Chapter 9 Collect and represent data

Specification

FS coverage and range	Collect and represent discrete and continuous data, using ICT where appropriate
	Use and interpret statistical measures, tables and diagrams, for discrete and continuous data, using ICT where appropriate
	Use statistical methods to investigate situations
FS exemplification	Using:

- Collecting data
- Tally charts
- Frequency tables
- Pie charts
- Bar charts
- Line graphs
- Grouped frequency tables
- Scatter graphs

Positive and negative correlation and line of best fit

Use line of best fit

Compare proportions in a pie chart

GCSE

GCSE specification	**A s**	Discuss, plot and interpret graphs (which may be non-linear) modelling real situations
	SP a	Understand and use statistical problem solving process/handling data cycle
	SP d	Design data-collection sheets distinguishing between different types of data
	SP e	Extract data from printed tables and lists
	SP g	Produce charts and diagrams for various data types
	SP i	Interpret a wide range of graphs and diagrams and draw conclusions
	SP j	Look at data to find patterns and exceptions
	SP k	Recognise correlation and draw and/or use lines of best fit by eye, understanding what these represent
	SP u	Use calculators efficiently and effectively, including statistical functions
Edexcel GCSE course	**Specification A:**	
	Foundation 3.1–3.5, Chapter 12, 16.1, 16.4–16.6, 22.1–22.3, Chapter 25	
	Higher 6.1–6.2, 6.4–6.8, 11.4, 15.1, 15.3, 15.6, 18.1–18.10, 24.1–24.5	
	Specification B:	
	Foundation Unit 1: 1.1–1.5, Chapter 2, 3.2, 3.6–3.8, 3.10, Chapter 4; **Unit 2:** 12.1–12.3; **Unit 3:** Chapter 5	
	Higher Unit 1: 1.1–1.2, 1.4–1.8, 2.6, 3.1–3.10, 4.1–4.7; **Unit 2:** 9.3, 9.6	

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Resources

General resources
Song to play for data-collection activity
Examples of data sources showing tables and charts
Holiday brochures

Resource sheets
9.1, 9.2, 9.3

Links
http://www.bbc.co.uk/schools/gcsebitesize/maths/data/
(choose Representing data, then Line graphs, frequency
polygons and stem and leaf diagrams page 5)
http://www.databaseolympics.com/
http://www.censusatschool.org.uk
http://nationalstrategies.standards.dcsf.gov.uk/node/154736
http://www.vcacarfueldata.org.uk/ved

ActiveTeach resources
Video
ResultsPlus Knowledge Check
ResultsPlus Problem Solving
Question Audio

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Lesson 1

Objectives

- Learn to recognise redundant information
- Understand which graph is the most appropriate to use for particular kinds of data
- Read axes and scales accurately
- Communicate results clearly giving reasons for conclusions

Starter

- Play a song and ask students to find out how many times two or three appropriate words are used. Students should use a tally chart to record the words as they hear them. The information can then be collated in a frequency table to summarise their findings. Discuss the methods used.

Main teaching and learning

- Ask students how the tally chart and frequency table used in the Starter would have been different if they had been asked to record the playing times of all songs played on a radio show. Discuss how tallying the times in intervals and using a grouped frequency chart would be more appropriate.
- Ask students, in groups, to think of as many different types of chart or diagram that can be used to display data as they can.
- Extend the music theme from the Starter to discuss whether a pie chart, a bar chart or a line graph would be most suitable to display data such as the following:
  - The number of times each word comes up in a song
  - The number of times that a new song is downloaded each day for a 10-day period
  - The proportion of different types of music played by a radio station over 24 hours.
- Discuss the particular use of a scatter graph to display and analyse bivariate data. Consider the difference between positive and negative correlation.
- Ask students to suggest some possible pairs of variables on the music theme that could show correlation. Students should then complete *Have a go* Q1–4 (pp90–1).

