Collect

Mass

1. Find the mass of several objects. Record your results in the data table like the one shown here on the *Sink and Float Data Tables* page in the *Student Activity Book*.

Sink and Float

Object	*V* Volume in cc	*M* Mass in g	Sink or Float?	$\frac{M}{V}$ Ratio
steel sphere				
plastic sphere				
water			—	

2. Put each object into a pan of water. Record in the table whether it sinks or floats.
3. Do each of the objects that sink have more mass than the objects that float? If not, give an example.
4. Does whether an object sinks or floats depend only upon its mass? Explain.

Volume

5. Find the volume of the same objects. Record your results in the table.
6. Are each of the objects that sink larger in volume than the objects that float? If not, give an example.
7. Does whether an object sinks or floats depend only upon its volume? Explain.

***Student Guide* - Page 538**

Discuss

Now that you have collected and thought about your data, discuss again what properties of an object you think determine whether it will sink or float.

Density

Sinking or floating has something to do with both mass and volume. If something is heavy for its size, it will sink. If it is light for its size, it will float. We can measure heaviness by mass and size by volume. To help predict whether an object will sink or float, scientists compare an object's mass to its volume. To compare, they find the ratio of the object's mass to its volume. This ratio is called **density.**

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

For example, if a rock has a mass of M = 65 g and a volume of V = 23 cc, its density is

$$\frac{M}{V} = \frac{65 \text{ g}}{23 \text{ cc}}$$

Sinking and floating have something to do with density. We will explore this more by finding the density of some objects and looking for patterns in the data.

8. Complete data tables like the ones below on the *Sink and Float Data Tables* page in the *Student Activity Book*. Write the density of each object as a ratio of its mass to volume.

Sinks in Water

Object	Density as Ratio $\frac{M}{V}$
	$\frac{?\text{ g}}{?\text{ cc}}$

Floats in Water

Object	Density as Ratio $\frac{M}{V}$
	$\frac{?\text{ g}}{?\text{ cc}}$

***Student Guide* - Page 539**

Student Guide

Sink and Float (SG pp. 538–541)
Questions 1–20

1–2.* See Figure 2 in the lesson for a sample data table.

3. No. In our sample data, paraffin has more mass than the rock. But paraffin floats in water and the rock sinks.

4. No. From the sample data table we can see that clay sinks in water. In our sample data, wood has less mass than clay and wood floats. Paraffin has more mass than clay and it also floats. Therefore, whether an object sinks or floats does not depend only upon its mass.

5.* See Figure 2 in the lesson for sample data.

6. No. In our sample data, the piece of wood has more volume than the plastic or steel sphere, but wood floats.

7. No. From the data table we can see that clay sinks in water. In our sample data, the cork has less volume than clay and cork floats. Paraffin has more volume than clay and it also floats. Therefore, whether an object sinks or floats does not depend only upon its volume.

8.* See Figure 4 in the lesson.

*Answers and/or discussion are included in the lesson.

9.* Answers may vary. Possible patterns include:

If the mass of an object is larger than its volume (in cubic centimeters) then the object sinks in water; otherwise it floats. If the density of an object (in grams) is greater than $\frac{1 \text{ g}}{1 \text{ cc}}$, then the object sinks in water; otherwise it floats.

10.* Since the density of the object is $\frac{30 \text{ g}}{40 \text{ cc}}$, which is less than 1 g/cc, the object will float.

11.* We can't tell whether the object will sink or float. We need to know its volume also.

12.* The $\frac{M}{V}$ ratio of water is 1.

13.* The $\frac{M}{V}$ ratios of objects that sink are greater than the $\frac{M}{V}$ ratio of water. The ratios of objects that sink are greater than 1.

14.* The $\frac{M}{V}$ ratios of objects that float are less than the $\frac{M}{V}$ ratio of water. The ratios of objects that float are less than 1.

15. A.* Neither; they both weight 1 pound.

B.* 1 pound of lead is more dense than 1 pound of feathers.

Finding Patterns

9. Look at your tables. What patterns do you see about objects that sink and those that float in water? Write your conclusions in sentences.
10. An object has a mass of 30 g and a volume of 40 cc. Will it sink or float in water?
11. Will an object with a mass of 500 g sink or float in water?
12. What do you notice about the $\frac{M}{V}$ ratio for water that is different than the $\frac{M}{V}$ for the other objects?
13. What do you notice about the $\frac{M}{V}$ ratios of the objects that sink in relation to the $\frac{M}{V}$ ratio of water? Is it less than 1 or greater than 1?
14. What do you notice about the $\frac{M}{V}$ ratios of the objects that float in relation to the $\frac{M}{V}$ of water? Is it less than 1 or greater than 1?

