



Guidance

Curriculum and  
Standards

# Key Stage 3

## National Strategy

# Securing level 5 in ICT

**ICT teachers**

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# Securing level 5 in ICT

### **Acknowledgements**

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## Introduction

The *Framework for teaching ICT: Years 7, 8 and 9* (DfES 0321/2002) provides teachers with guidance on meeting the National Curriculum requirements for ICT. The core training *Progression into and through Year 9* (DfES 0223/2003) showed, through three case studies, how the Year 9 objectives could be grouped and taught.

The three units in this booklet are designed to support the teaching of ICT in Year 9 to secure achievement at level 5. Evidence suggests that the three key areas that pupils find difficult are control and monitoring, handling data, and modelling. The choice of objectives and the range of activities suggested in the units are designed to support both teaching and summative assessment in these key areas. They are based on the three case studies and show one way in which they can be adapted to meet the needs of pupils who are capable of attaining level 5 but may not have evidence to support such a judgement. The units do not cover the whole content of the case studies but do focus on those areas that pupils find difficult. They are designed to enable pupils to demonstrate their ICT capability and follow ideas already exemplified in the sample teaching units. It is important that the original case studies are referred to as teachers prepare to teach these units.

It is expected that pupils will already have been taught the objectives for Years 7 and 8, either through use of the sample teaching units or through a similar scheme of work. These units are also supported by the exemplification of outcomes for unit 8.5, *Year 9: Boosting achievement in ICT Key messages* (DfES 0816-2003) and core training *Increasing pupils' rates of progress in ICT* (DfES 0644-2004).

## The units

Each unit comprises five lessons of an hour in length and is designed to enable teaching of a set of framework objectives. These and the unit outcomes are listed in the introduction to each unit. Also included is the level description and characteristics of level 5, with the relevant sections marked in bold.

Each lesson has learning objectives couched in language suitable for pupils and these objectives should be shared with them. There are also the learning outcomes to be shared with pupils. The lessons are structured with starters, teaching activities and plenaries to secure understanding. They are accompanied by a CD-ROM containing resources referred to in the lesson text. Many of them show how teachers can model activities, demonstrating to pupils the processes that are being used. They then give opportunities for pupils to apply these independently in their own work to allow them to demonstrate their ICT capability.

These units are also designed to follow the possible test model of problem analysis and implementation of a solution, so will further support pupils in demonstrating how they might structure a solution to a problem, which is a key requirement of level 5 attainment. This is explored fully in the core training *Preparing Year 9 pupils for assessment including tests, part 1* (DfES 0752-2004).

These units do not cover the whole requirements of the programme of study and assessment evidence will also need to be gathered from other work completed by pupils.

## Aspects of control and monitoring

In this unit pupils explore ICT systems within the context of a water ride in a theme park. The ride involves one or more boats riding through the water channel safely and under control.

Pupils assess the safety requirements of the ride and develop a computer-controlled system to enhance safety. The key process throughout is for pupils to use a sequence of sensors to control the movement of logs through the system to ensure that they don't collide. There are a number of possible solutions and pupils should be supported to develop their own. Pupils should apply and develop their knowledge, skills and understanding to plan, build, test and evaluate their control system. They will also employ their capability in using sensors and control software.

This unit is based on Case study 9.1. It exemplifies how the unit can be planned to ensure that pupils are given the opportunity to demonstrate their ICT capability in **Control and monitoring** within the **Developing ideas and making things happen** theme. It builds on the work pupils will have completed in *Sample teaching units 7.6* and *8.5*. The unit provides many opportunities for pupils to demonstrate independently their knowledge, skills and understanding, and thus demonstrate their ICT capability at level 5.

The unit exemplifies the core aspects of the case study and is intended to take approximately 5 hours. It is possible to extend the unit further to enable pupils to demonstrate aspects of level 6 or 7.

### Framework objectives

#### Control and monitoring

Use ICT to build and test an efficient system to monitor and control events, including:

- testing all elements of the system using appropriate test data;
- evaluating the system's performance;
- annotating work to highlight processes and justify decisions;
- reviewing and modifying own and others' monitoring and control systems to improve efficiency (e.g. use more efficient procedures, reduce the number of instructions or procedures, add an element of feedback).

