MEASURING MASS

BENCHMARK and TASKS

SC.A.1.2.1 The student determines that the properties of materials (e.g., density and volume) can be compared and measured (e.g., using rulers, balances, and thermometers).

- The student determines the mass of equal volumes of various materials using metric tools.
- The student determines the mass of a given volume of water to discover that the mass and volume of water are equal (e.g., 10 mL of water = 10 g)**.**

KEY QUESTION

Do materials with equal volume also have equal mass?

BACKGROUND INFORMATION

Mass is defined as the measure of the amount of **matter** in a **solid**, **liquid**, or **gas**. All solids, liquids, and gases have mass because they are all made of matter. Mass is recorded in units such as kilograms or grams. The amount of space that an object or substance takes up is defined as **volume**. Volume is measured in units such as liters. The mass and volume of water are equal (e.g., 1 mL = 1 g).

The materials in this activity all have the same volume. They take up an equal amount of space, but they have a different mass. This is because they have different **densities.** This beginning investigation can help students build their background knowledge for understanding density.

MATERIALS

Per group

1 graduated cylinder
4 baby food jars
1 balance with gram set
paper towels
masking tape
1 permanent marker

3 oz. cup of each solid
macaroni
popcorn kernels
sand
pinto beans

100 mL of each liquid
water
orange juice
milk
liquid soap

Per student

activity sheets

Teacher

tray

Per class

4 large containers of each of the liquids
4 large containers of each of the solids
4 index cards for leveling the solids

TEACHING TIP

Have students measure the liquids they will need for Part 2 of the activity:

- Use a graduated cylinder to measure 100 mL of water.
- Pour 100 mL of water into each of the four baby food jars.
- Mark the 100 mL level with masking tape.
- Empty the water.
- Use masking tape and a permanent marker to label the four containers with the names of the liquids.
- Pour 100 mL of each liquid into the labeled jar.

ENGAGE (Part 1)

Display a tray holding the 3 oz. cups containing the solid materials the students will be exploring. Show them that each material takes up exactly the same amount of space – 3 oz., so they are all equal in volume. Ask students if they think the substances are also equal in mass.

EXPLORE (Part 1)

1. Have one student from each group go to a designated table and fill four 3 oz. cups to the brim with each of the four substances: popcorn kernels, sand, pinto beans, and macaroni. Use an index card to level each material.
2. Ask students to heft (lift) the materials, predict their order from heaviest to lightest, and record.
3. Distribute the balances and gram sets and direct students to predict the mass of the first material and record on the data sheet. Then have them find the actual mass and record this on the data sheet.
4. Have students continue this process - predict and then measure each material - until they have found the estimated and actual mass for each of the four materials.

EXPLAIN (Part 1)

How did the order for mass determined by hefting compare with the actual order after measuring?
How did you know that all the materials had the same volume? (Each one occupied the same amount of space in the 3 oz. cups.)
Did all the materials have the same mass? (no)
Why do you think the materials had different masses?
Which solid had the most mass?
Which solid had the least mass?
What can you conclude about the masses of solid materials when their volumes are equal? (The masses are not likely to be equal, even though the volumes are.)

ENGAGE (Part 2)

We measured different kinds of solid materials earlier, and learned that even though they had equal volumes, they did not have equal masses. Ask: *What else could we measure in the same way?* (liquids)

EXPLORE (Part 2)

1. Tell students they are going to repeat the activity they did earlier, but this time they will be exploring the mass of equal volumes of different liquids: milk, orange juice, water, and liquid soap.
2. Have students use the graduated cylinder and the baby food jars to measure exactly 100 mL of each liquid. Label the jars with masking tape.
3. Have students estimate the mass of each liquid and then find the actual mass and record.
4. Have students continue this process – predict and then measure each material - until they have found the estimated and actual mass for each of the four materials.

EXPLAIN (Part 2)

Did all the liquids have the same volume? (yes)
Did all the liquids have the same mass? (no)
Why do you think the liquids had different masses?
Which liquid had the most mass?
Which liquid had the least mass?
What can you conclude about masses of liquids when their volumes are equal? (The masses are not likely to be equal, even though the volumes are.)
How does this investigation compare with the investigation of the solid materials?

EXTEND/APPLY

Student instructions:

- Find the mass of the empty graduated cylinder.
- Pour 20 mL of water into the graduated cylinder.
- Find the combined mass of the graduated cylinder and the water.
- Subtract the two measurements to find the mass of the 20 mL of water.
- Observe that the 20 mL of water has a mass of *approximately* 20 g because the mass and volume of water are equal.
- Predict in grams the mass of 10 mL of water.
- Repeat the above procedure. (The 10 mL of water has a mass of 10 g.)
- What would the mass of one mL of water be? (1 mL of water has a mass of 1g.)

ASSESSMENT

Have students respond in their journals about what they would expect to find if they investigated to find the mass of four different substances of equal volume: 5 oz. each of pasta, salt, sugar, and dirt.

NAME _____

MEASURING MASS

VOLUME AND MASS OF LIQUIDS

LIQUID	WATER	MILK	JUICE	LIQUID SOAP
VOLUME				
PREDICTED MASS				
ACTUAL MASS				

NAME _____

MEASURING MASS

VOLUME AND MASS OF SOLIDS

Heft (lift) the four solids and predict their order according to mass by writing the name of each solid on the lines in order from heaviest to lightest.

_____ _____ _____ _____

SOLID	POPCORN KERNELS	SAND	PINTO BEANS	MACARONI
VOLUME				
ESITMATED MASS				
ACTUAL MASS				