Explore

15. A. Which is heavier, a pound of feathers or a pound of lead?
B. Which is more dense, a pound of feathers or a pound of lead?

540 SG • Grade 5 • Unit 11 • Lesson 3 Sink and Float

Student Guide - Page 540

*Answers and/or discussion are included in the lesson.

✓ Check-In: Questions 16–20

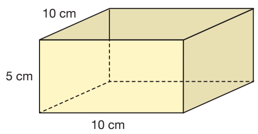
16. Jerome forgot to write down all the information on his Sink and Float table. Copy and complete his data table for him.

Sink and Float: Jerome

	Object	Sink or Float?	V Volume in cc	M Mass in g	$\frac{M}{V}$ Ratio
A.	rock	sink	8.3 cc	24.0 g	
B.	cork		13.0 cc	2.0 g	
C.	clay		14.1 cc	29.0 g	
D.	steel sphere (1 inch diameter)	sink	8.5 cc		
E.	plastic cap	float	8.5 cc		

17. How did you decide if the item in Question 16B was going to sink or float?
18. How did you choose the mass for Question 16D?
19. Ming and Jackie measured the volume and mass for different amounts of water and found the following ratios: 50 g/49 cc, 35 g/34.5 cc, 25 g/25 cc, 6 g/5.8 cc.
    A. Create a graph for Mass vs. Volume of Water using the ratios and draw a best-fit line through (0, 0). Title your graph and label the axes.
    B. Are the ratios equivalent? Write two reasons that support your answer.
20. A boat in the shape of a box is shown here.

    The mass of the empty boat is 150 g. How much extra mass can the boat hold before it sinks? Show your work.



***Student Guide* - Page 541**

16. **A.** $\frac{24 \text{ g}}{8.3 \text{ cc}}$

B. float; $\frac{2.0 \text{ g}}{13.0 \text{ cc}}$

C. sink; $\frac{29.0 \text{ g}}{14.1 \text{ cc}}$

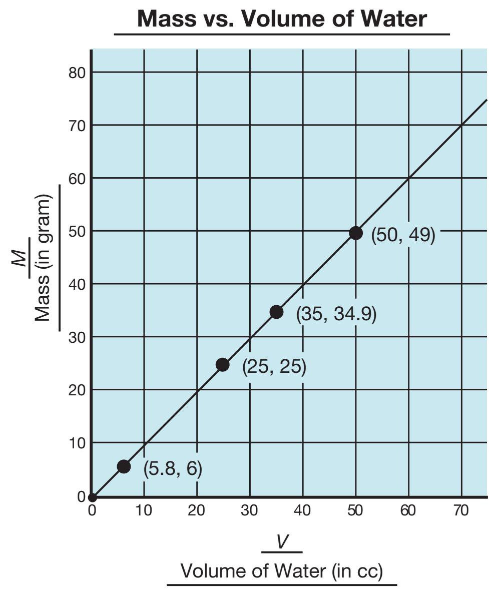
D. Answers will vary and show that the mass is greater than the volume. $M = ? > 8.5$ g; $\frac{M}{V} = ? > \frac{8.5 \text{ g}}{8.5 \text{ cc}}$

E. Answers will vary and show that the mass is less than the volume. $M = ? < 8.5$ g; $\frac{M}{V} = ? < \frac{8.5 \text{ g}}{8.5 \text{ cc}}$

17. The volume was greater than the mass, so the cork floats.

18. $M > 8.5$. Since the steel sphere sinks, I chose a value for the mass of the sphere that was greater than its volume of 8.5 cc.

19. **A.**



B.* Answers will vary. Students could make the case that the ratios are equivalent because they are all close to one and that the straight best fit-line goes through the point (0,0). On the other hand, students could make the case that the ratios are not equivalent because they do not exactly reduce to a common factor and are not equal to one.

20.* The volume of the box is 10 cm × 5 cm × 10 cm = 500 cc. The total mass of the boat (the mass of the empty boat and the mass of the load) cannot have more than 500 g. If the ratio $\frac{M}{V}$ is greater than 1, the boat will sink. Thus, as long as the extra mass is less than 350 g, the total mass will be less than 500 g and the boat will not sink.

*Answers and/or discussion are included in the lesson.

Homework (SG p. 542)
Questions 1–4

1. Answers will vary. Items sink because their mass is greater than their volume. Items float if their mass is less than their volume.
2. **A.** All of the blocks will sink because the mass is greater than the volume.