#### Unit outcomes

Pupils will have:

- produced a computer-based control system to enhance the safety of a water ride;
- used sensors efficiently within the system;
- explained how the system works and enhances safety;
- demonstrated the development process.

## Level 5

Pupils select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. They use ICT to structure, refine and present information in different forms and styles for specific purposes and audiences. They exchange information and ideas with others in a variety of ways, including using e-mail. **They create sequences of instructions to control events and understand the need to be precise when framing and sequencing instructions. They understand how ICT devices with sensors can be used to monitor and measure external events.** They explore the effects of changing the variables in an ICT-based model. They discuss their knowledge and experience of using ICT and their observations of its use outside school. They assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.

**Level 5** is characterised by **combining the use of ICT tools** within the overall structure of an ICT solution. Pupils critically evaluate the **fitness for purpose** of work as it progresses.

### Characteristics

Typically, pupils:

- select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. An increased range of quantitative and qualitative information is considered;
- structure and refine information in different forms and styles for specific purposes and audiences;
- explore the effects of changing the variables in an ICT-based model;
- **create sequences of instructions to control events and understand the need for precision;**
- **monitor and measure external events with sensors;**
- **assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.**

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>break down a system into its component parts;</li> <li>identify areas of possible danger within the system.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson pupils will have identified: <ul style="list-style-type: none"> <li>the sequence of actions involved in moving a log flume through a water ride;</li> <li>the danger points for the ride.</li> </ul>	
<b>Resources</b> lesson1.ppt sensorgrid.doc  <b>Key vocabulary</b> control monitor components solution sequence	<b>Starter</b> Show <b>slide 1</b> of <b>lesson1.ppt</b> and ask pupils to work in pairs to complete the worksheet <b>sensorgrid.doc</b> . After 5 minutes select pupils to explain how the examples work.  Use <b>slides 2, 3</b> and <b>4</b> of <b>lesson1.ppt</b> to check pupil understanding of control and monitoring systems. Select pupils to respond to structured questions. Encourage pupils to use key vocabulary.	<b>20 minutes</b>
	<b>Share objectives</b> Introduce the unit and share learning objectives and outcomes with pupils. Make explicit the unit outcomes and the requirements for achieving level 5.	<b>5 minutes</b>
	<b>Model</b> Show a video of a log flume ride. Tell pupils that you want them to focus on the sequence of actions of the log flume. They might make notes to help them. Note: videos showing such examples are available on websites.  Engage pupils with questions to construct the initial data of a diagram on the whiteboard showing the first sections of the ride. Emphasise the key components: get on, ramp, splash down, boat waiting area, get off.	<b>15 minutes</b>
	<b>Try and apply</b> Show the video again and allow pupils to sketch the complete ride.	
	<b>Model</b> Identify possible danger points of the ride by role-playing the ride using pupils as elements of the process. You might do this by moving pupils around the classroom going through possible stages of the ride.  Identify the need to control the flow of logs through the ride by allowing more than one pupil (log) into a section.  Discuss elements identified and the need to control the flow of logs through the ride.	<b>10 minutes</b>
	<b>Secure</b> Pose the question: 'How can we make the log flume ride safer?' Select pupils to answer a series of structured questions to review the process exemplified by the lesson activities. Ensure pupils understand the process they have been through in the lesson. Emphasise the following points. <ol style="list-style-type: none"> <li>Analysis of the log flume ride.</li> <li>Identification of the sequence of the ride components.</li> <li>Identification of possible danger areas.</li> </ol>	<b>10 minutes</b>
	<b>Homework</b> Ask pupils to review their sketch of the ride and to add annotations showing possible solutions to control the flow of logs through the ride.	