Issues and misconceptions

- Ensure that students understand the difference between the points plotted on a scatter graph (to represent a pair of variables) and the points on a line graph (where different values of a single variable are shown, often to show change over a time period).
- Establish that frequencies for each category can be identified more easily from bar charts than pie charts, which show proportions more clearly.

Support

- You may need to help students decide on a suitable scale for the vertical axis in Q4.

Extension

- Ask students to draw a pair of pie charts for the data shown in Q2, incorporating an 'other' sector to ensure a total of 100% for each year.

Plenary

- Show some examples of misleading graphs (see http://www.bbc.co.uk/schools/gcsebitesize/maths/data/representingdata2rev5.shtml). Ask students to identify why they are misleading and how they should be changed.

Formative assessment

- As a class, discuss the answers to Q1–4 before students peer-assess each other's work.

Homework

- Ask students to find three different types of graph in current news articles. For each, they should write down how effectively it displays the data and whether it could be improved.

Lesson 2

Objectives

- Understand how to find information from pie charts
- Analyse and understand the shape of a line graph
- Explain relationships and make conclusions

Starter

- Show students the two pie charts from *Take a look:* School council election (p92) but do not give any information about student numbers. Make some statements such as: *James and Kayleigh received the same number of votes from students in Years 7 to 11. James received more votes from Year 12 and 13 students than from students in Years 7 to 11.* Ask students to show thumbs up if the statement is true, thumbs down if it is false or hands open if they do not have enough information to decide.

Main teaching and learning

- Go through *Take a look:* School council election, emphasising that pie charts show proportions, rather than actual numbers, and information about totals is needed to interpret and compare them.
- Explain that bar charts and line graphs can show total frequencies more easily but a good scale is essential. Ask students, in pairs, to jot down all the factors of 10 and then 100.
- Give students the scale strips from Resource sheet 9.1. These 15 cm strips of graph paper show incomplete scales with 1 cm representing 1, 2, 3, 4, 5, 8 and 10, 20, 25, 30 and 50 units. Ask students to complete the scales and then try to plot some numbers on them, such as 2, 2.5, 7, 15, 23 and 40. Discuss any problems faced and relate difficulties to the fact that the best scales make use of factors of 10 or 100. Emphasise that scales must always be labelled with equal intervals.
- Ask students to complete *Have a go* Q5–8.

Issues and misconceptions

- When completing scales, students may initially label with just the required data values (for example, for Q5: 53, 45, 76, etc.). Make sure that instead they label major grid lines appropriately before plotting points.

Support

- Reminders of fractions and percentages will help with interpretation of pie charts.
- In Q8, students need to plot data with up to two decimal places so an appropriate scale is essential. As the question involves a prediction, students may find it helpful to allow space for extrapolation on the right of their graph.

Extension

- Ask students to write down all the reasons why the extrapolation used in Q8 may or may not be reliable.

Plenary

- Discuss answers to Q5–7. Invent three gym users for whom Alpha, Bodies and Curves would be the ideal gym. Discuss Q8. Is there evidence to support the claim?

Formative assessment

- The Starter gives immediate feedback about students' understanding of pie chart proportions. Students should be encouraged to self-assess their answers to Q5–8 during the Plenary discussion.

Homework

- Ask students to use http://www.databaseolympics.com/ to plot graphs comparing the performance of male and female gold medallists over time in another Olympic event. They should write a report on their findings.

Lesson 3

Objectives

- Choose a suitable method to answer the question
- Examine relationships by drawing line graphs or scatter diagrams
- Make conclusions and communicate results

Starter

- Divide students into small groups and give each group a set of variable cards from Resource sheet 9.2, showing pairs of variables such as 'Height of man, Height of adult son', 'Soup sales, Temperature', etc. Ask students to sort the cards into three categories:
  - As one variable increases, the other will too
  - As one variable increases, the other will decrease
  - There is unlikely to be any such link.
- Discuss positive and negative correlation as a way of describing a relationship between two variables, but emphasise that correlation does not necessarily imply dependence or causality.

