5 Collecting and displaying data

- Decide which data would be relevant to an enquiry and collect and organise the data.
- Design and use a data collection sheet or questionnaire for a simple survey.
- Construct and use frequency tables to gather discrete data, grouped where appropriate in equal class intervals.
- Draw and interpret:
  - bar-line graphs and bar charts
  - frequency diagrams for grouped discrete data
  - simple pie charts
  - pictograms.

Collecting data

Pieces of information are often called **data**. **Primary data** is information you collect yourself. **Secondary data** is data which somebody else has collected, for example information you may find on the internet or in newspaper articles.

This chapter looks at how to collect primary data through surveys and at different methods for displaying the data when it has been collected.

Surveys are needed by companies and organisations for a number of reasons. For example, if a government wishes to spend more money on schools it may need to raise more money through taxes to achieve this. It may want to carry out a survey to find out what people think of that idea.

Discuss in groups.

Q Which of the following questions do you think would be the best one for the government to use in a questionnaire?

a) Do you think you pay too much tax?

b) Do you think our schools are good?

c) Would you be prepared to pay more tax if the money raised was spent on improving schools?

d) Do you think the government spends too much money on offices for politicians and not enough on new schools?

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A car manufacturer wants to know which things (electric windows, air conditioning, heated seats, etc.) people expect to have in a car and which are seen as extras.

Q What sort of questions might be asked in a questionnaire?

A television company wants to find out which are its five most popular programmes.

Q What sort of questions might the television company ask in a questionnaire?

Your discussion may have shown that asking the *right* question to give a *meaningful* and *useful* answer is not as easy as it seems.

The design of questionnaires is very important. There are some simple rules which you need to think about so that:

- people will co-operate and try to answer your questions
- people will answer honestly
- the answers you get can be presented and understood easily.

The rules are as follows.

1. Make it clear what it is you are trying to find out.

For example, 'Excuse me. I am conducting a survey to find out if people would like to see new traffic lights at these crossroads. Please would you help by answering a few simple questions?'

2. Make the questions simple and give a choice of answer.

For example, a television company wishes to know how much its coverage of the athletics events in the Beijing Olympics was watched.

An example of a bad question would be:
Did you watch much of the Beijing Olympics on TV?

A better question might be:
The Beijing Olympics were shown on TV. How many hours did you watch of the athletics events?
a) none **b)** 1–5 hours **c)** 6–10 hours **d)** 11–15 hours **e)** 16–20 hours

3. Make your question ask for the other person's opinion. Do not make it clear what your own opinion is (this would be called a *biased question* or a *leading question*).

A bad example would be: Fishing is a very cruel pastime. Do you agree?
A better question might be: Do you think that fishing is a cruel pastime?
a) strongly agree **b)** agree **c)** neutral **d)** disagree **e)** strongly disagree

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4. Do not ask sensitive or embarrassing questions.

EXERCISE 5.1A

Re-write the questions below so that they could be used in a questionnaire.

1 Do you have too much homework?

2 Maths is the most important subject at school, isn't it?

3 What is the food like at this school?

4 Do you go to the cinema?

5 Do you think children spend too much time playing computer games?

6 Are boys in this class taller than girls?

7 The eight o'clock bus is always late. Do you agree?

8 How many languages do you speak?

9 Television is boring. Do you agree?

10 Do you agree that people only use supermarkets because it is easy to park there?

Discuss and compare your answers with friends.

EXERCISE 5.1B

1 A mobile telephone company thinks that younger people use mobile telephones more than older people do.
   a) Suggest five questions which could be used in a suitable questionnaire.
   b) Use your questionnaire to conduct a survey to test the statement 'Young people are always on the mobile phone. Older people do not use them.'

2 Suggest five questions for a questionnaire to discover what opinions people in your class have about school.

3 **a)** Write some suitable questions for a questionnaire to discover which students in your class are interested in football, whether they go to matches or watch it on TV, which team they support and whether they buy things to show their support for a team.
   b) Use your questionnaire to conduct a survey to test the statement 'Students in this class are not interested in football.'

4 Construct a suitable questionnaire to carry out a survey on a subject of your own choice. Discuss and compare your questionnaire with friends and suggest ways of improving it.

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Organising data

Data can be organised in several ways. Which method is chosen depends largely on the type of data being collected.

Constructing a **tally and frequency table** is a simple way of recording the number of results in each category.

For example, a survey is carried out to test the manufacturer's claim that there are 'about 36 chocolate buttons in each packet'. The number of buttons in each of 25 packets is counted, giving the figures below.

35	36	34	37	36	36	38	37	36	35	38
34	35	36	36	34	37	38	37	36	35	36
36	37	36								

Displayed as a list, the numbers are not clear. However, they are easier to analyse if they are recorded in a tally and frequency chart like this.