<b>Learning objectives</b>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>• identify possible solutions to a problem;</li> <li>• test a possible solution to a problem.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson pupils will:</p> <ul style="list-style-type: none"> <li>• have considered a range of possible solutions;</li> <li>• be able to explain the advantages of a computer-controlled system;</li> <li>• have designed and tested flow charts to represent the first section of the water ride.</li> </ul>	
<p><b>Resources</b></p> <p>scenarios.doc planninggrid.doc</p> <p><b>Key vocabulary</b></p> <p>system motor sensor flow chart input outpost</p>	<p><b>Starter</b></p> <p>Ask pupils to work in pairs to explain the possible solutions they identified for homework.</p> <p>After 5 minutes arrange pupils into groups of four and distribute the scenario grid (<b>scenarios.doc</b>). Say that these are possible solutions and there is space to add their own. Ask each group to consider the possible solutions on the scenario grid and to identify the advantages and disadvantages of each.</p> <p>Allow 5 minutes before asking each group to give feedback on what they consider to be the best way to enhance the safety of the log flume ride. They should give reasons for their choice.</p> <p>Say that the log flume owner has decided to implement the computer-controlled system. Pose the question: 'What will this system have to do?' Gather responses and record on the whiteboard to develop shared criteria for a successful system.</p> <p><b>Model</b></p> <p>Model the process of constructing a system to operate the start of the ride, including a motor to open and shut the gate, and a sensor to indicate when the gate should open.</p> <p>Start by planning on the whiteboard using the <b>planninggrid.doc</b> as a guide. Relate this to the starter from lesson 1. Then, using appropriate software and equipment, create and test the flow chart on screen.</p> <p><b>Try and apply</b></p> <p>Students create, develop and test their solution to operate a gate including motor control and sensor. Make sure pupils have an understanding of how the software tests their solution.</p> <p>As pupils are working:</p> <ul style="list-style-type: none"> <li>• identify pupils who may need extra support;</li> <li>• use structured questions to prompt individual pupils towards a solution;</li> <li>• increase complexity by asking how they will know when a log is coming and when it has passed through.</li> </ul> <p>Ensure that pupils print out their flow chart.</p> <p><b>Secure</b></p> <p>Revisit learning objectives of the lesson.</p> <p>Ask pupils to explain why a computer-controlled system will enhance the safety of the ride. Select one or two pupils to show their finished flow chart/program for section 1 and explain how it works.</p> <p><b>Homework</b></p> <p>Ask pupils to write an explanation of the advantages and disadvantages of a computer-controlled system. They should use their completed <b>scenarios.doc</b> to help them. This will form part of the unit portfolio.</p>	<p><b>20 minutes</b></p> <p><b>10 minutes</b></p> <p><b>20 minutes</b></p> <p><b>10 minutes</b></p>

<b>Learning objectives</b>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>• use software to develop a computer system to control a water ride safely;</li> <li>• test and evaluate the water ride system;</li> <li>• annotate the work to explain and justify the choices made.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson pupils will have:</p> <ul style="list-style-type: none"> <li>• developed a safety control system for a water ride;</li> <li>• tested the system to ensure that it works;</li> <li>• annotated printouts to explain the choices they have made.</li> </ul>	
<b>Key vocabulary</b> annotate subroutine decision structure	<p><b>Starter</b></p> <p>Load a copy of the flow chart created in the previous lesson. Ask the students to label their copies of the flow chart to show the different components.</p> <p>After 2 minutes, ask pupils to come up and label the flow chart on the big screen.</p>	<b>5 minutes</b>
	<p><b>Model</b></p> <p>Tell pupils that although they have labelled the flow chart/program it is not clear how it works.</p> <p>Model the process of annotating a flow chart to:</p> <ul style="list-style-type: none"> <li>• show what each component does;</li> <li>• show the sequence of actions, e.g. by numbering and labelling;</li> <li>• explain why this solution works.</li> </ul> <p>Pupils add the extra annotations to their own printouts.</p> <p>Emphasise that annotation helps to show the process they have been through and will be used in the assessment of their work.</p>	<b>10 minutes</b>
	<p><b>Try and apply</b></p> <p>Share lesson objectives and learning outcomes with pupils.</p> <p>Pupils develop the system to control sections 1 and 2, ensuring that gate 2 will not open at the same time as gate 1. They should print out their solution and annotate it to show their reasoning.</p>	<b>20 minutes</b>
	<p><b>Secure</b></p> <p>Ask one pair to share the working of their system with the class.</p>	<b>5 minutes</b>
	<p><b>Apply</b></p> <p>Pupils develop a system to include the next section of the ride.</p>	<b>15 minutes</b>
	<p><b>Secure</b></p> <p>Select two pupils to go through their annotations and explain their reasons for comments and choices made.</p>	<b>5 minutes</b>
	<p><b>Homework</b></p> <p>Pupils annotate a printout of the new section.</p>	

