# 2.7.1: Graphing Data

**Learning Objectives**

- Read and interpret data from tables and pictographs.
- Read and interpret data from bar graphs and histograms.

## Introduction

A nurse is collecting blood type data from her patients. When a new patient is checked in, the nurse does a simple finger-prick test to see whether the patient's blood is type A, B, AB, or O. (These are the four possible blood types. Each one also carries a + or - to represent the RH factor, but for our purposes, let's just track the type, not the + or -.) She tracks her results by creating a two-column table with the patient's name and blood type.

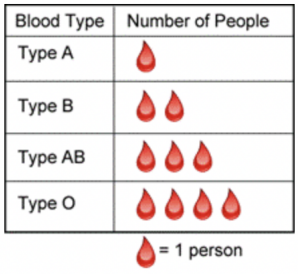
| Name | Blood Type |
|---|---|
| Dominique | A |
| Ilya | O |
| Raul | AB |
| Madison | O |
| Philip | AB |
| Samuel | B |
| Josefine | O |
| Brett | O |
| Paula | B |
| Leticia | AB |

The information in this table is an example of **data**, or information. In this case, the nurse has gathered a fair amount of data about her patients' blood types. By analyzing the data, she can learn more about the range of patients that she serves.

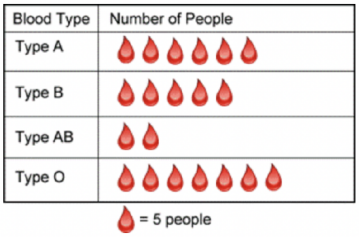
Data helps us make many kinds of decisions. Organizing data into graphs can help us get a clear picture of a situation and can often help us make decisions based on the picture. So how do you take data and make a picture out of it? Let's take a look.

## Pictures of Data

Let's return to the data set used previously. If the nurse wanted to represent the data visually, she could use a **pictograph**. Pictographs represent data using images. This visual presentation helps illustrate that for the data in her table, Type O blood is the most common and Type A blood is the least common.




Interested by the results of this small survey, the nurse continues to document the blood types of her patients until she has surveyed 100 people. She puts all of this data in a table, but she finds that it is hard for her to quickly identify what the data is telling her. She decides to make another pictograph using a different scale.




To read this pictograph, all you need is the scale, which, in this case, is the number of people that each blood drop symbol represents. In this graph, each blood drop represents 5 people. There are six drops next to Type A, so $5 \cdot 6 = 30$ people had Type A blood. The table below shows the rest of the information.

| Blood Type | Number of People |
|---|---|
| Type A | $6 \text{ drops} \cdot 5 \text{ people} = 30 \text{ people}$ |
| Type B | $5 \text{ drops} \cdot 5 \text{ people} = 25 \text{ people}$ |
| Type AB | $2 \text{ drops} \cdot 5 \text{ people} = 10 \text{ people}$ |
| Type O | $7 \text{ drops} \cdot 5 \text{ people} = 35 \text{ people}$ |

## Example

**The pictograph below shows the number of medals earned at an international competition. How many medals did Japan earn?**

| Country | Medals |
|---|---|
| Japan | **MMMMM** |
| Argentina | **M** |
| Germany | **MMMMMM** |
| Egypt | **MMMM** |
| | **M = 4 medals** |

### Solution

| | |
|---|---|
| | Look at the scale of the pictograph. Each **M** represents 4 medals. |
| $5 \cdot 4 = 20$ | Japan has **5M** symbols, so the total number of medals is $5 \cdot 4 = 20$. |

Japan earned 20 medals.

## Exercise

Which table accurately represents the data shown in the pictograph below?

| Employee | Hourly wage |
|---|---|
| Wayne | $ $ $ $ $ |
| Sarah | $ $ $ $ $ $ $ |
| Leigh | $ $ $ $ |
| | $ = $4 |

A.

| Employee | Hourly wage |
|---|---|
| Wayne | $5 |
| Sarah | $7 |
| Leigh | $4 |

B.

| Employee | Hourly wage |
|---|---|
| Wayne | $20 |
| Sarah | $22 |
| Leigh | $19 |

C.

| Employee | Hourly wage |
|---|---|
| Wayne | $10 |
| Sarah | $14 |
| Leigh | $8 |

D.

| Employee | Hourly wage |
|---|---|
| Wayne | $20 |
| Sarah | $28 |
| Leigh | $16 |

**Answer**

A. You identified the correct number of symbols, but it looks like you forgot to factor in the scale. Each dollar sign represents $4, so multiply the number of dollar signs in a row by 4. The correct answer is Table D.