Number	Tally	Frequency
34	III	3
35	IIII	4
36	~~IIII~~ ~~IIII~~	10
37	~~IIII~~	5
38	III	3

The tally column is filled in as the survey is being carried out. The frequency column is completed by counting up the tally marks at the end of the survey.

Sometimes, if there is a big range in the data, it is more useful to group the data in a **grouped frequency table**. The groups are chosen so that no data item can appear in two groups.

For example, the ages of 30 residents in a care home are shown below.

98	71	76	77	72	78	77	73	76	86
75	79	81	105	100	74	82	88	91	96
85	90	97	102	83	101	83	84	80	95

Constructing a tally and frequency table with a list of individual ages will not be very useful as most ages in the range will only have one or two results. Grouping the data into the age ranges 71–80, 81–90, etc. produces this more useful table.

Age	Tally	Frequency
71–80	~~IIII~~ ~~IIII~~ II	12
81–90	~~IIII~~ IIII	9
91–100	~~IIII~~ I	6
101–110	III	3

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The ages could have been grouped 71–75, 76–80, 81–85, etc. The group size is the decision of the person collecting the data, but it is important that the groups are all the same size and do not overlap.

Displaying data

Once the data has been collected, it can be displayed in several ways. Which method is chosen depends on the type of data collected and the audience it is intended for.

One of the simplest and most effective is to use a **pictogram**.

This method uses pictures to represent the frequency. The chocolate button data can be displayed on a pictogram like this, using one circle to represent one chocolate button.

Number of chocolate buttons	Frequency
34	● ● ●
35	● ● ● ●
36	● ● ● ● ● ● ● ● ● ●
37	● ● ● ● ●
38	● ● ●

Sometimes one symbol represents more than one item. In the pictogram below, for example, each circle represents four chocolates and fractions of a circle represent smaller amounts.

Number of chocolate buttons	Frequency
34	◔
35	●
36	● ● ◗
37	● ◢
38	◔

Key

● = 4 chocolates

Look at the key to see what each symbol represents.

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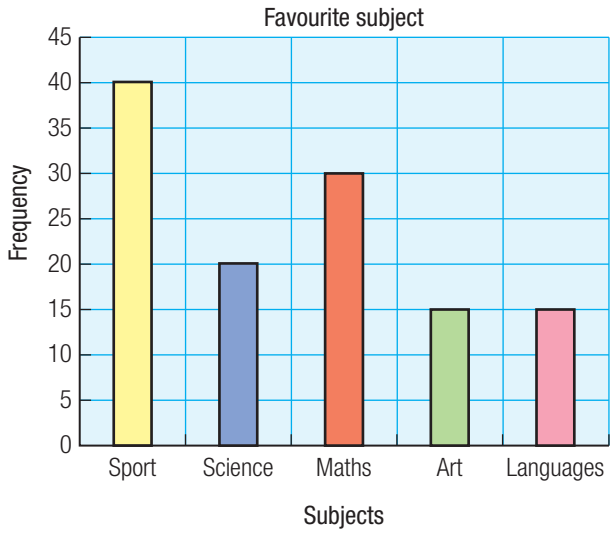
Probably the most common way of displaying data is the **bar graph** or **frequency diagram**. It is quick and easy to draw, and straightforward to understand.

Worked example

A school of 120 students carry out a survey to see which subjects are most popular. Their results are shown in the frequency table.

Show this information on a frequency diagram.

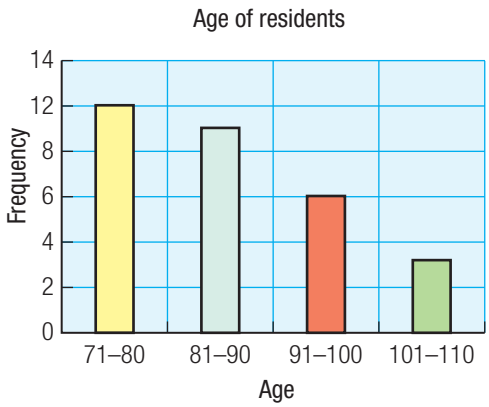
Subject	Frequency
Sport	40
Science	20
Maths	30
Art	15
Languages	15
Total	120



The graph is fully labelled.

The bars are all the same width and do not touch. The height of each bar represents the frequency.

Frequency diagrams can also be used to display grouped data, such as the ages of the residents in the care home.



As before, the bars are all the same width and do not touch.

An alternative to a frequency diagram is a **bar-line graph**. Instead of bars, lines are drawn to represent the frequencies. The height of each line indicates the frequency.

