
**Lesson 3 Physics Experiment** (All Series Combined – SS, CS, SS+, CP)

Student Challenge (Lessons 3A & 3B) Classical Physics

**OBSERVE:**
*Look at the world around you.*
What natural processes are controlled by density?

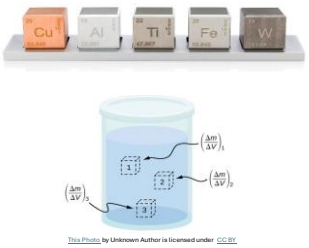
_____

_____

_____

Elemental Densities

| Element or Substance | Density in g/cc | Melting Temp in C |
|---|---|---|
| Gold | 19.3 | 1063° |
| Platinum | 21.45 | 1768° |
| Aluminum | 2.7 | 660° |
| Silver | 10.49 | 961.8° |
| Iron | 7.874 | 1538° |
| Osmium | 22.59 | 3050° |
| Lead | 11.34 | 327.5° |
| Titanium | 4.51 | 1668° |
| Water | 1.0 | 0° |
| Silicate/Quartz Rock | 2.65 | 1670° |
| Copper | 8.96 | 1084° |
| Tin | 7.31 | 232° |




Zinc = primary component of pennies = 7.14 g/mL

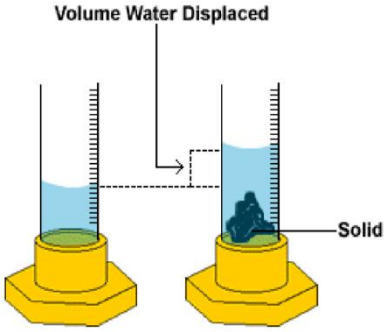
**EXPLORE:**

1. Ice and Water
2. Sugar, Syrup, Alcohol, and/or Oil in Water
3. Try other Objects such as foam/rubber balls, paperclips, tin, plastic, and Diet vs Regular soda in a pitcher of water.
4. Remember the feather and hammer drop in absence of air (on the Moon).
   a) What do you observe on Earth with a feather and hammer on Earth?
   b) Why does it behave differently in air verses than in absence of air?
   c) How is density involved?

**EXPERIMENT:**
**Measuring Volume**

1. Using a beaker, cylinder, or other container, add a known quantity of water (i.e., .5 Liter = 500 mL)
2. Add an unknown volume of solids (try 100 pennies)
3. Note the new measure in the container
4. Calculate the volume by subtracting initial measure from the Final Measure:

   **Final Measure – Initial Measure = Volume**




**ANALYZE:**

**Basic (SS)** Math Skills – Finding Volume

**Problem #1** If the measured amounts for 100 pennies equals:
Initial Measure: 500 mL (no pennies)
Final Measure: 535 mL (100 pennies)

**QUESTION:** What is the measured volume of 100 pennies?

535 mL – 500 mL = _____ mL  Volume Measure of 100 pennies: _____mL

**(ANSWER: 35 mL)**

**Problem #2: Weight of 100 Pennies**
Using a scale, determine the Weight of 100 pennies = _____

Challenge Question: How can you determine the weight of 1 penny from the weight of 100 pennies?

Equation: _____

With Base 10, how can you determine the weight of 1 penny by changing a decimal point?

_____

**ANSWER: Weight should be about 250 grams; move decimal 2 places = 2.5 grams**

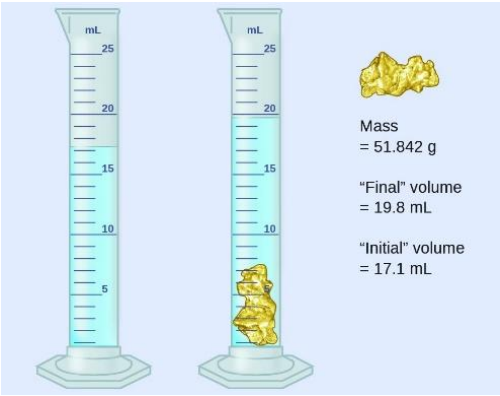
**Advanced (CS)** Math Skills

Using the Measures from Problem #1 Calculate the Density (p) of the Pennies.
Set Up the Equation Using the Weight/Mass of 100 pennies and their Volume Measure
**Problem #3**

**p = m/v**  Equation: _____

Answer:_____ is the density of the material used in pennies. How close is your answer to the density of Zinc (7.14 g/mL)? This is one way scientists or mineralogists determine the purity of metals.

**ANSWER: 250 g/35 mL = 7.14 g/mL (Identical to Zinc, a penny's primary metal)**




**Applied (SS+)** Math Skills p = m/v

Using the image to the left, and the mass, determine both the volume and density of the substance.

Mass = 51.842 g
Volume = Amt of Displacement 19.8 mL – 17.1 mL

**Problem #4**
**p = m/v**  Equation: _____

Answer:_____ What element, listed in the chart on the 1st page, appears to have a similar density? _____ Does it appear to be pure?

Why or Why Not_____

**ANSWER PROBLEM #4** **p = 51.842 g/2.7 mL = 19.2 g/mL = Gold (very close)**

**Compute (CP)** Math Skills

Compare Densities: Regular Soda verses Diet Soda verses Salt Water verse Pure Water
Use kitchen equipment available to measure: grams and liters

Use 1 g/ml for pure water (distilled)

**Problem #5 p = m/v**
Determine Density each of the following:

Regular Soda

Diet Soda

Salt Water (max dissolved at room temperature)

What ingredients are primarily included in Regular Soda _____

What ingredients are primarily included in Diet Soda _____

a) What ingredients likely cause the difference in density between diet and regular soda?

b) How would salt water concentrations vary in the ocean?

c) How might these density differences affect the movement of ocean nutrients or freshwater glacier melts?

**ANSWER PROBLEM #5** **Diet Soda p = 1 g/1 mL = to pure water**
**Regular Soda p = 1.1 g/mL (varies)**
**Salt Water p = 1.16 g/mL**

**a) The primary difference between diet and regular is the density of sugar verses sugar substitutes. Both sodas contain carbonation ($CO_2$ under pressure or dissolved) which is similar in density to pure water when dissolved in water.**

**b) Temperatures alter density of salt water, but also near freshwater sources, concentrations would vary.**

**c) Fresh water might remain on top whereas colder, greater salt concentrations, would sink taking surface nutrients deeper into the ocean.**