Creating Data Tables and Graphs

How can you make sense of the data in a science experiment? The first step is to organize the data to help you understand them. Data tables and graphs are helpful tools for organizing data.

Data Tables
You have gathered your materials and set up your experiment. But before you start, you need to plan a way to record what happens during the experiment. By creating a data table, you can record your observations and measurements in an orderly way.

Suppose, for example, that a scientist conducted an experiment to find out how many Calories people of different body masses burn while doing various activities. The data table shows the results.

Notice in this data table that the manipulated variable (body mass) is the heading of one column. The responding variable (for Experiment 1, the number of Calories burned while bicycling) is the heading of the next column. Additional columns were added for related experiments.

Bar Graphs
To compare how many Calories a person burns doing various activities, you could create a bar graph. A bar graph is used to display data in a number of separate, or distinct, categories. In this example, bicycling, playing basketball, and watching television are the three categories.

To create a bar graph, follow these steps.
1. On graph paper, draw a horizontal, or x-, axis and a vertical, or y-, axis.
2. Write the names of the categories to be graphed along the horizontal axis. Include an overall label for the axis as well.
3. Label the vertical axis with the name of the responding variable. Include units of measurement. Then create a scale along the axis by marking off equally spaced numbers that cover the range of the data collected.
4. For each category, draw a solid bar using the scale on the vertical axis to determine the height. Make all the bars the same width.
5. Add a title that describes the graph.
**Line Graphs**

To see whether a relationship exists between body mass and the number of Calories burned while bicycling, you could create a line graph. A line graph is used to display data that show how one variable (the responding variable) changes in response to another variable (the manipulated variable). You can use a line graph when your manipulated variable is **continuous**, that is, when there are other points between the ones that you tested. In this example, body mass is a continuous variable because there are other body masses between 30 and 40 kilograms (for example, 31 kilograms). Time is another example of a continuous variable.

Line graphs are powerful tools because they allow you to estimate values for conditions that you did not test in the experiment. For example, you can use the line graph to estimate that a 35-kilogram person would burn 68 Calories while bicycling.

To create a line graph, follow these steps.

1. On graph paper, draw a horizontal, or \(x\)-, axis and a vertical, or \(y\)-, axis.
2. Label the horizontal axis with the name of the manipulated variable. Label the vertical axis with the name of the responding variable. Include units of measurement.
3. Create a scale on each axis by marking off equally spaced numbers that cover the range of the data collected.
4. Plot a point on the graph for each piece of data. In the line graph above, the dotted lines show how to plot the first data point (30 kilograms and 60 Calories). Follow an imaginary vertical line extending up from the horizontal axis at the 30-kilogram mark. Then follow an imaginary horizontal line extending across from the vertical axis at the 60-Calorie mark. Plot the point where the two lines intersect.
5. Connect the plotted points with a solid line. (In some cases, it may be more appropriate to draw a line that shows the general trend of the plotted points. In those cases, some of the points may fall above or below the line. Also, not all graphs are linear. It may be more appropriate to draw a curve to connect the points.)
6. Add a title that identifies the variables or relationship in the graph.

**Activity**

Create line graphs to display the data from Experiment 2 and Experiment 3 in the data table.

**Activity**

You read in the newspaper that a total of 4 centimeters of rain fell in your area in June, 2.5 centimeters fell in July, and 1.5 centimeters fell in August. What type of graph would you use to display these data? Use graph paper to create the graph.
**Circle Graphs**

Like bar graphs, circle graphs can be used to display data in a number of separate categories. Unlike bar graphs, however, circle graphs can only be used when you have data for all the categories that make up a given topic. A circle graph is sometimes called a pie chart. The pie represents the entire topic, while the slices represent the individual categories. The size of a slice indicates what percentage of the whole a particular category makes up.

The data table below shows the results of a survey in which 24 teenagers were asked to identify their favorite sport. The data were then used to create the circle graph at the right.

### Favorite Sports
<table>
<thead>
<tr>
<th>Sport</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soccer</td>
<td>8</td>
</tr>
<tr>
<td>Basketball</td>
<td>6</td>
</tr>
<tr>
<td>Bicycling</td>
<td>6</td>
</tr>
<tr>
<td>Swimming</td>
<td>4</td>
</tr>
</tbody>
</table>

To create a circle graph, follow these steps.

1. Use a compass to draw a circle. Mark the center with a point. Then draw a line from the center point to the top of the circle.
2. Determine the size of each “slice” by setting up a proportion where $x$ equals the number of degrees in a slice. (Note: A circle contains 360 degrees.) For example, to find the number of degrees in the “soccer” slice, set up the following proportion:

   \[
   \text{Students who prefer soccer} : \frac{x}{\text{Total number of students}} = \frac{x}{\text{Total number of degrees in a circle}}
   \]

   \[
   \frac{8}{24} = \frac{x}{360}
   \]

   Cross-multiply and solve for $x$.

   \[
   24x = 8 \times 360
   \]

   \[
   x = 120
   \]

   The “soccer” slice should contain 120 degrees.

3. Use a protractor to measure the angle of the first slice, using the line you drew to the top of the circle as the 0° line. Draw a line from the center of the circle to the edge for the angle you measured.

4. Continue around the circle by measuring the size of each slice with the protractor. Start measuring from the edge of the previous slice so the wedges do not overlap. When you are done, the entire circle should be filled in.

5. Determine the percentage of the whole circle that each slice represents. To do this, divide the number of degrees in a slice by the total number of degrees in a circle (360), and multiply by 100%. For the “soccer” slice, you can find the percentage as follows:

   \[
   \frac{120}{360} \times 100\% = 33.3\%
   \]

6. Use a different color for each slice. Label each slice with the category and with the percentage of the whole it represents.

7. Add a title to the circle graph.

### Activity

In a class of 28 students, 12 students take the bus to school, 10 students walk, and 6 students ride their bicycles. Create a circle graph to display these data.