Mini Ideas

Pennies in the Classroom
Guided Inquiry Laboratories©

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Safety Procedures

Before working with a flame, boiling solution, and/or any chemicals, especially unknown solutions, there are certain safety procedures that should always be remembered and followed!

General Rules:

1. NEVER put your finger inside a test tube, beaker, plastic cup, or on the ends of a glass rod or dropper that has been dipped in an unknown chemical (liquid).

2. NEVER touch or taste any forms of chemicals (solid, liquid, or gas) unless you are instructed to do so by your teacher.

3. TO TEST FOR TEMPERATURE CHANGES without a thermometer, hold a test tube upright in your hand. You should be able to feel a change in temperature through the test tube.

4. To test for gas produced, NEVER BRING A TEST TUBE TO YOUR NOSE! For smelling vapors from a test tube, waft the odors toward you with your hands.

5. Wash your hands after conducting each lab experiment or investigation.

6. Handle all glassware, equipment, and reagents (both solid and liquid) carefully.

7. Use laboratory chemicals with special care: they might stain clothing or skin, and cause irritation, etc.

8. If someone spills a solution on themselves, inform your teacher and wash it immediately with water.

9. YOU MUST follow directions carefully and use caution with flame and boiling solutions.

10. Do you know where the fire extinguisher and other safety equipment are located in this lab/classroom?

Inquiry Lab I: So Many Tarnished Pennies

Read all the procedures before you start the lab experiment.

Inquiry Question:

1. What do you think would happen if you placed an old tarnished penny in a:

A. medicine cup 1/4 full of vinegar and stir for five minutes?

B. medicine cup 1/4 full of bleach and stir for five minutes?

C. medicine cup 1/4 full of 7-Up and stir for five minutes?

D. medicine cup 1/4 full of vitamin C and stir for five minutes?

E. medicine cup 1/4 full of hydrogen peroxide (3%) and stir for five minutes?

F. medicine cup 1/4 full of water and stir for five minutes?

G. medicine cup 1/4 full of vinegar and a pinch of salt and stir for five minutes?

H. medicine cup 1/4 full of bleach and a pinch of salt and stir for five minutes?

I. medicine cup 1/4 full of 7-Up and a pinch of salt and stir for five minutes?

J. medicine cup 1/4 full of vitamin C solution and a pinch of salt and stir for five minutes?

K. medicine cup 1/4 full of hydrogen peroxide (3%) and a pinch of salt and stir for five minutes?

L. medicine cup 1/4 full of water and a pinch of salt and stir for five minutes?

Write down all your predictions; then discuss them with the members of your group. Keep only those predictions that you couldn't eliminate logically and/ or you couldn't come to an agreement about. Use Table 1 to record your agreed upon predictions.

2. What Actually Happened? Conduct an experiment to find out what actually happens in each case. Use Table 2 to record your observations. To conduct the experiment:

A. Label 6 cups as: vinegar, bleach, 7-Up, vitamin C, hydrogen peroxide, and water and place them on an undisturbed,flat surface.

B. Fill 1/4 of each cup with its corresponding solution.

C. Carefully place in each cup one old tarnished penny and stir.

D. Observe the cups every minute for 5 minutes. After 5 minutes, remove the pennies, dry them, and place them on a clean white paper.

E. Record your what actually happened in Table 2.

Repeat the procedures in 2-1 using new paper cups, a new set of old tarnished pennies, clean plastic medicine cups, and vinegar with salt, bleach with salt, 7-Up with salt, vitamin C with salt, hydrogen peroxide with salt, and water with salt. Record your observations of what actually happened in Table 2. Record additional observations on the other side of the page.

Table 1
Student's Predictions of What Will Happen

Tarnished Penny In	Predictions (What Will Happen)
Vinegar	
Bleach	
7-Up	
Vitamin C	
Hydrogen Peroxide	
Water	
Vinegar and salt	
Bleach and salt	
7-Up and salt	
Vitamin C and salt	
Hydrogen Peroxide and salt	
Water and salt	

Answer The Following Questions

1. How do your predictions agree or disagree with what actually happened?

2. What happened to the tarnished pennies when they were left in the solutions?

3. What happened to the pennies when they were left out to dry outside their corresponding solutions?

4. How long did each penny stay shiny and bright after you removed it from its solutions?

5. In which liquid or solution did the tarnished penny change its brightness, the first, the second, the third, and so on?