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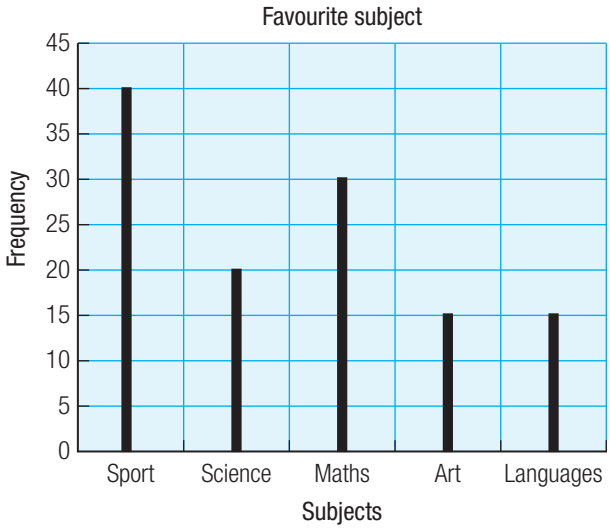
The data about students' favourite subjects can be shown on a bar-line graph like this.



In frequency diagrams and bar line graphs, each frequency is represented by the *height* of a bar or line. Another way of displaying data is on a **pie chart**. On these, each frequency is represented by a *fraction of a circle*.

Worked example

Look again at the data about students' favourite subjects. Show this information on a pie chart.

- First you need to express the frequency of each subject as a fraction of the total number of students.

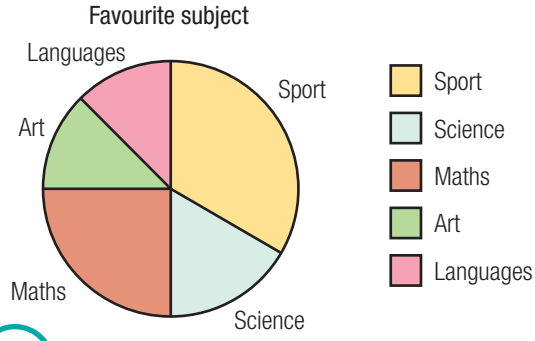
  Sport is $\frac{40}{120} = \frac{1}{3}$ of the total,

  Science is $\frac{20}{120} = \frac{1}{6}$,

  Maths is $\frac{30}{120} = \frac{1}{4}$ of the total

  and Art and Languages are $\frac{15}{120} = \frac{1}{8}$ each.

- To draw the pie chart without a protractor, an understanding of fractions helps. For example, Sport and Science together represent half of the total, and Maths, Art and Languages represent the other half of the total.



The pie chart has a heading and a key, and each slice is clearly labelled.

The pie chart is divided into slices, which are fractions of the circle. The size of each slice represents the frequency, as a fraction of the total number of students.

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EXERCISE 5.2

1 Twelve people were asked which sandwiches they had bought from a sandwich shop. Their answers were:

Chicken	Tuna	Egg	Chicken
Egg	Tomato	Chicken	Tuna
Tomato	Egg	Chicken	Chicken

Show this information on a pictogram.

2 A baker's shop sells brown (B), white (W), wholemeal (M) and soda (S) bread. It keeps a record of the types of loaves it sells. The data is shown below.

B	B	W	W	W	M	B	W	M	S
B	B	B	W	M	W	M	B	M	B
S	W	W	B	B	W	M	M	M	M
B	M	M	W	M	W	B	S	M	M

a) Construct a tally and frequency table of the results.
b) Draw a pictogram of the results.
c) Draw a bar-line graph of the results.

3 A fitness club carries out a survey to find out the ages of its members. Here are the results.

22	18	23	17	44	42	50	19	21	23	11	16
38	55	62	41	17	19	23	36	38	42	35	33
18	22	63	48	9	7	17	23	36	48	54	60

a) Make a grouped tally and frequency table using the age groups 1–10, 11–20, 21–30, etc.
b) Draw a frequency diagram of the data.
c) What does the data tell you about the ages of people at the fitness club?

4 A class of 30 students were asked how many brothers and sisters they have. Here are the results.

2	4	0	1	1	4	1	1	2	2	2	5	2	3	0
1	2	1	2	3	1	1	2	3	2	0	2	0	2	5

a) Draw a tally and frequency table of the results.
b) Use your table to draw a frequency diagram.
c) Interpret the results and comment on the numbers of brothers and sisters that the students have.

5 The numbers of litres of milk consumed in a group of 150 houses are shown in the table.

Number of litres	1	2	3	4	5	6
Frequency	27	54	34	16	15	4

Show this information on a frequency diagram.

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6 90 students sat a maths exam. On the way out of the hall, they were asked whether they found it hard, OK or easy. Here are the results.

Response	Easy	OK	Hard
Frequency	15	45	30

Show the results on a pie chart.

7 Two football teams have the results shown in the table.

	Total	Win	Draw	Lose
Spain	36	27	9	0
England	36	6	18	12

Illustrate these on two pie charts.

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