Displaying data using charts and graphs

GETTING STARTED

In pairs, see if you can identify any **trends** in the data from the previous lesson, either in the raw data or in the tabulated form.

KEY TERMS

Trends are patterns in data, e.g. values might increase for one variable as the values decrease for another.
Charts are usually used when data are being presented in groups.
Graphs are used to plot individual data values.

We have looked at ways in which data can be recorded from investigations. Next we discuss how the data may be displayed. This can be done graphically using **charts** and **graphs**.

When deciding which type of graph or chart to use, you need to think about the type of data you are showing and what information about the data you want to share. For example, the results of an investigation into the diameter of screws could be presented in a graphical chart, where shapes are used to represent data. Alternatively, a graph could be plotted for the load–extension investigation in Table 3.2, with a line graph used to represent the data.

There are many types of chart and graph that are used to present data. Some are listed in Table 3.3.

Table 3.3: Types of chart and graph

Chart type	Graph type
Pie chart	Line graph
Bar chart	Scatter graph
Pictograph	

Types of chart

To compare the types of chart, look at how the data collected for the diameter of screws in Table 3.1 can be presented in different ways:

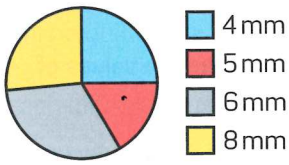

Figure 3.2: Pie chart

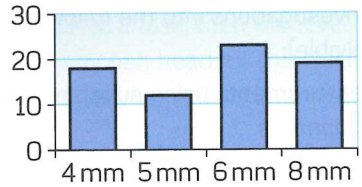

Figure 3.3: Bar chart

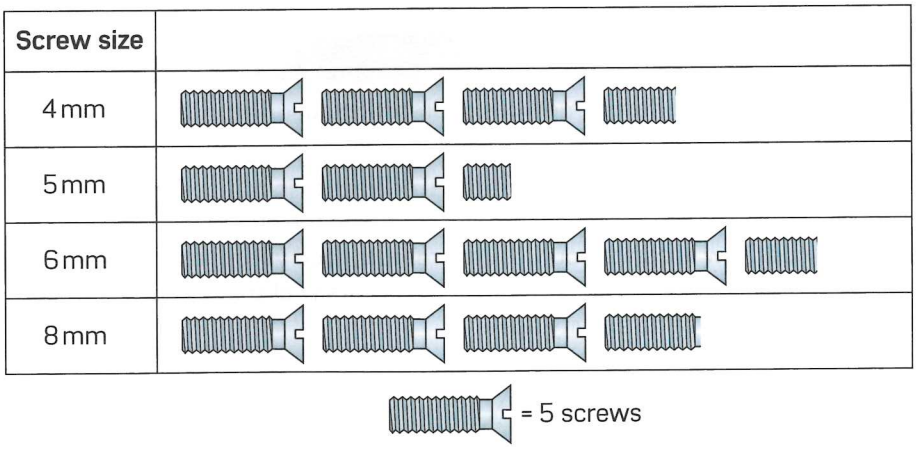

Figure 3.4: Pictograph

Pie charts are good for showing the relationship between individual groups of data and the total amount of data. They show each group as a proportion of the total. In Figure 3.2, each sector, or slice of the pie, represents the quantity of each size of screw as a proportion of the total number of screws.

Bar charts are useful for identifying trends, such as what is most popular or what happens the most. In Figure 3.3, it is easy to see that there are more 6 mm screws than the other sizes. The **scale** of the chart is important, so check the scale on the *y*-**axis** and try to use scales that are easy to interpret. Vertical bar charts are also known as column charts.

Pictographs show data by using images. In Figure 3.4, each picture of a screw represents five actual screws, which can be confusing when the data is not in groups of five. Pictographs can be useful if you are presenting data about numbers of items or activities completed, but it is important to choose a sensible value for each image to represent. If each screw represented one actual screw in Figure 3.4, then you would need to draw 23 screws for the 6 mm screw size, which would be time-consuming. Alternatively, if each image of a screw represented 100 actual screws, the values would be hard to work out because the images of partial screws would be small and very similar to each other.

KEY TERMS

Axis is the name of either the horizontal or the vertical line that is used to show the scale of the graph or chart.
A **scale** on a graph is used to show the quantity of each group.

ACTIVITY

Using data you have collected or that your teacher has provided, produce an example of each different type of chart. It is important that you present the results of the investigation with accuracy. You will need to:

1. create a pie chart, with a key to represent each group of data
2. draw a bar chart to represent the values of the different groups of data
3. draw a pictogram that represents each group of data using a suitable symbol for the values
4. write a review of the graphical methods used, stating which is most effective for the data and why.

Discuss with your partner.

Types of graph

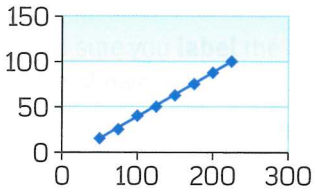

Figure 3.5: Line graph

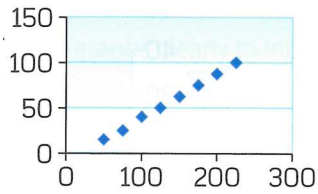

Figure 3.6: Scatter graph

Line graphs, as shown in Figure 3.5, are useful for showing how things change over a period of time or where one value is being compared to another – for example, the extension of a spring relative to the load applied or the distance travelled as a function of time.

