Calculating Densities of Earth's Materials Lesson Plan

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Course Name: 7th Grade Integrated Science

Core Curriculum Standard Fulfilled: Standard II: Students will understand the relationship between properties of matter and Earth's structure.

Core Curriculum Objective Fulfilled: Objective 1: Examine the effects of density and particle size on the behavior of materials in mixtures.

Intended Learning Outcomes (ILOs) Fulfilled:

#1: Use Science Process and Thinking Skill;

1d. Select the appropriate instrument; measure, calculate, and record in metric units, length, volume, temperature and mass to the accuracy of instruments used.

3: Demonstrate Understanding of Science Concepts and Principles;

3d. Solve problems appropriate to grade level by applying scientific principles and procedures.

Time Needed To Complete Inquiry: Two 45 minute class periods

Inquiry:

a. What is the research question to be scientifically investigated by the students?

1. What is the density in g/cm^3 of several materials that are found in the earth?

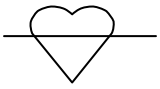
b. Will you use Structured Inquiry, Guided Inquiry, or Open Inquiry as the teaching method? **This is a Confirmation Activity**

Prior Knowledge Needed:

a. What background knowledge and skills do the students need to be prepared for this inquiry?

1. They need to know how to calculate the volume of a rectangular block.
2. They will also need to know how to find the mass using a triple beam balance.
3. They will need to know how to find the volume of an irregular solid using a graduated cylinder by using the water displacement method.

4. They will need to know the mathematical equation for density:

Density = Mass / Volume or (D = )

Teacher information: Here are some common densities

Substance	Density (g/cm^3)
Air	0.0013
Wood(Oak)	0.6 - 0.9
Ice	0.92
Water	1.00
Bricks	1.84

Aluminum	2.70
Quartzite	2.70
Steel	7.80
Silver	10.50
Gold	19.30

b. How will they obtain it?

1. Teachers should give students the mathematical equation for density.
2. Teachers should spend time covering with the students the way the find mass and volume of both liquids and solids.

Introduction:

a. Tell how you will introduce the inquiry to your students to make it meaningful and relevant.

Students need to understand how an understanding of density can help people solve problems. A good way to start the lesson is to tell the famous story of Archimedes and the King's gold crown:

Density
by Martha Marie Day, Ed.D., Anthony Carpi, Ph.D.

Sometime around 250 b.c., the Greek mathematician Archimedes was given the task of determining whether a craftsman had defrauded the King of Syracuse by replacing some of the gold in the King's crown with silver. Archimedes thought about the problem while relaxing in a bathing pool. As he entered the pool, he noticed that water spilled over the sides of the pool. Archimedes had a moment of epiphany. He realized that the amount of water that spilled was equal in volume to the space that his body occupied. This fact suddenly provided him with a method for differentiating a mixed silver and gold crown from a pure gold crown. Because a measure of silver occupies more space than an equivalent measure of gold, Archimedes placed the craftsman's crown and a pure gold crown of equivalent mass in two tubs of water. He found that more water spilled over the sides of the tub when the craftsman's crown was submerged. It turned out that the craftsman had been defrauding the King! Legend has it that Archimedes was so excited about his discovery that he ran naked through the streets of Sicily shouting "Eureka! Eureka!" (the Greek word for "I have found it!").

Archimedes had used the concept of density to expose the fraud. Density is a physical property of matter that describes the degree of compactness of a substance - in other words, how closely packed together the atoms of an element or molecules of a compound are. The more closely packed together the individual particles of a substance are, the more dense that substance is. Since different substances have different densities, density measurements are a useful means for identifying substances.

After the story discuss with the students the procedure of determining density using water displacement.

Materials / Resources needed for the Investigation:

1. Triple Beam Balance
2. Graduated Cylinder
3. Water
4. Pebbles or small rocks
5. Blocks of wood
6. Steel nuts or washers
7. Calculator (optional)

Procedures of the Investigation:

a. Describe the actual investigation:

- In this investigation students will be comparing and calculating the densities of water, pebbles, wood, and steel. The teacher will begin by giving the students the experimental problems:
    1. "What is the calculated density of at least three different earth materials including water?"
    2. "Which are the densest and which is the least dense: Water, pebbles, wood, or steel?
- After giving the students their problems, break the students up into groups of 2-4 depending on class size and equipment available.
- Have the students work together to solve the problems, but make sure each student completes his/her own lab sheet.

b. What will the students do?

- The students will be measuring the volume of several earth materials.
- The students will be measuring the mass of several earth materials.
- The students will be calculating the density of several earth materials
- The students will be filling out a lab sheet which requires the students to:
    1. predict comparative densities.

2. write a procedure
3. record data in a data table
4. calculate density in g/cm^3 or g/ml
5. create a bar graph comparing data
6. form a conclusion

Data Collection:

a. How will students collect and organize data (tabulation)?

The students will be placing the data in a data table in order to organize data. They will also be creating bar graphs in order to compare the different densities.

Data Analysis:

a. How will students be able to interpret the data (e.g., graphs), to reach consensus (if appropriate)?

They will see that the largest bar on the bar graph is the object with the highest density and the smallest bar has the lowest density.

Assessment:

a. How will you know that your students have met the objective?

Create a data table for the entire class on the white board. Have the students record density values on the board for the substances they have measured. Have students account for variances and determine the value of repeating trials.

Density Lab Sheet

Problem: Calculate the density of several materials.

Prediction: _____

Materials Needed to Solve Problem: (*you don't have to fill in every blank*)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____

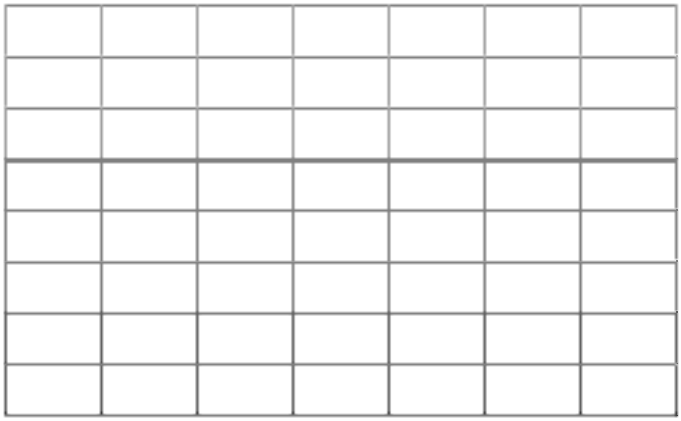
Procedure:

1. _____
   _____
2. _____
   _____
3. _____
   _____
4. _____
   _____
5. _____
   _____

Data Table:

	Mass (grams)	**Volume (milliliters or cm^3)**	**Density g/cm^3 or g/ml**
Water			
Pebbles			
Wood Blocks			
Steel (nuts)			

Graph: *(complete a bar graph comparing densities)*



Conclusion: _____

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