

MATHEMATICS AND PHYSICS

Just as physicists create simplified models to better understand the real world, they use the tools of mathematics to analyze and summarize their observations. Then they can use the mathematical relationships among physical quantities to help predict what will happen in new situations.

Tables, graphs, and equations can make data easier to understand

There are many ways to organize data. Consider the experiment shown in **Figure 13**, which tests Galileo's hypothesis that all objects fall at the same rate in the absence of air resistance (see Section 2). In this experiment, a table-tennis ball and a golf ball are dropped in a vacuum. The results are recorded as a set of numbers corresponding to the times of the fall and the distance each ball falls. A convenient way to organize the data is to form a table like **Table 7**. A clear trend can be seen in the data. The more time that passes after each ball is dropped, the farther the ball falls.

Table 7 Data from Dropped-Ball Experiment

Time (s)	Distance golf ball falls (cm)	Distance table-tennis ball falls (cm)
0.067	2.20	2.20
0.133	8.67	8.67
0.200	19.60	19.59
0.267	34.93	34.92
0.333	54.34	54.33
0.400	78.40	78.39

One method for analyzing the data in **Table 7** is to construct a graph of the distance the balls have fallen versus the elapsed time since they were released. This graph is shown in **Figure 14** on the next page. Because the graph shows an obvious pattern, we can draw a smooth curve through the data points to make estimations for times when we have no data. The shape of the graph also provides information about the relationship between time and distance.

SECTION OBJECTIVES

- Interpret data in tables and graphs, and recognize equations that summarize data.
- Distinguish between conventions for abbreviating units and quantities.
- Use dimensional analysis to check the validity of equations.
- Perform order-of-magnitude calculations.

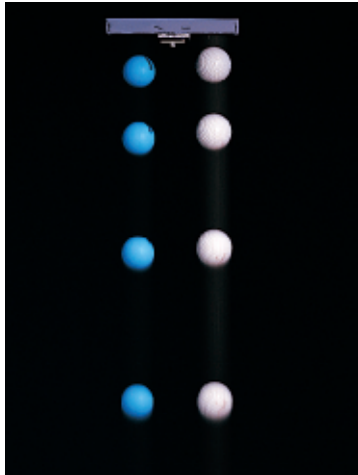


Figure 13

This experiment tests Galileo's hypothesis by having two balls with different masses dropped simultaneously in a vacuum.