Lab Framework

Text: CORD Applied Math

Unit number and title: Unit 11 Using Signed Numbers and Vectors

Short Description: Determine the mass of objects by displacement of water. Items that sink can be placed in a container that will float.

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Lab Title

Find the Mass of Anything…at Least if It Is Small Enough to Fit in a Cup.

LAB PLAN

TEACHER: Teacher Prep/ Lesson Plan

- **Lab Objective**

  By measuring the mass of the displaced water we can calculate the mass of the object we are measuring. Use 1 gram= 1cc of water. (This is true at very near 4 degrees C. for distilled water, however for the purposes of this lab, the difference is too small to cause additional error of measurement.)

- **Statement of pre-requisite skills needed** (i.e., vocabulary, measurement techniques, formulas, etc.)

  Metric measures of mass and volume.
  Displacement of water and why/how/what level objects float.
  Graduated cylinder to measure volume of water displaced.
  Basic math skills.
  1cubic centimeter(cc)= 1 gram

- **Vocabulary**

  Negative number
  Positive number
  Absolute Value
  Displacement
  Direct proportion
  Inverse proportion

- **Materials List**

  Graduated cylinder…200 cc or larger should be okay.
  Water to partly fill the graduated cylinder.
  1 Paper cup or 1 glass small enough to fit inside the graduated cylinder.
  Tongs
  Various small objects you would like to measure the mass.
  Paper, pencil.

- **GLEs (State Standards) addressed:**

  Math: **1.1.4 Understand the concept of inverse proportion and apply direct and inverse proportion. W**

  2.2.2 Apply mathematical concepts and procedures from number sense, measurement, geometric sense, probability and statistics, and/or algebraic sense to construct solutions.

4.2.1 Organize, clarify, and refine mathematical information relevant to a given purpose. W

Reading: **3.2.2 Apply understanding of complex information, including <u>functional documents</u>, to perform a task.**

Writing: **1.5.1 Publishes in formats that are appropriate for specific audiences and purposes.**

- **Leadership Skills**
  Group Skills:
  2.1 The student will communicate, participate, and advocate effectively in pairs, small groups, teams, and large groups in order to reach common goals.
- **SCAN Skills/Workplace Skills**
  Responsibility:
  A. Exerts a high level of effort and perseverance towards goal attainment.
  Self-Esteem:
  B. Demonstrates knowledge of own skills and abilities.
  Sociability:
  C. Relates well to others
- **Set-up information**
  1. Choose several small objects which will fit into a paper cup or the graduated cylinder. Test which objects float and which don't by placing each into a bowl of water. The objects that float can be placed into the water in the graduated cylinder directly during measuring without being placed in a paper cup first.
  2. Test the sinkers by placing each in the paper cup and put the paper cup containing the object into the bowl to make sure that floats. If that sinks as well(like a solid piece of iron in the paper cup) choose a larger paper cup or a smaller piece of the material being measured.
  3. Carefully record the level of the water in the graduated cylinder (L1).
  4. Place the first object in the graduated cylinder and record the new water level(L2).
  5. Remove that object and record the water level after removing that object to reduce error from water sticking to each object. More water can be added and/or removed as necessary to make the measurements.
  6. Place the paper cup into the graduated cylinder and measure the water level.
  7. Replace the object in the cup with the other objects one at a time recording the water levels each time.
  8. Calculate displacement by L1-L2. The number will be the negative volume displaced and the and the absolute value of the negative volume displaced in cc will be the mass of each object in grams.
  9. Calculate the mass of each object in this manner.

- **Lab organization**(-Grouping/leadership opportunities/cooperative learning expectations; -**Timeline required)**
  Students work in pairs.
  Day 1 set up equipment, perform procedure, and collect data,
  Day 2 Do calculations and organize data.
- **Teacher Assessment of student learning** (scoring guide, rubric)

Participation in measurements, Data is collected and calculations are accurate.

- **Summary of learning** (to be finished after student completes lab)
  -discuss real world application of learning from lab
  -opportunity for students to share/present learning

Discussion of water displacements of boats and ships to determine the cargo capacity based on water displacement.

Question: How does the Coast Guard determine safety of boat and ship capacities?

- **Optional activities**
  Find mass of objects by using a balance scale and comparing these results to the data gotten from water displacement.
- **Career Applications**
  Coast Guard, ship engineering, boat design.

LAB TITLE: Find the Mass of Anything…At Least if It Is Small Enough to Fit in a Cup

STUDENT INSTRUCTIONS:

- **Statement of problem addressed by lab**

  How can I determine the mass of objects by floating them in water?

- **Grouping instructions and roles**

  Work in pairs.

- **Procedures** – steps to follow/instructions

  1. Choose several small objects which will fit into a paper cup or the graduated cylinder. Test which objects float and which don't by placing each into a bowl of water. The objects that float can be placed into the water in the graduated cylinder directly during measuring without being placed in a paper cup first.

  2. Test the sinkers by placing each in the paper cup and put the paper cup containing the object into the bowl to make sure that floats. If that sinks as well(like a solid piece of iron in the paper cup) choose a larger paper cup or a smaller piece of the material being measured.

  3. Carefully record the level of the water in the graduated cylinder (L1).

  4. Place the first object in the graduated cylinder and record the new water level(L2). The displaced water in milliliters(1milliliter = 1 gram) is the inverse proportion of the mass of the object in grams.

  5. Remove that object and record the water level after removing that object to reduce error from water sticking to each object. More water can be added and/or removed as necessary to make the measurements.

  6. Place the paper cup into the graduated cylinder and measure the water level.

  7. Replace the object in the cup with the other objects one at a time recording the water levels each time.

  8. Calculate displacement by L1-L2. The number will be the negative volume displaced and the and the absolute value of the negative volume displaced in cc will be the mass of each object in grams. Remember that the displaced water in ml. is the inverse proportion of the mass of the object in grams.

  9. Calculate the mass of each object in this manner.

- **Outcome instructions**

  Each group to have one data sheet with agreed upon values.

  Calculations to show displacement(negative value) and mass of object(absolute value of displacement)

- **Assessment instructions** (peer-teacher)

  Each student to check each others observations and calculations.

  Teacher to do spot checks on observations and calculations.

Lab Data Collection

Student: _____ Date: _____

Unit: Unit 11 Using Signed Numbers and Vectors

Lab Title: Find the Mass of Anything…at Least if It Is Small Enough to Fit in a Cup.

Criteria: Write the problem/objective in statement form

Data Collection: Record the collected/given data

Use a data collection form with the following headings:

Object floated ml L1 ml L2

Calculations: Complete the given calculations to solve for an answer(s)

Object floated ml L1 ml L2 L1 – L2 lL1 –L2l Mass in grams

Summary Statement:

Other Assessment(s)