Main teaching and learning

- Discuss *Take a look:* The Premiership (pp94–5) and the type of correlation shown on the scatter graph. Emphasise the construction and use of a line of best fit. Ask: *In what circumstances might a club be plotted a long way from the line of best fit and thus be an exception or outlier?* (For example, points deducted or poor defence in a few matches.)
- Give students access to real data (for example, at www.censusatschool.org.uk). Ask them to choose a pair of variables to investigate and either plot the data by hand or use Excel or similar to construct a scatter graph. In groups they should then compare their scatter graphs to check that they show the correlation expected. They should identify the strength of any correlation and suggest reasons for any outliers seen. Refer students to the data handling cycle (http://nationalstrategies.standards.dcsf.gov.uk/node/154736) and encourage them to plan their work accordingly.
- Ask students to complete *Have a go* Q10.

Issues and misconceptions

- From work in science, students may be more familiar with the word 'anomaly' to describe an outlier. Students may use the word 'negative' incorrectly when there is no correlation.

Support

- Remind students of what they learnt about graph scales in Lesson 2. Encourage students to choose scales that give a square aspect, as this will make their diagram easier to interpret for possible correlation.

Extension

- Ask students to find examples of pairs of variables which are likely to show correlation, but are not, in fact, dependent on one another. For example, 'Number of students sitting examinations, Sales of hay fever tablets'.

Plenary

- Ask: *Could the scatter graph plotted for Q10 be used to predict the price of a car which is 10 or more years old? Would a curved line be more suitable to show this later trend?*

Formative assessment

- Students should peer-assess each other's scatter graphs (plotting and interpretation) during the group activity.

Homework

- Ask students to find four different examples of charts or tables that can be used to find information.

Lesson 4

Objectives

- Choose a suitable method to answer the question
- Examine relationships by drawing line graphs or scatter diagrams
- Make conclusions and communicate results

Starter

- Show students the holiday brochure information from *Have a go* Q9 (p96). Divide students into pairs and give each pair one of the four holiday cards from Resource sheet 9.3, which show the dates and activity requirements of families going to the outdoor activity centre. Ask students to find the cost of their holiday and then check their accuracy by comparing the costs calculated by different pairs of students for each of the four holidays.

Main teaching and learning

- Divide students into small groups and give each group a selection of real data sources showing information in charts and tables (for example, mileage charts, tide tables, catalogues, takeaway menus). (Ideally students should use data found as Homework for Lesson 3.) Set a limited time in which students must devise 10 quiz questions that involve finding out information from the charts and tables. They should write out their questions and the correct answers on separate sheets of paper. Students should then try to answer the questions set by another group within a time limit before using the answer sheets to mark and score their work. Repeat as time allows.
- Ask students to complete Q9 or Q11.

Issues and misconceptions

- Some vocabulary may need explaining, particularly terminology on the unfamiliar tables and charts in the quiz activity.

Support

- Students may need support to access Q9 and Q11, which are both open questions. Details such as percentage discount and the emissions formula may cause difficulty. The Starter activity will help students to access Q9 more independently later. For Q11, encourage students to use a strategy and plan their work in a sensible order, to minimise the number of cars for which they need to calculate annual emissions.

Extension

- Ask students to devise a spreadsheet to find booking costs for Q9 or annual CO_2 emissions for any given emissions rate and annual distance (information about CO_2 emission rates for individual models of car can be found at http://www.vcacarfueldata.org.uk/ved).

Plenary

- Discuss and compare answers to Q9 or Q11. Identify any that have results outside of a reasonable range and encourage students to spot any errors made.

Formative assessment

- Students self-assess their quiz questions and answers during the quiz activity.
- Ensure that the Plenary involves peer assessment of students' answers.

Homework

- Ask students to use a real holiday brochure to cost the same 2-week holiday in April and June at a resort of their choice. They should show all details of their calculations.