Experiment 85

The Half-Life of Pennies

Problem
What does flipping pennies have to do with the concept of half-life?

Introduction
The half-life of a radioactive sample is the time required for half of the original sample of nuclei to decay. Knowing the half-life of carbon-14, for example, enables us to determine the age of wooden artifacts.

Prelaboratory Assignment
- ✓ Read the entire experiment before you begin.
- ✓ Answer the Prelaboratory Questions.
  1. In this experiment, what do the pennies that land "heads" represent?
  2. In this experiment, what do the pennies that land "tails" represent?
  3. In this experiment, what does each flip represent?

Materials
100 pennies
Graph paper

Procedure
1. Flip 100 pennies and separate them according to which landed heads and which landed tails. Record the number of heads.

2. Flip only the pennies that landed heads, and then separate the pennies according to which landed heads and which landed tails. Record the number of heads. Repeat this until you are out of pennies. Record the number of times until you are out of pennies.

Cleaning Up 
1. Leave the pennies on the lab bench.
2. Wash your hands thoroughly before leaving the laboratory.

Analysis and Conclusions
Complete the **Analysis and Conclusions** section for this experiment either on your Report Sheet or in your lab report as directed by your teacher.

1. Make a graph of number of pennies flipped vs. trial number from your data.
2. Gather together all of the class data and make a second graph of the total number of pennies flipped vs. trial number.
3. Why is there a difference between the graph of your data and graph of the class data?

4. Draw a graph that shows the decay of a 100.0-g sample of a radioactive nuclide with a half-life of 10 years. This should be a graph of mass versus time for the first four half-lives.
5. Compare the two graphs using your data and the class data to the graph of the 100.0 g sample. Does your graph or the graph of the class data look more like the graph of the 100.0-g sample? Why?
6. Approximately how many half-lives would it take for one mole of a radioactive nuclide to completely disappear?

Something Extra

Would the shape of the graph change if you used a different number of pennies? Try this activity again with a different number of pennies and comment on the results. Use a wide range (from 10 pennies to a few hundred pennies).