6. In which liquid or solution did the tarnished penny stay shiny and bright the longest period of time?

7. In which liquid or solution did the tarnished penny stay shiny and bright the shortest period of time?

8. In which liquid(s) or solution(s) did you see no significant change in the brightness or color of the penny?

9. In which liquid(s) or solution(s) did you see additional characteristics of chemical reactions? Identify these additional characteristics or behaviors.

10. What is the composition of American modern pennies?

11. What is the composition of the tarnish of the pennies that were used in the experiment?

12. What is the nature and the composition of each liquid or solution that was used in the experiment? (In terms of acid, base, neutral, salt, chemical composition).

13. What do you think would happen if you placed those pennies (which developed a darker color) into the solutions in which the pennies lost their tarnish? Write down your predictions and then conduct the experiment to find out what actually happens.

14. What do you think would happen if you were to place those pennies (which lost their tarnish into the solutions in which the pennies developed a darker color? Write down your predictions and then conduct the experiment to find out what actually happens.

15. Why and how did some pennies lose their tarnish when placed in their corresponding solution?

Table 2
Student's Observations of What Actually Happened

Tarnished Penny In	What Actually Happened
Vinegar	
Bleach	
7-Up	
Vitamin C	
Hydrogen Peroxide	
Water	
Vinegar and salt	
Bleach and salt	
7-Up and salt	
Vitamin C and salt	
Hydrogen Peroxide and salt	
Water and salt	
Dilute Hydrochloric Acid	

Table 3
Student's Observations of What Actually Happened To The Color of the Pennies

Tarnished Penny in Medicine Cup With	Stays The Same	Developed Darker Color		Becomes Cleaner, Brighter and		
		Dark	V. Dark	Dull	Shiny	V. Shiny
Vinegar						
Bleach						
7-Up						
Vitamin C						
Hydrogen peroxide						
Water						
Vinegar and salt						
Bleach and salt						
7-Up and salt						
Vitamin C and salt						
Hydrogen peroxide & salt						
Water and salt						
Dilute hydrochloric acid						

Table 4
Student's Predictions

What Will Happen If	Predictions (What Will Happen)
What will happen if those pennies which developed a darker color were placed in the solutions in which the pennies lost their tarnish?	
What will happen if those pennies which lost their tarnish were placed in the solutions in which the pennies developed a darker color?	

Table 5
Student's Observations of What Actually Happened

Situation	What Actually Happened
Placing those pennies which developed darker color in the solutions in which the pennies lost their tarnish.	
Placing those pennies which lost their tarnish in the solutions in which the pennies developed darker color.	

Name(s): _____ Date: _____

Table 6
Identified Factors, Investigated Questions, & Student Hypotheses

Potential Factor	Investigated Question	Hypothesis

16. Why did some of the tarnished pennies fail to loose their tarnish when placed in their corresponding solutions?

17. Why and how did some of the tarnished pennies developed a darker color when placed in their corresponding solutions?

18. What role did the salt play in how some pennies changed their appearance?

19. Did the salt play the same role in all the liquids that it was added to?

20. What conclusions can you make from your findings?

Inquiry Lab Investigation II: So Many Tarnished Pennies But So Little Time To Clean

1. Identify a maximum of 6 factors that might affect the outcomes of the experiments that you have just successfully completed. Use Table 6 for your answers.

2. Make an investigative question involving each of the 6 identified factors. List your questions in Table 6.

3. Hypothesize how each potential factor could affect the outcomes of the experiments that you have just successfully completed. Use Table 3 for your answers.

4. Design and conduct an experiment to investigate at least 3 hypotheses and to answer each of your corresponding investigative questions.

