DEALING WITH DATA

by Dr June Hassall

Data is information, often in the form of numbers, which you may have collected during an experiment.

Tables

Use tables to: Record similarities and differences between organisms, and to enter the readings you take during an experiment.

Making tables

- Use a title to describe the information.
- Columns are labelled with the things being described or the quantities being measured (and their units, such as %, g, °C).
- Across the rows, enter your observations or readings.

The table below shows a comparison of the composition of two foods:

Foods	Percentage of food constituents			
	Protein%	Fat%	Carbo-hydrate%	Inedible%
Peanut	26	46	10	18
Corn	10	5	70	15

Interpreting tables

- You will usually need to do some simple arithmetic on numerical data:
  - add, subtract, multiply, and divide whole numbers, decimals and fractions
  - work out ratios, percentages, and fractions
  - find the mean and median.

For example, from the table above:
1 How many grams of protein would there be in 50 g of peanuts?
For peanuts, the % of protein is 26; this means 26 g of protein are present in 100 g of peanuts. So in 50 g there are 26/100 x 50 = 13 g.

2 What fraction of peanuts is made up of carbohydrate?
For peanuts, the % of carbohydrates is 10%. This means 10 parts out of a hundred, or 10/100 = 1/10 (one tenth). This can also be written as 0.1.

Pie charts

What they are: Pie charts are circles with lines dividing them into parts (sectors), like cutting a cake.

Use pie charts to: Show parts of the whole as a diagram, for example of food constituents in a certain food, different uses of chemicals, or various kinds of music, books etc.

Making pie charts: We start with a table.

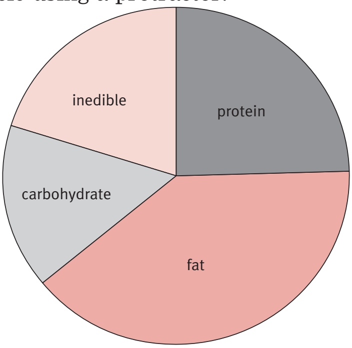
	Percentage of food constituents			
	Protein	Fat	Carbo-hydrate	Inedible
Peanut	26	46	10	18

The angle at the centre of a circle is 360°. We divide this angle in the same proportion as the constituents:

$$\frac{\text{Percentage of constituent}}{100} \times 360° = \text{angle of segment}$$

Protein = 26/100 x 360° = 93.6°
Fat = 46/100 x 360° = 165.6°
Carbohydrate = 10/100 x 360° = 36°
Inedible part = 18/100 x 360° = 64.8°

The sectors are then drawn onto the circle using a protractor.



Interpreting pie charts

- Use a protractor to find an angle, e.g. 72° for the sector of rock CDs sold.
- Find what percentage this is of the whole by dividing by 360 and multiplying by 100:

72/360 x 100 = 20%.

- If the value of the total is, for example, 4000 records, then this sector equals:

20% of 4000, which is 20/100 x 4000 = 800 rock CDs sold.

Bar charts

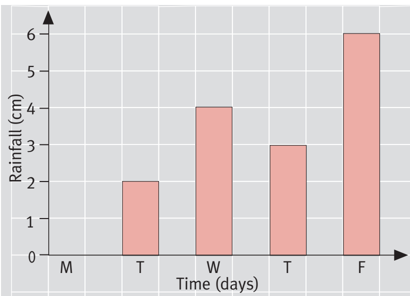
What they are: Bar charts have vertical or horizontal bars. The lengths of bars represent the value of the variable being measured.

Use bar charts: When one variable is numerical (for example amount of rainfall), and the other variable is a description (for example days of the week).

Making bar charts

Rainfall (cm) for five days					
	Days				
	Mon	Tues	Wed	Thurs	Fri
Rainfall (cm)	0	2	4	3	6

- On the horizontal axis, enter the names of the descriptive variable.
- On the vertical axis, enter the scale for the numerical variable.
- Draw bars of equal width to represent the values. Bars do not usually touch each other.



Interpreting bar charts

- You may have to read off (find from) the bar chart the totals, averages, highest and lowest readings etc.
- Each reading or bar in a bar chart is independent from the others, so you cannot use a bar chart to predict other readings.

