

Experiment OnLine: Part2 A Penny for your Thought; Exploring the Unexpected

Part 2 Exploring the Unexpected It has often been the case in science that great discoveries occurred when an unexpected result was obtained during the course of an experiment. For example, both x-rays and the process for vulcanizing rubber were discovered by accident. As Einstein once stated, "Great discoveries are made by the prepared mind".

In the second part of this experiment you will be following up on the unexpected result that coins minted prior to 1982 weight more than coins minted after that date. There are two plausible hypothesis: 1) The size of the penny decreased after 1982 (since there would be fewer atoms, the total mass of the penny would therefore decrease). 2) The composition of the penny changed while the size remained the same (although there would be about the same number of atoms present in the same volume, changing the composition could lower the average mass of penny thereby lowering the total mass). Do you have any other hypotheses? Jot your hypothesis in your notebook. Again, the scientific approach is used to find answers to the unexpected result found in part I. From the data that is generate in this part of the experiment, you will try to figure out which hypothesis appears to be correct (if any).

Procedure: Exploring the Unexpected (Continue from Part I)

- 3 Write a hypothesis consistent with the unexpected result found in the first part of this lab.
- 4 a Now for the hard part, find 25 pennies all of which are either old pennies (minted before 1980) or newer pennies (minted after 1982).
 - b. Determine the total mass of all 25 pennies using the digital pocket scale. Use the correct precision of the digital scale and record this data in your lab notebook.
 - c. Take a 50 ml graduated cylinder and fill it to 20.0 ml with water. Use a medicine dropper to get it exactly to 20.0 mL.
 - d. Carefully place 25 of the pre-82 pennies to the water in the cylinder. Avoid trapping air bubbles under the pennies or splashing water up the cylinder.
 - e Repeat the procedure above with the 25 post-82 pennies as summarize in the next step.
 - f. Take the 25 post-82 pennies and weigh all of them together accurately. Next take a 50 mL graduated cylinder and accurately measure the initial volume of the water at 20.0 mL, add the 25 post-82 pennies and measure the final volume of the water..

Digital Picture2: Take a digital picture of the pennies submerged in graduated cylinder with the volume of the water showing.

- g. Remove the pennies and thoroughly dry them with paper towel
- h. Calculate the volume of the pre-82 pennies and the post-82 pennies by taking the final volume of the graduated cylinder and subtracting the initial volume of the graduated cylinder.

5 Calculate the results of your experiment.

- a) For the result section for the pre-82 pennies, calculate the following:

Pre-82 Pennies

- 1) the average volume of the pre-82 pennies 2) the average mass of the pre-82 pennies 3) the density of the pre-82 pennies.

- b) For the result section for the post-82 pennies, calculate the following:

Post-82 Pennies

- 1) the average volume of the post-82 pennies 2) the average mass of the post-82 pennies 3) the density of the post-82 pennies

One way of determining that pennies minted before 1982 and those minted after 1982 are made of different material is to determine the composition of the pennies by physically cutting the pennies in half and looking at the reactivity of the material. The next part of the lab will determine the composition of the pre-82 and post-82 pennies.

In the next part of the lab you have the option of either working through the experiment and seeing first had the results of the composition of a penny or you can watch the QuickTime movie of this experiment. The experiment will require the use of **hydrochloric**



acid, HCl. See steps1 below.

CHEMICAL ALERT: HCl - toxic and corrosive. HCl solutions are toxic and corrosive. Use safety goggles at all times when performing this experiment. HCl solutions can cause skin burns. Prevent contact with your eyes, skin, and clothing. Do not ingest these solutions. If you spill solution, immediately clean it up with a sponge and let water rinse the sponge thoroughly for a few minutes.

6a. Procedure to determine the composition of a penny

- Take 1 penny minted after 1982 and 1 penny minted prior to 1981 and use a metal cutter to cut these pennies in half.
- Examine the interior of the two pennies and record your observations in your datasheet.
- Next take these pre81 and post 82 penny-halves along with the vial of HCl solution chemical issued to you in class. Go to a ventilated area when working this procedure. Place the pre-82 and post-82 pennies in separate Petri dish. Use the bottom and top of the Petri dish set. Add a small amount of 1 M hydrochloric acid (CAUTION: This is a corrosive liquid) Observe any difference in chemical reactivity between each of the halves for the two pennies. Such differences, if they occur, can be taken as evidence of differences in composition.

Digital Picture3: Take a digital picture of the penny halves in the HCl solution. **If you are watching the video, be sure to take a screen shot of this step. (See below)**

- When you are done with this procedure, take the HCl solution from the Petri dish and pour it back into the original HCl solution vial. Reseal the vial. Take the penny-halves and thoroughly wash with water.
- What conclusion can you make base on your data? Use the evidence in this experiment to support your conclusion. Write your answers in complete sentences.
- Draw a flowchart of the scientific method you employed in this experiment. Write this in your lab notebook.