   B. Use multiplication and division to see that they are equivalent fractions.

   C. The blocks are probably made out of the same material because the $\frac{M}{V}$ ratios are equivalent, and they are part of the same block set. However, the blocks could be made out of different materials that have the same $\frac{M}{V}$ ratio.
3. **A.** The volume of the box is $10 \text{ cm} \times 5 \text{ cm} \times 10 \text{ cm} = 500 \text{ cc}$. The total mass of the boat (mass of the empty boat and the mass of the load) cannot be more than 500 or the boat will sink. If the ratio $\frac{M}{V}$ is greater than 1, the boat will sink. As long as the extra mass is less than 490 g, the total mass will be less than 500 g and the boat will still float.

   B. The boat will sink if the total mass (mass of the empty boat and the mass of the load) is greater than 500. Since the mass of the empty boat is 10 g and the volume of the boat is 500 cc, the total mass of the pennies needs to be greater than 490 g. $196 \text{ pennies} \times 2.5 \text{ g} = 490 \text{ g}$. Therefore, a load of 197 pennies or more will sink the boat.
4. Answers will vary.

   A submarine has chambers that sailors control and can open and close to fill with water or empty to fill with air. When the chambers are filled with water, the mass increases to be greater than the volume, and the submarine sinks; when the chambers are filled with air, the mass decreases to be less than the volume of the submarine, and the submarine floats.

Student Activity Book

Sink and Float Tables (SAB p. 443)

* See Figures 2 and 4 in the lesson for sample completed tables.

*Answers and/or discussion are included in the lesson.

Homework

1. Choose five household objects and find out if they sink or float in water. (Be sure to get permission to put the items in water.) Make a table showing your results

Sink and Float at Home

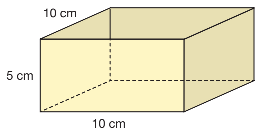
Object	Sink or Float?	Why did it sink or float?

2. John found the ratios for mass to volume for three different sized blocks from his sister's building set.

   Small block: 7 g/5 cc
   Medium block: 14 g/10 cc
   Large block: 21 g/15 cc

   A. Which blocks will sink and which blocks will float?
   B. What strategies could you use to find out if the ratios are equivalent?
   C. Do you think the blocks are made out of the same material? Why or why not?

3. An aluminum foil boat in the shape of a box is shown here. The mass of the empty boat is 10 grams.



   A. How much extra mass can the boat hold before it sinks? Show your work.
   B. How many pennies will it take to sink the boat if a penny's mass is 2.5 grams?

4. Why do you think a submarine can both sink and float in water?

542 SG • Grade 5 • Unit 11 • Lesson 3 Sink and Float

***Student Guide* - Page 542**

Name ______ Date ______

Sink and Float Tables

First practice finding the mass and volume of the first two objects in the table. Then continue to collect data.

Sink and Float

Object	V Volume in cc	M Mass in g	Sink or Float?	$\frac{M}{V}$ Ratio
steel sphere				
plastic sphere				
water			——	

Sinks in Water

Object	Density $\frac{M}{V}$ as Ratio

Floats in Water

Object	Density $\frac{M}{V}$ as Ratio

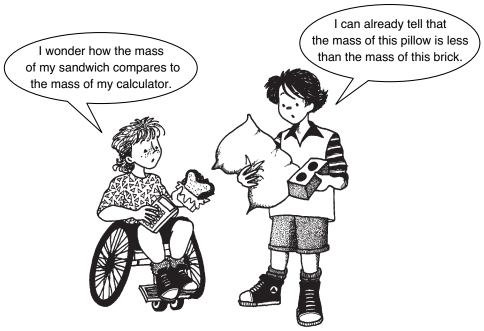
Sink and Float SAB • Grade 5 • Unit 11 • Lesson 3 443

***Student Activity Book* - Page 443**

Mass Review

What is mass?

Mass is the amount of matter in an object. We can get an idea about the mass of an object by lifting it up. Objects that weigh more than other objects have more mass.



If we want to compare the mass of two things, we can use a two-pan balance. But before we use the balance, we should make sure it is level. You can use a small piece of clay to level your balance by placing it on the side that is higher.

Teacher Guide **- Page 1**

Teacher Guide

Mass Review (TG pp. 1–2)

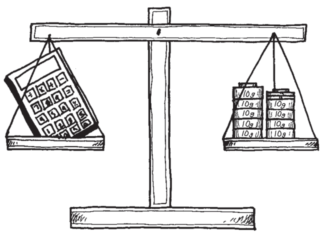
Michael used nine 10-gram masses, which is equal to 90 grams, and two 1-gram masses, which is equal to 2 grams, to give a total of 92 grams.