For example, for the bar chart above:
What is the average rainfall during the week?
(Add together all the values, and divide by the number of readings.)

$$\frac{0 + 2 + 4 + 3 + 6}{5} = 15/5 = 3 \text{ cm rain/day}$$

Histograms

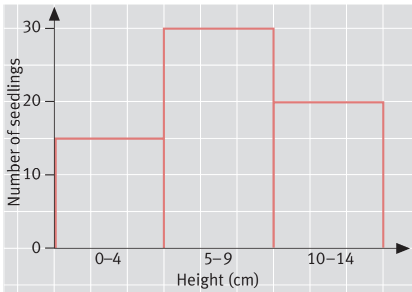
What they are: Histograms also have bars, the heights of which represent values.

Use histograms: When information on both the axes is numerical, for example the number of seedlings that are different specified heights.

Making histograms

- We often combine the readings of one variable into groups (or classes) and the scale for these is put along the horizontal axis.
- On the vertical axis, enter the scale for the readings that were taken.
- Draw bars of equal width to represent the values. Bars touch each other because they are showing values of the same variable.

Number of seedlings of different height			
	Height (cm)		
	0-4 cm	5-9 cm	10-14 cm
Number	6	20	4



Interpreting histograms

- You may have to read off various values, and work out totals, averages etc.
- You may have to explain how the experiment was set up and why.

For example, for the histogram above:
1 How many seedlings were used?
(Add the total number of readings.)
Total = 6 + 20 + 4 = 30.
2 Why were so many seedlings used?
When we do experiments with living things we need to use large numbers, because some may die.

Line graphs

What they are: Line graphs are points recorded on graph paper (marked with squares) that are then joined by lines.

Use line graphs: To show how one numerical variable changes in relation to another. For example a line graph can record how children increase in height as they become older.

Making graphs
a) *Draw the axes*
- Draw the lines for the axes at right angles and as long as you can, in order to fill the space that you have.

- On the horizontal (x) axis put the values you decide, called the independent variable. This could be time (minutes, days, years etc) or temperature.

- On the vertical (y) axis put the readings you take of the experiment (what you are investigating). This is called the dependent variable, and could be height, mass, or number.

b) *Label and choose scales*

- Add the units in which readings will be made, for example time (days), height (cm) etc.

- *Decide on the scales* These usually begin from zero (but they don't have to). Look at your lowest and highest readings and mark these on the axes. Then divide the space between them into equal parts and add numbers.

c) *Plot the points*
Use the numerical data you have collected or have been given in a table. Read the scales carefully and then run an imaginary line up from a value on the horizontal axis, and another across from the corresponding value on the vertical axis. Where these two lines meet, make a cross or a dot inside a circle.

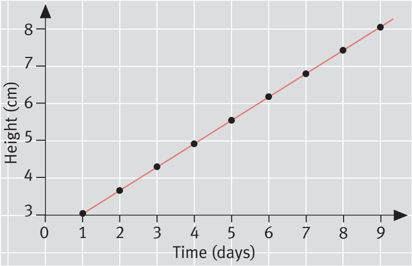
d) *Join the points*
Check each point is in the correct place, then join the points with straight lines.

e) *Add a title*
Include both the dependent and the independent variables.

Prepare a line graph of this information that shows the relation between time and the increase in height of seedlings.

Height (cm)	3	3.5	4.2	4.8	5.5	6.1	6.7
Time (days)	1	2	3	4	5	6	7

Axes: The values chosen by the experimenter are the days on which readings are made – so this is the horizontal axis. The values that depend on these are the readings of height that are recorded – so these go on the vertical axis.
Scales: You can chose one large square for each day and for each cm.
Plot points: Record with a cross or a dot the intersection of each pair of values.
Join points: Use a ruler.
Add a title: 'Graph to show the relation between height of seedlings and time'.



Interpreting graphs

- Use the graph line to find values on the axes:
  - On which day is the height 3.5 cm?
  - A height of 5.5 cm is found on which day?

- You can make predictions. If a reading had been missed, then the line could be used to estimate it. The line can also be extended to predict new values, as shown by a dotted line on the graph above. This shows a predicted value of 7.4 cm for an 8-day-old seedling.

- Describe the graph.
  - If the line is steep, it means a high rate of growth.
  - If the line is less steep, then the growth rate is also less.

Have fun dealing with data!