6b. Link to QuickTime Movie (See html version of this to access movie) or type the following URL address using your browser.



http://online2.sdccd.edu/faculty/fgarces/Mov_Lib/Ch100/Penny/zzPFYT_Media/PFYT_Media.htm

- In the movie, one penny minted after 1982 and one penny minted prior to 1981 are both cut in half with a shear metal cutter.
- Note the interior of the two pennies and record your observations in your datasheet.
- The next part of the movie shows each half of the half-cut pennies in a Petri dish. A small amount of 1 M hydrochloric acid (CAUTION: This is a corrosive liquid) is added to the Petri dish. Observe any difference in chemical reactivity between each of the halves for the two pennies. Such differences, if they occur, can be taken as evidence of differences in composition.
- What conclusion can you make base on your data? Use the evidence in this experiment to support your conclusion. Write your answers in complete sentences.
- Draw a flowchart of the scientific method you employed in this experiment. Write this in your lab notebook.

Part II: Experiment OnLine - Explaining the unexpected; an introduction to the Scientific Method

___ / pts score

Last Name _____ First _____

Lab Partner _____ Date _____

Hypotheses: Write a complete hypothesis as to why the weight of a penny changed after 1982.

State in your hypothesis what happened to the mass of the penny after a certain year.

Table 2 Mass and volume of 25 pennies

| Penny Type | Mass of 25 pennies (g) | Vol initial (ml) | Vol final (ml) | Vol of 25 pennies (ml) |
|------------|------------------------|------------------|----------------|------------------------|
| Pre- '82 | | | | |
| Post - '82 | | | | |

- Write your detail observation on the appearance of the inside of the pre'82 & post '82 pennies.
- Describe what you see when the inside of the pennies are exposed to acid.

The details in your observation is the basis of your grade in this section.

• **Calculation:** (show detailed calculations with appropriate significant figures)

(for pre-'82 pennies)

A. Average volume of 1 penny
for pennies minted before 1981 (mL)

$$\text{Vol}_{\text{average}} = \frac{\text{Vol}_{25\text{-pennies}}}{25} = \frac{\text{Vol}_{\text{final}} - \text{Vol}_{\text{initial}}}{25}$$

B. Average mass of 1 penny
for pennies minted before 1981 (g)

$$\text{Mass}_{\text{average}} = \frac{\text{Mass}_{25\text{-pennies}}}{25}$$

C. Density of pennies
minted before 1981 (g/ml)

$$\text{Density} = \frac{\text{Mass}_{25\text{-pennies}}}{\text{Vol}_{25\text{-pennies}}}$$

(for post-'82 pennies)

D. Average mass of 1 penny
minted after 1982 (mL)

$$\text{Vol}_{\text{average}} = \frac{\text{Vol}_{25\text{-pennies}}}{25} = \frac{\text{Vol}_{\text{final}} - \text{Vol}_{\text{initial}}}{25}$$

E. Average mass of 1 penny
minted after 1982 (g)

$$\text{Mass}_{\text{average}} = \frac{\text{Mass}_{25\text{-pennies}}}{25}$$

F. Density of pennies
minted after 1982 (g/ml)

$$\text{Density} = \frac{\text{Mass}_{25\text{-pennies}}}{\text{Vol}_{25\text{-pennies}}}$$

Results: Record your results from the above analysis to this table.

1 Results of Avg. mass, volume and density of pre-'82 and post-'82 pennies.

| Type of penny | Average Vol (ml) | Avg. Mass (g) | Density (g/ml) |
|---------------|------------------|---------------|----------------|
| pre - 1982 | A. | B. | C. |
| post - 1982 | D. | E. | F. |

2 Based on your findings in part II, write an appropriate conclusion on how the scientific method was used in this experiment.

3 Diagram a flowchart of the scientific method and then comment how each step in your flowchart illustrated how the "penny experiment" followed the steps in the scientific method. (Use extra sheet to complete this)

In addition, be sure to turn in the following with your report:

Digital Picture1 (Lastname_ex1_pic1.jpg):

Take a digital picture of ten pennies all in the weighing pan of the digital pocket scale.

Digital Picture2 (Lastname_ex1_pic2.jpg):

Take a digital picture of the pennies submerged in graduated cylinder with the volume of the water showing.

Digital Picture3 (Lastname_ex1_pic3.jpg):

Take a digital picture of the penny halves in the HCl solution. Screen shot if you watched video.

Digital Picture4 (Lastname_Lb_p1.jpg, Lastname_Lb_p2.jpg ...):

Take digital photos of all your lab notebook pages for this experiment.