Volume Review (TG pp. 1–4)
Questions 1–4

1. 11 cc

To measure mass, we need a unit of measure. Common metric units of mass are the gram (g) and the kilogram (kg). A kilogram is 1000 grams. So, we measure the mass of small objects in grams and the mass of large objects in kilograms.

Michael used the two-pan balance to find the mass of his calculator. His standard masses have a mass of 1 gram and 10 grams.

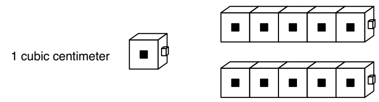


He found the mass was 92 grams. Can you see why?

Teacher Guide **- Page 2**

Volume Review

The **volume** of an object is the amount of space it takes up. A common metric unit of volume is the **cubic centimeter (cc),** the volume of a cube that is one centimeter long on each side.



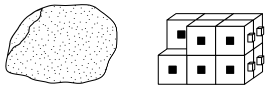
What is the total volume of these cubes?

A **milliliter (ml)** is another metric unit of volume. It is the same as 1 cubic centimeter.

A **liter (l)** is a metric unit used to measure the volume of larger objects. One liter holds 1000 milliliters; it also holds 1000 cubic centimeters.

We can estimate the volume of a rock by making a model of the rock using centimeter connecting cubes and counting the cubes.

1. Estimate the volume of the rock in the picture by counting the cubes.



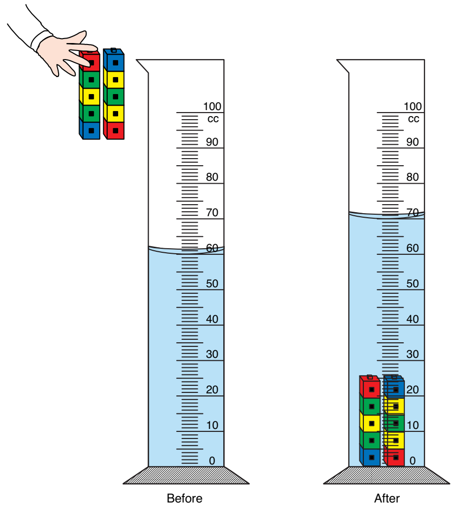
Teacher Guide **- Page 1**

2. A. 60 cc
   B. 10 cc
3. A. Read the water level at eye level. Read the lower line at the meniscus.
   B. He should not pick up the graduated cylinder and tip it to read the water level. He should not look down from the top of the graduated cylinder to read the water level.
4. Jerome can compare the volume of the rock he found when he made the model out of cubic centimeters with the measurement he found by water displacement.

Measuring Volume by Displacement

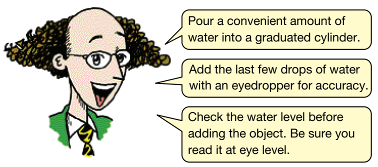
We can also measure the volume of an object using a graduated cylinder. This method is called **measuring volume by displacement** because you find out how much water the object displaces or pushes away.

2. Look carefully at the scale of the graduated cylinder before the cubes are added.
   A. How much water is in this graduated cylinder?
   B. How much water did the cubes displace or push away?



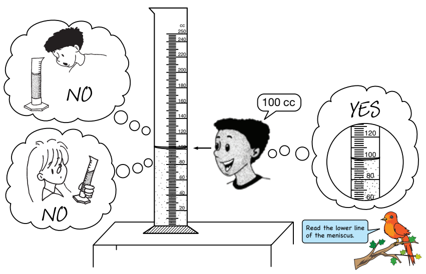
Teacher Guide - Page 2

Professor Peabody shows Jerome how to accurately measure the volume of the rock by displacement.



Jerome reads the graduated cylinder to check the water level. He tries to remember what he should do and what he should not do.

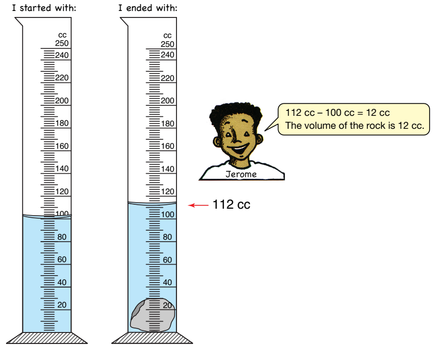
3. A. What should Jerome do?
   B. What should Jerome not do?



Teacher Guide - Page 3

Jerome carefully added a rock to the graduated cylinder.

He then calculated the volume.



4. How can Jerome check the reasonableness of his volume measurement? [Hint: Use Question 1.]

Teacher Guide - Page 4