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>develop a computer system to control a water ride safely;</li> <li>test and evaluate the safety system.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson pupils will have: <ul style="list-style-type: none"> <li>developed a completed system to control the water ride, including traction device and camera feature;</li> <li>annotated printouts to show how the system has been tested.</li> </ul>	
<b>Resources</b> flowchart.doc	<b>Starter</b> Provide pupils with a copy of <b>flowchart.doc</b> . Ask pupils to work in pairs to complete the annotation of the first flow chart, suggesting what it might be used for.  After 5 minutes draw the class together to share their findings.	<b>15 minutes</b>
	<b>Apply</b> Introduce pupils to the second flow chart and ask them to complete it. Allow pupils time to consider their responses.	
	<b>Secure</b> Draw the flow chart on the whiteboard and ask selected pupils to share their conclusions with the class. Use this opportunity to clarify misconceptions. Ask pupils to annotate their solutions.	
	<b>Model</b> Demonstrate how to add the camera control to the overall solution for the ride. Pupils will need to decide where to place it.	<b>5 minutes</b>
	<b>Apply</b> Pupils develop their system to build in the camera function and test the system to ensure that it works.  As pupils are working: <ul style="list-style-type: none"> <li>provide support as appropriate;</li> <li>select pupils to assess their progress by questioning and possibly sharing ideas with the whole class.</li> </ul>	<b>10 minutes</b>
	<b>Development</b> Draw the class together and introduce the problem of the boats getting up the slope. Discuss how this might be achieved. Ensure that pupils understand the need to open and close the gates before starting the traction system.  Pupils should then develop a system which includes control of motors to draw the boats up the slope using a traction device.  Pupils print out and annotate their system.	<b>25 minutes</b>
	<b>Secure</b> Select pupils to demonstrate their finished systems, using their annotations to help them explain their systems.	<b>5 minutes</b>
	<b>Homework</b> Ask pupils to write a description of their solution which can be added to their portfolio.	

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>• create a portfolio, folder or display to demonstrate clearly the process of creating a control system.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson pupils will have: <ul style="list-style-type: none"> <li>• created a portfolio, folder or display to demonstrate how a system has been developed.</li> </ul>	
<b>Resources</b> control.ppt systemcycle.doc  <b>Key vocabulary</b> analyse evaluate modify review implement	<b>Starter</b> Ask pupils to gather all their work from this project and arrange it in order. After 5 minutes ask pupils to work in pairs to decide what evidence they would need to show another person that their system works. Prompt with questions as appropriate, or provide a worksheet to help pupils. Allow time for discussion before taking feedback. Begin to make a list of evidence on the whiteboard generated from pupil responses. Ask pupils to identify the aspects of their work that enable them to show they have met the success criteria identified in lesson 2 and to discuss with their partner why it meets these criteria. It is essential that pupils can describe the methods they used to check that each part of their system worked.	<b>20 minutes</b>
	<b>Development</b> Tell pupils that creating a system that works was not the only activity they completed during these lessons. Say that the process they used is just as important. Refer to the system life cycle ( <b>systemcycle.doc</b> ) on the screen or on a poster and select pupils to identify the process they went through. Ask pupils to work in pairs to decide what evidence they have in their portfolio to show they had followed this process in developing their system. They should be able to show which pieces of work contributed to analysing a problem, for example. Allow time for discussion before taking feedback. Add pupil responses to the list on the whiteboard. Ask pupils to demonstrate to their partner that they have all the evidence required to show that they have used the system life cycle in developing their system. Allow time for pupils to respond to comments.	<b>20 minutes</b>
	<b>Secure</b> Use one pupil's portfolio to pull together all the unit outcomes. Refer back to the success criteria, the unit outcomes and the system life cycle as you do this. Summarise the key learning points for pupils and complete the bigger picture. For example, explain how the process is the same as that required in GCSE work; explain that they will follow the same process in the next unit to solve a problem.	<b>20 minutes</b>



## Aspects of handling data

In this unit pupils create a database system to collect data for a specific purpose, analyse the information, draw conclusions and test hypotheses.