B. You correctly identified that Wayne earns $20, since the table indicates that he has 5 dollar signs, and each dollar sign represents $4. Sarah's row shows that she earns seven dollar sign symbols, so she earns $28, not $22. The correct answer is Table D.

C. You identified the correct number of symbols, but it looks like you used the wrong scale. Each dollar sign represents $4, not $2. Multiply the number of dollar signs in a row by 4. The correct answer is Table D.

D. Each dollar sign symbol represents $4, so if you multiply the number of dollar signs in a row by $4, you will find that Wayne earns $20, Sarah earns $28, and Leigh earns $16.

## Bar Graphs

Representing data as pictures doesn't always make sense either. **Bar graphs** are an alternative (and popular) way to represent data sets, especially those with large amounts of data or which do not lend themselves well to individual symbols. In a bar graph, the number of items in a data category is represented by the height or length of bars.

As when reading pictographs, paying attention to the scale is essential: small differences in the height of two bars can sometimes represent thousands of dollars, for example!

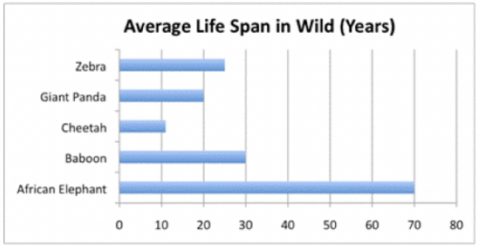
Let's consider an example. Here is some information about the average life span of five animals in the wild, presented in a table.

Source: National Geographic, accessed July 2011

| Animal | Average Life Span in the Wild (Years) |
|---|---|
| Zebra | 25 |

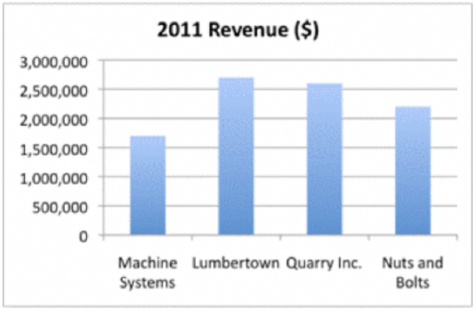
| | |
|---|---|
| Giant Panda | 20 |
| Cheetah | 11 |
| Baboon | 30 |
| African Elephant | 70 |

This data is fine in a table, but presenting it as a bar graph helps the viewer compare the different life spans more easily. Look at the bar graph below. In this example, the animals are listed on the left side of the graph (also called the **y-axis**), and the life span in years is listed on the bottom (the **x-axis**). The graph shows the information by the length of the bar associated with each animal name.



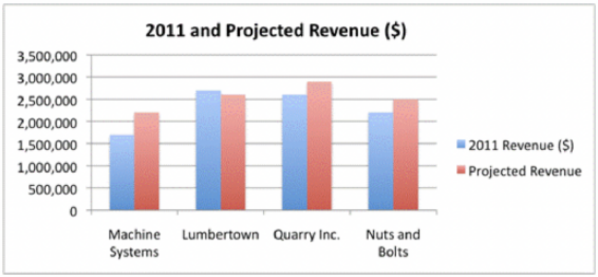

Bar graphs are generally used to compare quantities, not to determine exact quantities, especially when the scale is large, as in the next graph.

The bar graph below shows total revenue for four fictional companies in 2011. Notice that the scale, on the y-axis, is very large; each horizontal line represents an increase of $500,000. For this reason, it is difficult to tell exactly how much money each company made in 2011. However, comparing the bars is straightforward. Glancing at the data, you can tell that Lumbertown earned the most (a little over $2,500,000), while Machine Systems earned the least (about one million less, at just over $1,500,000).



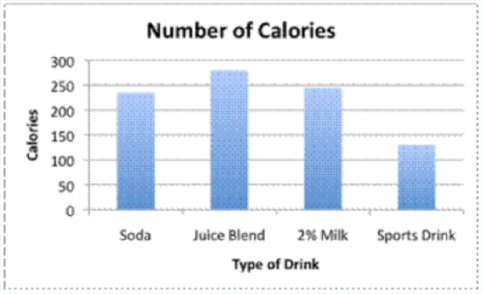

You can also use bar graphs to showcase multiple pieces of information about a specific situation. For example, let's show the next year's projected revenue for each company on the graph that you just looked at. You can leave the existing bars in the graph and just add four more.