Scatter graphs, as shown in Figure 3.6, can be useful if you are collecting lots of measurements from an investigation. A scatter graph can be used to produce a line of best fit. Scatter graphs and lines of best fit are covered in the next lesson.

Remember, when you are deciding on the type of chart or graph to use, think about the following questions.

- How many groups of data are there?
- What do you want the chart or graph to show?
- What is the information going to be used for?

CHECK MY LEARNING

You have looked at the types of graph and chart that can be used to present data.

Using some examples of charts and graphs, discuss as a class group why each type of graph/chart was chosen to present that data, and which methods are most effective.

Displaying data using lines of best fit

GETTING STARTED

Lines of best fit were mentioned in the previous lesson. Do you know what they are? Discuss with your class.

So far, we have looked at data that:

- can be sorted into groups
- follow a trend or pattern.

Unfortunately, when we carry out investigations into how a material or component reacts to different conditions, the data often cannot easily be grouped or presented as perfect straight-line graphs.

To ensure that the data from an investigation is valid, the same test is often repeated. This means that there will be a number of different values for each test (see, for example, Table 3.4), and these values are best presented using a scatter graph.

Scatter graphs

Once you have created a scatter graph (see, for example, Figure 3.7), the results are presented visually, but they are not always very effective at communicating information. For example, it is difficult to identify trends or patterns that might be useful or conclusive to the extent you require when investigating an engineered component or material.

Table 3.4: Example of data from a practical investigation

	Length (mm)				
Mass (g)	Test 1	Test 2	Test 3	Test 4	Test 5
50	10	12	11	8	10
100	14	15	13	17	15
150	19	20	21	21	19
200	26	25	27	24	26
250	32	30	29	30	28
300	34	35	37	33	35

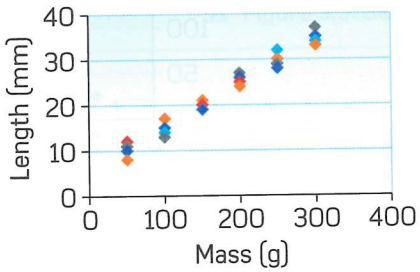

Figure 3.7: Scatter graph for the data in Table 3.4

ACTIVITY

Carry out an investigation to see how much a spring extends under different amounts of loading. You will need to measure the extension of the spring for each load five times. Use the data from the investigation to produce a scatter graph.

Lines and curves of best fit

When you look at the scatter graph in Figure 3.7, the large number of individual points plotted can be difficult to interpret. To make it easier to understand the message a scatter graph is trying to tell us, we use the plotted data to draw a line of best fit.

A line or curve of best fit can pass through some of the plotted points, sometimes most of them, or sometimes none of them! A line of best fit can also help to identify values that have been measured incorrectly.

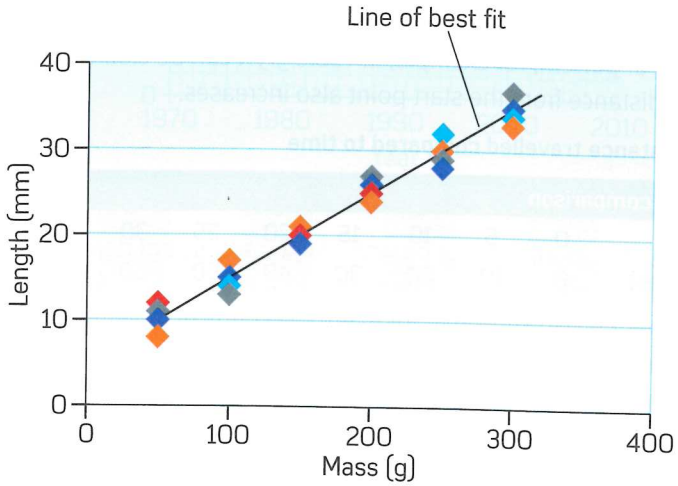

Figure 3.8: Line of best fit for the information in Table 3.4

As you can see in Figure 3.8, drawing a line of best fit shows that there is a straight-line relationship between the load and the length of the extended spring.

When plotting a graph, you need to ensure that you use the most precise scale that you can, using graph paper with 1 mm or 2 mm squares if possible. Draw your *x*-axis and *y*-axis clearly. Normally, times would be on the *x*-axis and distances would be on the *y*-axis.

Make sure you **label** the axes of your charts and graphs clearly to indicate what is being shown.

It is important to use your observational skills when looking at the data/results of practical activities; it could be that one of the measurements you made was inaccurate or a component was faulty. This will be covered in more detail in the next lesson.

KEY TERM

Labelling should be used to identify groups of data clearly.

CHECK MY LEARNING

You carried out an activity to collect some data from a spring load–extension experiment. Take the scatter graph you produced and try to draw a line of best fit. What do the results show you?

With a partner, think about and discuss the reasons why tabulated data and scatter graphs are useful in engineering investigations.