Determining Density
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An Introduction to Density

Density is a property of a material that compares the mass of an object and its volume. The density of a substance can assist us in identifying an element or mineral. The density also may cue us about the changes in a substance, such as water, when it goes through a density shift near its freezing point.

Finding the Density of a Regular-shaped Object

Finding the density of a regular-shaped object is very straightforward. Density equals mass divided by volume

The formula for Density is:  \[ D = \frac{M}{V} \]

First, find the volume of the object by measuring the length, the width, and the height in centimeters. Multiply the three dimensional values together. The units will be expressed as cm\(^3\).

\[ V = L \times W \times H \]
\[ V = 10\text{cm} \times 6\text{cm} \times 2\text{cm} \]
\[ V = 120\text{cm}^3 \]

Next, find the mass by using a triple beam balance. Record the mass in grams.

Now, find the density of each regular-shaped object by taking the mass of the object and dividing it by the volume as the formula above indicates.

Show Your Work Below:

<table>
<thead>
<tr>
<th>Object #1</th>
<th>Object #2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name Object:</td>
<td>___________</td>
</tr>
<tr>
<td>Object Mass:</td>
<td>___________</td>
</tr>
<tr>
<td>Object Length:</td>
<td>___________</td>
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<tr>
<td>Object Width:</td>
<td>___________</td>
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<tr>
<td>Object Height:</td>
<td>___________</td>
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<tr>
<td>Object Volume:</td>
<td>___________</td>
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<tr>
<td>Object Density:</td>
<td>___________</td>
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</tbody>
</table>
Determining Density

**MATERIALS NEEDED**
- Graduated cylinder
- Irregular-shaped objects
- Metric ruler
- Regular-shaped objects
- Triple-beam balance

**Students should be able to:**
- Calculate the density of regular and irregular-shaped objects

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**Finding the Density of an Irregular-shaped Object**

Take a large object and submerge it in a pail of water. Take a small object and submerge it in a pail of water. What are your observations? Try two other objects of different volumes. What did you notice? The volume of the object gets displaced by an equivalent amount of water. Therefore we can determine the volume of an object by measuring the amount of water that it displaces. Using graduated cylinders or large beakers makes these measurements easier to read.

Find a rock or mineral specimen that will fit into a graduated cylinder.

While dry, measure the mass of the object using the triple beam balance.

Object Mass: ______________________

Find the volume of water displaced by your selected specimen.

Object Volume: ______________________

Calculate the density of the object and show your work.

Object Density: ______________________

**Questions:**

1. Does the density of an object change if you take it to the moon?
   _______________________________________________________________________

2. If an object is split into two parts, what happens to the density?
   _______________________________________________________________________
   _______________________________________________________________________

3. Explain what is happening in the following series of numbers and units.
   3 cm, 3cm², 3cm³
   _______________________________________________________________________
   _______________________________________________________________________

4. What are some possible sources of error in the density calculations used with the displacement of water method?
   _______________________________________________________________________
   _______________________________________________________________________

5. Calculate below the percent error for your sample.
   What does the percent error tell us?
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
   _______________________________________________________________________
Density Calculations

For the calculation of the densities choose two regular-shaped objects that are similar in volume with very different masses. Use a known substance with a known density for the irregular-shaped object.

Also, review the percent error formula:

\[
\% \text{ error} = \frac{\text{(experimental value)} - \text{(true value)}}{\text{true value}} \times 100
\]

Have the students calculate their % error given the actual density of the material. Discuss their percent error values.

New York State Standards

Middle School Activity

Standard 1: Math: Key idea 1
Standard 4: Key idea 3