The blue columns remain, but now they are accompanied by four new red columns that represent the projected revenue for these companies. Again, this data could be expressed in a table. With a bar graph, you gain ease of quick comparison, but lose the detail of the exact values. Looking at this graph tells you that while Lumbertown has the highest revenue for 2011, it is projected to decrease. Conversely, Machine Systems is projected to increase its revenue. Seeing data visually can help you understand the story that the data is telling about a situation.




**Example**

**Use the graph to list the drinks from the most number of calories to the least number of calories (serving size: 16 ounces).**




Solution

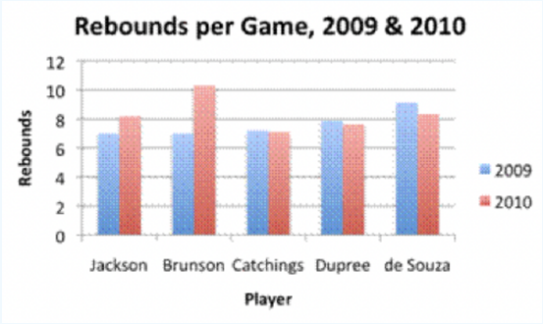
| | |
|---|---|
| | The y-axis shows total calories, and the x-axis shows the drink. The taller the bar, the more calories the drink has. |
| Juice Blend $\approx 275$ | The juice blend contains over 250 calories, so it has the most calories per serving. |
| 2% Milk $\approx 245$<br>Soda $\approx 230$ | Soda and 2% milk are both between 200 and 250 calories, but the bar for 2% milk is taller, so it must contain more calories. |
| Sports Drink $\approx 125$ | Sports drink has the shortest bar; it contains about 125 calories. |

From most to least number of calories per serving:

Juice Blend, 2% Milk, Soda, Sports Drink

**Example**

**Based on the graph below, which player's rebounding increased the most from 2009 to 2010?**




Source: WNBA.com, accessed July 2011

**Solution**

| | |
|---|---|
| Jackson and Brunson | The y-axis shows rebounds per game, and the x-axis shows the player's name. A taller bar represents more rebounds per game by the player.<br>This graph shows two sets of data: one for 2009, in blue, and one for 2010, in red. To compare the data from one year to the next, compare the heights of the two bars for each player.<br>Two players had higher rebound averages in 2010 than they did in 2009. This is indicated by the red bar being taller than the blue bar. The other players' red bars are shorter, so their rebounds decreased.<br>Comparing the sizes of the increases, you can tell that Brunson increased her per game rebounding *more* than Jackson did. |

The player whose rebounding increased the most from 2009 to 2010 was Brunson.

## Histograms

The data sets you have looked at so far have shown **categorical data**. Categorical data is data that can be separated into categories. For instance, data about eye color (brown, blue, green), blood type (O, A, B, AB), and the type of computer you use at work or home (PC or Mac) are all categorical.

**Quantitative data** is sometimes called *numerical data*, because it is data that is represented by numbers. Quantitative data sets consist of quantities such as age (1, 2, 23, 34, 77...), test scores (90, 95, 100, 72...), and height (55 inches, 50 inches, 68 inches, ...). Notice that all of the data here are numbers.

Continuous quantitative data can be graphed using a **histogram**. A histogram resembles a bar graph, but instead of having categories along the axis, it has numbers listed in order and usually grouped in intervals (such as 0, to 10, 11 to 20, and so on). While the bars in bar graphs can have space between the bars, the bars of a histogram are usually touching, as the data is continuous.

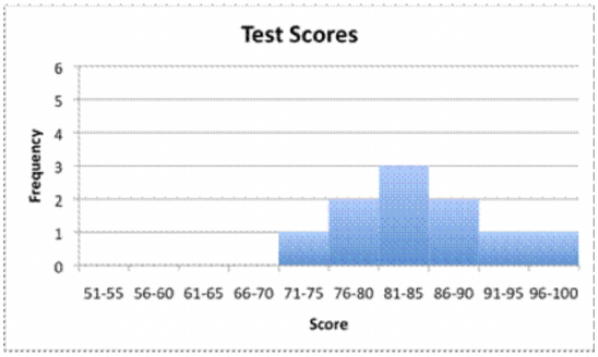
Let's look at how you could display the set of test score data listed below.

| Name | Score (0 to 100) |
|---|---|
| Alex | 81 |
| Beatriz | 73 |
| Celia | 79 |
| Donnie | 91 |
| Erykah | 87 |
| Fred | 79 |
| Gigi | 81 |
| Helene | 84 |
| Irma | 88 |
| Joelle | 96 |

Looking at the scores, you can tell that some people scored in the 70s, some scored in the 80s, and some scored in the 90s. You can organize the data in a histogram with the continuous data from 0 to 100, by using the intervals to 71 to 80, 81 to 90, and 91 to 100.


