Date: _____

Your Name: _____

New England Common Assessment Program

Released Science Inquiry Task

Density

2013

Grade 8

Science

Directions:

In this task, you will read a story about a student in a science class investigating the density and volume of two objects she found. You and a partner will conduct the same scientific investigation about density. You will measure the mass and volume of two objects and use calculations to determine the density of each object.

The following Word Bank defines the terms that you will need to understand throughout this investigation.

Word Bank

Average (mean)	a typical number for a data set; a value that is found by dividing the sum of a set of terms by the number of terms **Example:** The average of 4, 5, and 9 is $\frac{(4 + 5 + 9)}{3} = 6$.
Density	a ratio of mass over volume $\left(D = \frac{m}{V}\right)$
Fulcrum	the support, or point of rest, on which a lever turns when moving an object
Mass	the amount of matter in an object
Trial	each time you repeat the same step of an investigation
Volume	the amount of space that an object takes up
Water displacement	a method of measuring volume where a solid object is added to water in a cylinder and the increase in the height of the water in the cylinder is measured **Example:** If a cylinder contains 30 mL of water and adding an object causes the water to rise to 40 mL, the object has a volume of 10 mL. The volume of the object (10 mL) has displaced an equal volume of water (10 mL).

GO ON

Jennifer's Exciting Find

Jennifer was walking along an ocean beach in Rhode Island with her grandfather. She was using her grandfather's metal detector to try to find metal objects in the sand. While they were walking, Jennifer's grandfather told her the story of the HMS *Gaspee*, a British ship that was burned by Rhode Island colonists in 1772. Soon, the metal detector started to beep. Jennifer's grandfather held the detector over the sand while Jennifer began to dig. She felt one object and then another. She pulled them out of the sand and brushed them off. It looked like she had found a coin and a nugget of some kind of metal. Jennifer wondered if the objects were valuable. Her grandfather thought the objects might have been washed up on the beach from the *Gaspee*. He suggested she take the objects to school and talk with her teachers. Her science teacher might be able to help her identify the type of metal in each object, and her history teacher might be able to help her identify the types of objects that could have come from the ship.

Jennifer's science teacher asked the students to design an investigation for the whole class to determine the identity of the objects that may have come from the ship. The students decided they would investigate density. You will have the same materials for an investigation on density as Jennifer's class.

The teacher had the class focus on the following research question:

Can the property of density alone be used to determine the identity of an object?

You will answer the same research question.

Materials for the Investigation:

- 1 coin
- 1 nugget
- 1 bag of 25 cubes, each cube with a mass of 1 g
- two 40 mL graduated cylinders
- 1 single-beam balance and fulcrum
- 2 small plastic cups
- 1 large plastic cup with water
- paper towels

GO ON

Making a Prediction

Use the information from the story and what you already know about the properties of objects and substances to make a prediction **on your own** about the students' research question:

Research Question:

Can the property of density alone be used to determine the identity of an object?

Write your prediction.

Explain the reasoning for your prediction.

GO ON

Conducting Your Investigation

You and your partner will first measure the mass and volume of each object and then calculate the density of each object.

Part A. Measuring Mass: You will use a single-beam balance and gram cubes to measure the mass of each metal object. Each cube has a mass of 1 g.

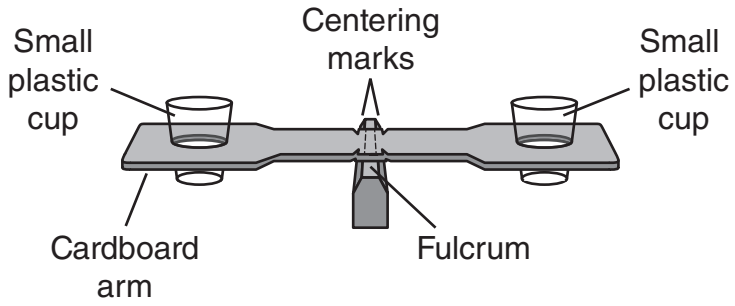
Procedure:

1. To assemble the single-beam balance (refer to the diagram below):

    a. Set the two small plastic cups in the cardboard arm. Do not bend the cardboard.

    b. Balance the arm and the two cups on the small wood block (the fulcrum). Use the centering marks to place the center of the cardboard arm on the fulcrum, as shown in the diagram below.

Single-Beam Balance



    c. Make sure that the cardboard arm is balanced on the fulcrum.

2. For consistency during each trial:

    a. Be sure to place the object in the left cup and the gram cubes in the right cup.

    b. Be sure to rebalance the cardboard arm after the object is placed in the cup.

3. To measure the mass of the coin, place the coin in the left cup and carefully add gram cubes, one at a time, to the other cup until the cardboard arm is balanced again.

4. Record the mass of the coin for **Trial 1** in the data table on page 5. Remember, each cube has a mass of 1 g.

5. Remove the coin and the cubes from the cups. Repeat steps 3 and 4 to obtain data for **Trial 2** and **Trial 3**. Be sure to record the mass of the coin for these trials in the data table.

6. Remove the coin and the gram cubes. Repeat steps 2–5 using the nugget.

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7. Use the measurements for Trials 1–3 in the data table to calculate the average mass of the coin and of the nugget. Record the average masses, to the nearest tenth of a gram, in the data table. Do not record the volume until you reach that step in Part B.

Data Table: Mass, Volume, and Density of Found Objects

Object		Mass (g)	Initial Volume (mL)	Final Volume (mL)	Volume of Objects (mL) (final volume – initial volume)	Density (g/mL)
Coin	Trial 1					
	Trial 2					
	Trial 3					
	Average					
Nugget	Trial 1					
	Trial 2					
	Trial 3					
	Average					

8. Go on to the next page to begin Part B.

GO ON

Part B. Measuring Volume: You will use the water displacement method.

Procedure:

1. Use the large plastic cup to fill each of the two graduated cylinders with approximately 30 mL of water. Record the volume of the water to the nearest milliliter in the row for **Trial 1** in the "Initial Volume" column of the data table on page 5.

2. Gently place the coin inside one graduated cylinder. Then gently place the nugget in the other graduated cylinder.

3. Record the final volume for each object in the row for **Trial 1** in the "Final Volume" column of the data table on page 5. Subtract the initial volume from the final volume to calculate the volume of each object.

4. Pour the water from each graduated cylinder into the large plastic cup and remove the object from each cylinder. Use the paper towels to dry off each object. **Make sure each object is dry before moving on to the next step.**

5. Repeat steps 1–4 for **Trial 2** and **Trial 3**.

6. Use the measurements for Trials 1–3 in the data table to calculate the average volume of the coin and of the nugget. Record the average volumes to the nearest tenth of a milliliter in the data table.

Part C. Calculating Density: You will use the averages for mass and volume in the data table to calculate the density (refer to the Word Bank) of the coin and the nugget.

Procedure:

1. Calculate the density of the coin. Record your calculation in the "Density" column of the data table on page 5.

2. Calculate the density of the nugget. Record your calculation in the "Density" column of the data table on page 5.

Reminder:

After completing the investigation and all the sections of your data table, follow your teacher's instructions for cleaning up the workspace.