5. Using graph paper and colored pencils, illustrate you findings on a line graph for each experiment.

6. How does the result from each experiment of investigative questions agree or disagree with your corresponding hypothesis?

7. What scientific term do we use to describe the factors that effect the results of a given experiment?

8. What scientific term do we use to describe the factors that do not effect the results of a given experiment?

9. What conclusions can you make from your findings?

Coins Throughout History

Answer the Following Questions:

1. When and where did the United States first mint its coin currency?

2. Which coin was minted first and from what kind of metal?

3. What was printed on the two faces of the first coin made in the USA?

4. Do these prints still exist?

5. List the names of all the people whose likenesses are on today's most common U.S. coins.(Sacajawea $1.00, John F. Kennedy $.50, George Washington $.25, Franklin D. Roosevelt $.10, Thomas Jefferson $.05, and Abraham Lincoln $.01).

6. Were all these people presidents of the United States? If not, who were they?

7. Why were these people chosen to be on a coin? Who would you choose and why?

Coin	Student's Prediction	Actual Make Up (Composition)
Quarter		
Dime		
Nickel		
Penny		

Coin	Prediction	What Actually Happened
Quarter		
Dime		
Nickel		
Penny		

Table -2-
Coins and Corrosion

Metal	Corrosion by	Color Change
Iron	Water vapor & Oxygen	From Dark-silver-gray To Reddish brown
Nickel	Oxygen	From Light-silver-gray To Pale blue
Copper	Carbon dioxide Water vapor , & Hydrogen sulfide	From Reddish-orange To Green
Silver	Hydrogen sulfide	From Silver To Black

Homework Assignment

1. Prepare four hard-boiled eggs and four different clean, shiny coins (a quarter, dime, nickel and penny).

2. Peel the four eggs, and then push the first coin half way into the white of the first egg; push the second coin into the white of the second egg, and so on.

3. Wait about 10-15 minutes before removing each coin. Record your observations.

4. Compare your observations and findings to your predictions.

5. Compare your findings to the findings of the other students in your classroom.

6. What does the white part of an egg contain?

7. What is the chemical make up (composition) of each coin you have used in the experiment?

8. Why do you think some coins change their color when they are pushed into the white part of an egg?

9. What is the effect of sulfur compounds on silver?

10. What useful application can you draw from your findings?

For Teachers Only:

The egg white contains sulfur, and silver reacts with many sulfur compounds.

Coins and Corrosion

Coins can be used to introduce corrosion in the classroom. Most students have seen rust and are familiar with the role water plays in causing rust. Most of us have seen and probably dropped coins into water fountains. Why are these coins not rusted? Rust (iron oxide) is the most common form of corrosion that is caused by the reaction of iron and water.

Oxygen (O_2), carbon dioxide (CO_2), hydrogen sulfide (H_2S), and water vapor (H_2O) are known to cause gradual wearing away of some metals, and/or gradual changing of the original color of some other metals. These gases react chemically with some materials and cause distinct physical changes. These processes of change are called corrosion. For example, nickel is corroded by oxygen, copper is corroded by carbon dioxide, water vapor, and/or hydrogen sulfide, and silver is corroded or tarnished by hydrogen sulfide. Ask students to predict what would happened if they exposed the four different coins to oxygen, carbon dioxide, water vapor, and/or hydrogen sulfide. Collect the students' predictions and discuss them with the students. Ask students to design their own experiments that enable them to examine the effects of gases such as oxygen (O_2), carbon dioxide (CO_2), hydrogen sulfide (H_2S), and water vapor (H_2O) on U.S. coins. When copper reacts with carbon dioxide, water, or hydrogen sulfide, for example, its color changes from reddish-orange to green. When silver reacts with hydrogen sulfide, its color changes to black.

Most U.S coins, both old and new, are not made of single, pure elements; instead, they are mixtures of metals called alloys. Alloys are often stronger than pure metals, and can also display other desirable characteristics (like the color and ease of polishing of brass, a combination of copper and zinc). Alloys are not compounds, because the proportions of the elements in the mixture can be varied at will, producing an infinite variety of possible mixtures. Alloys used in U.S. coins (like the copper/nickel alloy used in nickels and the outer shells of dimes, quarters and half dollars) are selected for their toughness and resistance to corrosion, increasing the useful life of the coins.

