Lab Framework

Text: CORD Unit 15 Soup Can Lab

Unit number and title: Unit 15 Soup Can Lab

Short Description: Make three models of cans (cylinders) out of paper. The first two will be pre described and the last will be a surface area to volume challenge.

Developed by: Jim Welsch

Contact Information: Central Kitsap High School
jimw@cksd.wednet.edu

Lab Title

Unit 15 Soup Can Lab

LAB PLAN

TEACHER: Teacher Prep/ Lesson Plan

- **Lab Objective**
  - To Familiarize students with the formulas, and vocabulary for surface area and volume of a cylinder and also notice a relationship between the two.
  - **Statement of pre-requisite skills needed** (i.e., vocabulary, measurement techniques, formulas, etc.)
    Basic measurement skills in the metric system.
    Use of scissors, and accurate cutting
    Exposure to the formulas for surface area and Volume for a cylinder
    Use of a calculator.

  - **Vocabulary**

    Surface Area
    Volume
    Lateral area
    Base of Cylinder
    Height of Cylinder
    Ratio and Proportion

- **Materials List**

  Colored paper – 2-4 sheets per group.
  Scissors – 1 pair per group
  Glue stick
  tape
  Metric ruler (mm)
  Calculator
  Pencil and Paper

Math State Standards

- 7.3.A Determine the surface area and volume of cylinders using the appropriate formulas and explain why the formulas work.
- Explanations might include the use of models such as physical objects or drawings.

- 7.3.B Determine the volume of pyramids and cones using formulas.
- 7.3.C Describe the effect that a change in scale factor on one attribute of a two- or three-dimensional figure has on other attributes of the figure, such as the side or edge length, perimeter, area, surface area, or volume of a geometric figure.

- A1.1.B Solve problems that can be represented by linear functions, equations, and inequalities.

Reading: State GLE's
1.1
1.2

Writing: State GLE'S
3.2.2
3.3.1
3.3.2
3.3.3

- **Leadership Skills**

1. Honestly, integrity, and trust;
2. Respect for self and others;
3. Responsibility for personal actions and commitments;
4. Self-discipline and moderation;
5. Diligence and a positive work ethic;
6. Healthy and positive behavior; and

- **SCAN Skills/Workplace Skills**
  - Unit three deals with measurement in the metric and standard system. Skills developed in this unit are useful in a variety of careers.
  - Construction Trades: Of course this industry could not exist without the use of measurement. Though most trades in the U.S. are still stuck in the Imperial system, someday we may get a clue and join the rest of the world.
  - Science and Manufacturing: Most scientific fields use the metric system, though it is useful to be able to convert from one system to the other.
  - Health and Medicine: These fields rely heavily on precise measurement and understanding all the various units.
  - Automotive Repair: Using both the metric and standard system is necessary for this career.

- **Lab organization** Allow at least two class periods for this lab.

- **Teacher Assessment of student learning** Observation during lab/Data taken and data chart/ Cans built by student groups/ Peer evaluation – Have the class evaluate the work done by others – quality of assembly, proper dimensions, neatness, and correct calculations.

- **Summary of learning** (to be finished after student completes lab)
  Discuss real world application of learning from lab – Talk about cans in the store and compare their sizes to their radius and height ratios – Pose the question as to why a manufacture would care about the surface area of a can.
  Opportunity for students to share/present learning

- **Optional activities**
  Measure real soup cans and compare radius and height ratios
  Assign different values of volume to different teams.

- **Career Applications**

Concrete work and working with volume
Manufacturing and sheet metals industry
Data gathering

LAB TITLE: Soup Can Lab

STUDENT INSTRUCTIONS: In this lab you will construct four"cans" (cylinders) out of paper. You have four criteria in you cans.

1. **All of your cans must have a volume of 314 cubic cm.**
2. **One can must have a radius that is four times the height of the can. (r = 4ht)**
3. **One can must have a height that is four times the radius. (ht = 4r)**
4. **You will increase the radius and height of the third and fourth cans and compute the "new" surface area and volume.**

You will first need to figure what size your cans need to be in order to have the proper volume. Use your CORD text to find the formulas needed and then use your calculators to try various sizes that meet the criteria.

You may want to use some algebra and consider something like this:

If $r = 4xh$ then $V = \pi r^2 x\ h$ becomes $V = \pi(4h)^2h = 314cc = \pi16h^2h = \pi16h^3$

$314\ cc = \pi16h^3$

So $h^3 = (314)/(16\pi)$

$h = \sqrt[3]{\ } 314cc/16\pi$

$\sqrt[3]{\ }$ means take the cube root.

If $h = 4r$ then $V = \pi r^2h$ becomes $V = \pi r^2 4r = 4\pi r^3 = r^3 = 314/4\pi$

$r = \sqrt[3]{\ } 314cc/4\pi$

We can now use our calculators to find what r or h should be.

- **Statement of problem addressed by lab**
  Is there any correlation, in physical size, between cylinders of the same volume?

- **Grouping instructions and roles**
  1-2 people through group
- **Procedures** – steps to follow/instructions
  Follow Lab Data sheet instructions.

- **Outcome instructions**

How does your least surface area can compare to a commercial soup can?

- **Assessment instructions**
- Assess your classmates can on quality of construction and if their can meets the criteria listed in the beginning of the lab.

Lab Data Collection

Student: _____ **Date:** _____

Unit: 15 USING FORMULAS TO SOLVE PROBLEMS

Lab Title: Soup Can Lab

Criteria

Construct four paper cylinders

Data Collection:

Can	Volume	Surface Area	Radius (cm)	Height (cm)
r = 4ht	314 cc			
ht = 4r	314 cc			
r_3 = 1.2 r				
?ht_3 = 1.2 ht				

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

Surface area (SA) = $2(\pi r^2) + 2\pi r \times ht$

Volume = $\pi r^2 \times ht$

1. Use the formulas in Student Instructions and calculate the radius and height for the two conditions r = 4ht and ht = 4r.
2. Construct the two cylinders.
3. Bring each cylinder to the Instructor for an initial.
4. Cylinder r = 4 ht _____ Instructor Initial
5. Cylinder ht = 4r _____ Instructor Initial
6. Calculate the surface area (SA) of each cylinder.
   a. SA r = 4 ht _____
   b. SA ht = 4r _____
7. Use the basic formula Volume = $\pi r^2 \times ht$ and calculate other two other values for r and ht. Record the new values of volume, height, radius and surface area for the changed radius and height.
8. Compare the increase in volume and surface areas between the cans of 314 cc volume. What is your conclusion about volume, surface area, and radius and height?

_____

_____

_____

Summary Statement:

Extremely different radii and height impact surface areas and volumes.

Other Assessment(s)