aluminum	2.7	5.5
Nail	Steel	7.9	3.0
Bolt	Nylon	1.2	9.0
Rod	Copper	8.9	4.0

Getting Started

1. Assign each student to one set of apparatus and tell students which balance they should use.
2. Hand out Student Sheet 9: Assessment.
3. Explain the following guidelines to students:
 - A. They should immediately check their apparatus against the materials list.
 - B. They are working individually and should not talk to other students.
 - C. They should answer all questions.
 - D. They should do the performance assessment (Inquiry 9.1) first.
 - E. As soon as they finish the performance assessment, they should begin the written assessment.
 - F. They should allow themselves about 15 minutes to do each section of the assessment and 5 minutes to check their answers.

- G. Three or four minutes before the end of the lesson, they should hand in Student Sheet 9. They should then empty the graduated cylinders for use by the next class (or put them away, if this is appropriate).

NOTE Students who finish the assessment before the end of the period should read “Choosing Materials for Pedal-Powered Flight” in the Student Guide.

Inquiry 9.1 What Substance Makes Up My Mystery Object?

PROCEDURE

1. Explain to students that they should use the apparatus (although all of the apparatus may not be necessary), the electronic balance, water, and Table 9.1 in the Student Guide to determine the identity of the substance from which their object is made. Warn students that the objects are different in both composition and size, so they must use their own results.
2. Tell students that they may refer to their science notebooks, student sheets, and Student Guides while working on Inquiry 9.1, but they cannot discuss their work with other students.
3. Have students write their name and the number of the object (see Step 4 in Preparation) in the designated spaces on the student sheet.
4. Have students carefully read Section A of Student Sheet 9 before they start working.
5. Have students do the assessment.

HOMEWORK

Have students who have not already read “Choosing Materials for Pedal-Powered Flight” and answered the accompanying questions complete this assignment for homework. Encourage students to investigate the topic of designing a human-powered plane further by using library and Internet resources. The reader will be discussed in full in “Getting Started” in Lesson 10.

EXTENSIONS

■ Mathematics

1. Ask students the following question: What formula would you use to determine the density of (a) a cylinder and (b) a sphere?

■ Mathematics

2. Have students complete the following exercise. You have been given three objects. Some information about them is provided in this table:

Object	Mass (g)	Volume (cm ³)	Density (g/cm ³)
A	250		2.5
B	500	200	
C		10	2.5

- A. Use the existing information in the table to fill in the blanks in the table.
- B. Is it possible that all three objects are made from the same substance?

ASSESSMENT

It is suggested that you base student scores on the assessment rubrics shown in Tables 9.2 and 9.3. Total points for the assessment: 25.

Table 9.2 Assessment Rubric for Section A

Criteria	Notes	Points ^a
Correct outline of method	Need to measure mass	1
	Need to measure volume	1
	Measurement of volume by displacement	1
Measuring mass	To the nearest 0.2 g	1
	To the nearest 0.1 g	An extra 1
Measuring volume	To the nearest 1 mL or cm ³	1
Use of correct units of measurement	For mass: grams	1
	For volume: cubic centimeters or milliliters	1
Correct formula for calculating density	Mass/volume	1
Correct math in calculation		1
Logical presentation of results and calculations		1
Correct use of units for density (g/cm ³)		1
Identification of the substance	Based on their results and their calculation	1

^aMaximum points for Section A: 13.

Table 9.3 Assessment Rubric for Section B^a

Question	Answer	Question	Answer
1	c	4A	c
2	a	4B	d
3A	c	5A	c
3B	a	5B	b
3C	b	5C	b
3D	d	5D	c

^aAllow 1 point for each correct answer (maximum points for Section B: 12).

PREPARATION FOR LESSON 10

In Lesson 10, you will need to bring a bicycle to class to conduct a class discussion.