There are only three intervals for this histogram and ten data points. For a histogram to be meaningful, it should include 100 data points or more and 7 intervals or more. (For this reason, many histograms are created using a variety of technical tools.) The histogram then takes on interesting shapes that can provide a lot of information.

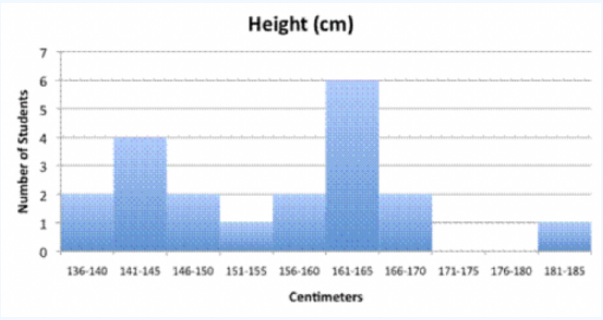
Even with only 10 data points, you find a much more meaningful histogram by using smaller intervals (such as 71 to 75, 76 to 80, 81 to 85, 86 to 90, 91 to 95, and 96 to 100).




This second graph shows a bit of a curve to the data. Nobody scored 70 or lower, and the data peaks in the 81 to 85 range. Increasing the number of intervals has an effect on the shape of the graph, and helps us see some trends that are in the data.

Example

**Based on the histogram below, how many students are between 151 and 180 centimeters tall?**




Solution

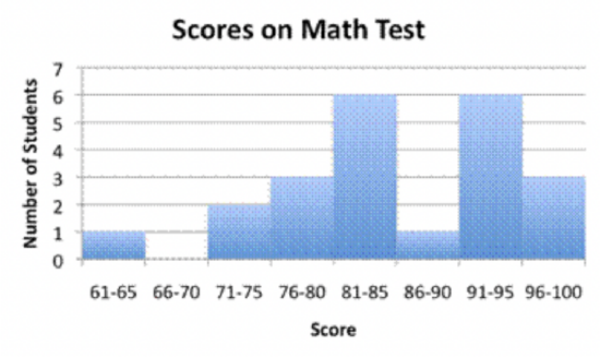
Number of students in each interval:

| | |
|---|---|
| 151 to 155, 1<br>156 to 160, 2<br>161 to 165, 6<br>166 to 170, 2<br>171 to 175, 0<br>176 to 180, 0 | Each interval in this histogram is 5 centimeters. |
| $1+2+6+2+0+0=11$ | Add the number of students. |

11 students are between 151 and 180 centimeters tall.

## Exercise

A teacher made this histogram to track scores on a recent math test. How many students scored in the 91 to 100 range?




A. 3
B. 6
C. 9
D. 22

**Answer**

A. Incorrect. Three students scored between 96 to 100 on the test, but if the teacher wants to find out how many students scored between 91 to 100, then she also has to consider the number of students who scored between 91 to 95. The correct answer is 9.
B. Incorrect. Six students scored between 91 to 95 on the test, but if the teacher wants to find out how many students scored between 91 to 100, then she also has to consider the number of students who scored between 96 to 100. The correct answer is 9.
C. Correct. Six students scored between 91 to 95 on the test, and 3 students scored between 96 to 100. The total number of students who scored between 91 to 100 is 9.
D. Incorrect. It looks like you calculated the total number of students who took the test. To find the number who scored between 91 to 100, look at the intervals for 91 to 95 and 96 to 100. The correct answer is 9.

## Summary

Data is mathematical information. Mathematical data is often recorded in tables to organize, or spreadsheets to organize and sort. Graphs can help you see the data visually, which can help you to better understand the data. A pictograph is a graph that uses symbols to represent data. Bar graphs show the frequency of categorical data, using bars instead of symbols. Histograms are similar to bar graphs in that they are constructed out of a series of bars. However, histograms represent continuous quantitative (numerical) data, which can illustrate trends as well as other more advanced attributes.

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