U.S. Coin Compositions

Pennies

1943 only - steel
1944 and 1945 - copper (shell case)/zinc/tin (bronze).
All other dates to 1982- standard copper/zinc/tin (bronze).
1982 and after - pure copper covering pure zinc.

Nickels

1942 through 1945 - 30% silver, 60% copper, 10% zinc. All other dates - standard copper/nickel alloy.

Dimes

Before 1965 - 91 % fine silver.
1965 and after - copper/nickel on copper (sandwich construct).

Quarters

Before 1965 - 91 % fine silver.
1965 and after - copper/nickel on copper (sandwich construct).

Half Dollars

Before 1965 - 91 % fine silver.
1965 and after - copper/nickel on copper (sandwich construct).

Dollars

Before 1935 - 91 % fine silver.
1971 to 1999 - copper/nickel on copper (sandwich construct).
2000 and after - copper/zinc (brass)

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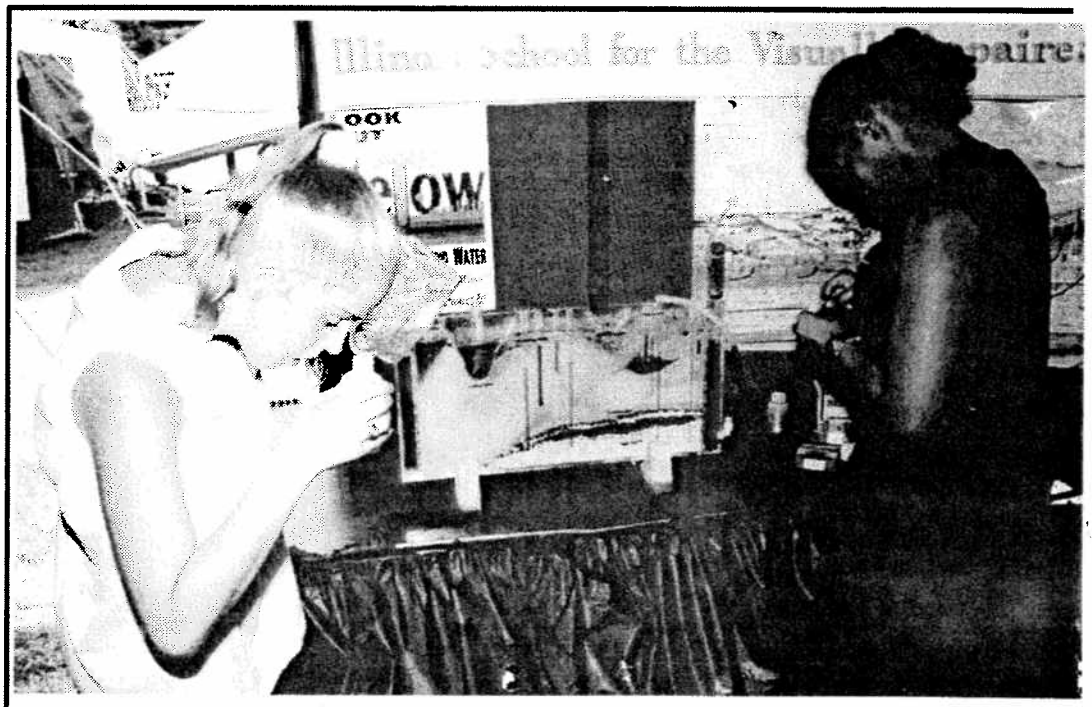

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Cover: Illinois School for the Visually Impaired students experience the IDNR Conservation World at the 2002 Illinois State Fair. Their teacher is John Moreland.

The Illinois Science Teachers Association recognizes and strongly promotes the importance of safety in the classroom. However, the ultimate responsibility to follow established safety procedures and guidelines rests with the individual teacher.

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