The Scientific Method
Exploring Experimental Design

Penny Lab

PURPOSE
In this activity you will learn about controls and variables in an experiment. You will also learn what constitutes a valid experimental procedure.

MATERIALS

penny
dropper or pipet
water
paper towel
graph paper and notebook paper
ruler
pen or pencil

DEFINITIONS

- **variable**: aspects of an experiment that change or could be changed
- **independent variable**: variable that is changed on purpose
- **dependent variable**: variable that responds to the independent variable
- **constant**: aspects of an experiment that are kept the same in all trials

PROCEDURE

1. Answer each of the following questions using complete sentences.

2. Your task is to guess how many drops of water will fit on the "Lincoln" side of a penny.

   [Copy the following statement.] PROBLEM: How many drops of water will fit onto the "Lincoln" side of a penny?

3. [Copy the following statement and make a prediction by filling in the blank.] PREDICTION: I predict that _____ drops of water will fit on the head side of a penny.

4. After you have made your prediction and have written it down on your lab paper, you will write it on the board under the heading "Predicted Number of Drops."

5. Copy the following chart onto your paper. Be neat and use a ruler!

TEST RESULTS:

	Trial #1	Trial #2	Trial #3
Number of Water Drops	_____	_____	_____

6. Test to see if your prediction is correct. Place your penny on a paper towel and, using the dropper, add water to the "Lincoln" side of the penny, one drop at a time, counting each drop until the water spills over. Do not count the drop that causes the water to spill over. Write the number of drops you counted under Trial #1 on your chart. Repeat this procedure two more times. Fill in the number of drops you count for each trial under the appropriate heading on your Test Results chart.

7. Then write your number of drops for each trial on the chalkboard next to the appropriate heading.

8. Write a sentence that will serve as your conclusion for this experiment. This conclusion should state if your prediction matched the actual data.

9. Make a bar graph of the class data. Before graphing, you will need to organize the class data into ranges — make a chart that shows how many trials got results between 0-10, 11-20, 21-30, etc. The *x*-axis (horizontal line) should be titled "Average Number of Drops" and the *y*-axis (vertical line) should be titled "Number of Trials." You will be graphing the total number of trials in your class that got a result within a range of numbers. For example, if 5 people got a result between 0 and 10, you would graph this data as your first bar. The next bar would be for all of those who got a result between 11 and 20 drops. When you have finished your bar graph, give it an appropriate title.

10. Answer the conclusion questions on your paper. Be sure to use complete sentences.

CONCLUSION QUESTIONS

1. Using your bar graph, determine if the resulting number of drops for each experimenter is about the same.

2. List four reasons why the actual number of drops for each experimenter was similar or dissimilar.

3. Are the results of this experiment "valid?" Why or why not? Be sure to think about what makes an experiment valid.

4. In this experiment, there were a limited number of constants. Name two of them.

5. What was the independent variable in this experiment?

6. What was the dependent variable in this experiment?

7. Is it possible to state definitively how many drops of water will fit on the "Lincoln" side of a penny with this lab procedure? Why or why not?