1 Amassing a Penny's Worth

Purpose

To formulate a hypothesis, accumulate data, and then develop a conclusion

Required Equipment/Supplies

balance (capable of measuring to the nearest hundredth of a gram)
20 pennies: 10 dated before 1982; 10 dated after 1982
graph paper

Discussion

Making measurements sometimes leads to important discoveries that might otherwise go unnoticed. In this activity you will measure the mass of some pennies and plot a histogram of your results. The results may be surprising.

The *mass* of an object refers to the amount of matter it possesses. The *weight* of an object, on the other hand, refers to the force of gravity on the object. Even though the mass of something remains constant, its weight can vary, since the gravitational force on an object depends on its location on Earth. We weigh a little bit less at the top of a mountain because we're farther from the center of Earth. So weight depends on location, whereas mass doesn't.

It is customary to measure the weight of things by how much they stretch a spring. S*pring scales* measure the weight (although they are typically calibrated in mass units such as grams). It is customary to measure the mass of an object by comparing it to a *standard mass*. Masses may be compared using a *beam balance*. Whereas a spring scale will give different readings in regions of different gravitation, a beam balance will accurately compare masses anywhere. A kilogram will balance a kilogram just as accurately at the top of a mountain as it will at sea level.

Procedure

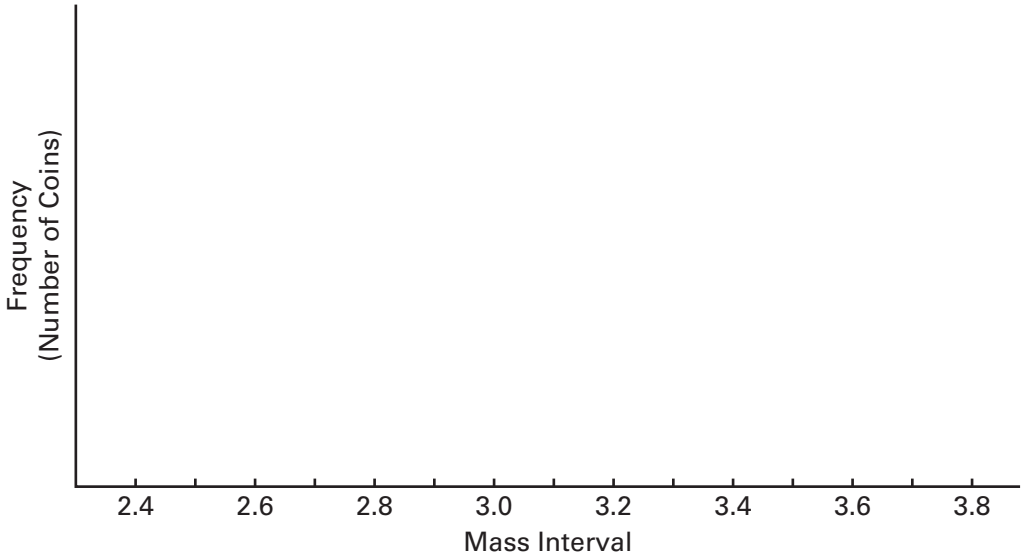
Step 1: Adjust your beam balance so that it balances with no load. This is *zeroing* the balance. After zeroing the balance, find the mass of a penny to the nearest hundredth of a gram and write down your measurement for each penny and the penny's date of issue. Repeat for all of the pennies.

Step 2: Note that the pennies do not have identical masses. To see if there is any pattern to the data, make a *histogram*. A histogram is a plot of the frequency of each measurement in a series of measurements. Label the horizontal axis as the mass and the vertical axis as the number

Penny	Mass (g)	Date
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Activity

of times that measurement occurred (sometimes called the "frequency" axis). The horizontal axis should range from the smallest to the largest mass in tenths of a gram. Number the vertical axis from 0 to 10. Place a dot above the value on the horizontal axis for the number of times each mass measurement occurs.



Analysis

1. Does your histogram reveal any information about the pennies that was not apparent by just looking at them? Do the coins *look* the same? Do they *feel* as though they have the same mass?

2. How do you account for the measured differences of the masses of the coins? What impact may the date of issue have on the mass of the pennies?

3. What other manufactured items besides pennies might exhibit variations in mass?