

Lab Framework

Text:CORD Classic

Unit number and title:Unit 15 - Using Formulas to Solve Problems

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Lab Title

Radius & Volume of a Sphere

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Short Description: The student will measure the diameter of 2 different spheres and determine the volumes of the sphere(s). They will measure the volume of a fixed number of each of the 2 spheres by the "water displacement method. An average volume for each sphere will be calculated and a comparison of this average volume to the calculated volume will be explored. The student will also calculate the radius of a sphere, given its volume.

LAB PLAN

TEACHER: Teacher Prep/ Lesson Plan

- **Lab Objective**

The students will calculate the volume of a sphere and use the water displacement method to measure volume.

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

Students will need to be familiar with diameter measurement tools. The student will need to understand how to measure using the metric system. The student will need to know how to convert a measurement from inches to centimeters.

- **New Vocabulary**

water displacement method
radii
radius of the sphere

- **Materials List**

5- 3/8th inch ball bearings
100 BB's
micrometer or vernier caliper
10-ml graduated cylinder
calculator

- **GLEs addressed**

Math: 1.1.8 - Apply understanding estimation strategies to determine the reasonableness of results.

1.2.6 - Understand and apply strategies to obtain reasonable measurement at an appropriate level of precision

Reading: (Reading)

Writing: (Writing)

- **Leadership Skills**

1.4 - The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions.

- **SCAN Skills**

Arithmetic

A. Performs basic computations

D. Uses tables, graphs, diagrams, and charts to obtain or convey quantities.

Mathematics

A. Approaches practical problems by choosing appropriately from a variety of mathematical techniques.

- **Set-up information**

- Handout worksheet and go over with students.

- Have the student collect the equipment needed. Have the students use a micrometer or vernier caliper to measure the ball bearings and do the conversions and calculate for volume and record data. Other students in the group can prepare graduated cylinder and begin putting the ball bearings in one at a time and record the data. Repeat the process with the BBs

- **Lab organization**(-Grouping/leadership opportunities/cooperative learning expectations; **-Timeline required**)

- Cooperative learning groups will be used to include a reader, recorder, equipment operator.

- Students organized into teams of 4.

- **Teacher Assessment of student learning** (scoring guide, rubric)

- Completion of lab & worksheet

- Accuracy of data and outcomes

- **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

- Discuss which is the most effective method by considering accuracy as a primary outcome.

- Discuss how you can apply this to industry settings.

- **Optional activities**

- Try the experiment on your own with other type of dense spheres.

- Is there another method that could be used to measure volume of a sphere?

- **Career Applications**

- Measurement is used in every job.

- Understanding displacement created when substances are placed in containers with or without liquids.

LAB TITLE: Radius and volume of a sphere

STUDENT INSTRUCTIONS:

- **Statement of problem addressed by lab**

In this activity you will:

- measure the diameter of two different spheres.
- calculate the volumes of the spheres.
- measure the volume of a fixed number of each of the sphere types by the "water displacement method.
- calculate the average volume to the calculated volume
- calculate the radius of a sphere, given its volume

- **Grouping instructions and roles**

Groups of 4

Identify a reader, recorder, and 2 equipment operators

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

You will need to create a data sheet to collect the information you collect.

1. Use the micrometer to measure the diameter of the 3/8" ball bearing.
2. Convert this measurement from inches to centimeters. (to the nearest .001cm)
3. Enter this on the data sheet.
4. Calculate the volume of the ball bearing using the formula that can be found on page 3. (Question: did you measure the diameter or the radius of the sphere?)
5. Record this information
6. Fill the 10 ml graduated cylinder with water to about the 5 ml mark.
7. Read the initial volume of the water and record it.
8. Add the ball bearings one at a time until all 5 are in the graduated cylinder.
9. Read the final volume of water and record it.
10. Subtract the initial volume from the final volume and divide this volume change by the number of ball bearings added to get average volume of a ball bearing. ($v_f - v_i / 5$ ball bearings = average volume of a ball bearing) and record the number.
11. Compare the average volume you calculated in step 10 to the calculated volume you calculated in step 4.
12. Next compare the average radius to 1/2 the diameter of the ball bearing measured with the micrometer/ vernier calipers. Use the average volume calculated in Step 10 and the formula for the volume of a sphere to calculate an average radius.
13. Repeat Steps 1 thru 12 this time using the 100 BBs.

- **Outcome instructions**

Use a piece of lined paper for the following questions. Write the question and then then discuss it with the group and come up with an agreed answer.

Write a statement for the following questions.

1. How do the average measured volumes compare to the calculated volumes?
2. How do the average radii compare to 1/2 the measured diameters.

3. Which method of measuring volume of a sphere do you think is more accurate? Defend your answer by writing down your reasoning.

- **Assessment instructions** (peer-teacher)
 - Check data sheets to see if information was entered properly.
 - Observe the groups activity.
 - Evaluate the 3 Questions.

Lab Data Collection

Student: _____ **Date:** _____

Unit: 15

Lab Title: Radius and volume of a sphere

Criteria: Write the problem/objective in statement form

Data Collection: Record the collected/given data

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

Summary Statement:

Other Assessment(s)