Pupils are asked to investigate the problem of pupils failing to hand in homework on time.

Pupils are introduced to the problem and offered a range of hypotheses that may provide an answer.

They construct a questionnaire by writing questions to collect the required data, refine the questions to remove bias, and create a structure to contain the data. Pupils analyse the data in various ways to test hypotheses and draw conclusions.

This unit is based on Case study 9.2. It exemplifies how the unit can be planned to ensure that pupils are given the opportunity to demonstrate their ICT capability in the **Finding things out** theme. It builds on the work pupils will have completed in *Sample teaching units 7.5 and 8.5*. The unit provides opportunities for pupils independently to demonstrate their knowledge, skills and understanding and thus demonstrate their ICT capability at level 5.

The unit exemplifies the core aspects of the case study and is intended to take approximately 5 hours. Extend the unit further to enable pupils to demonstrate aspects of level 6 or 7.

### Framework objectives

#### Searching and selecting

As part of a study, analyse high-volume quantitative and qualitative data systematically by:

- exploring the data to form and test hypotheses;
- identifying correlations between variables;
- drawing conclusions and making predictions;
- reviewing the process of analysis and the plausibility of the predictions or conclusions.

#### Organising and investigating

Construct, test and document the development of a database system that shows:

- a design specification;
- appropriate means of data input and validation;
- systematic testing of processes and reports;
- evaluation of the system's performance and suggested modifications.

## Unit outcomes

Pupils will have:

- analysed a problem and identified possible solutions;
- created questions for a questionnaire to collect data effectively, taking account of bias;
- created an appropriate data structure to store and retrieve data;
- analysed data systematically by using simple and complex searches to test hypotheses;
- drawn conclusions from the data and considered how plausible these are;
- provided an answer to the problem by presenting their conclusions in an appropriate way as tables or charts;
- provided evidence of their ICT capability by annotating, recording and saving work as it progresses.

## Level 5

**Pupils select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. They use ICT to structure, refine and present information in different forms and styles for specific purposes and audiences. They exchange information and ideas with others in a variety of ways, including using e-mail.** They create sequences of instructions to control events and understand the need to be precise when framing and sequencing instructions. They understand how ICT devices with sensors can be used to monitor and measure external events. They explore the effects of changing the variables in an ICT-based model. They discuss their knowledge and experience of using ICT and their observations of its use outside school. They assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.

**Level 5** is characterised by **combining the use of ICT tools** within the overall structure of an ICT solution. Pupils critically evaluate the **fitness for purpose** of work as it progresses.

### Characteristics

Typically, pupils:

- **select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. An increased range of quantitative and qualitative information is considered;**
- **structure and refine information in different forms and styles for specific purposes and audiences;**
- explore the effects of changing the variables in an ICT-based model;
- create sequences of instructions to control events and understand the need for precision;
- monitor and measure external events with sensors;
- assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.

<p><b>Learning objectives</b></p>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>• break down problems into smaller steps by identifying the inputs, processes and outputs;</li> <li>• identify the information needed to solve a problem.</li> </ul>						
<p><b>Learning outcomes</b></p>	<p>At the end of this lesson pupils will:</p> <ul style="list-style-type: none"> <li>• understand how to identify the inputs, processes and outputs for a given problem;</li> <li>• have broken down a problem into its component parts.</li> </ul>						
<p><b>Resources</b>                  lesson1.ppt                  pupil resource 1</p> <p><b>Key vocabulary</b>                  input                  process                  output</p>	<p><b>Starter</b></p> <p>Show <b>slide 2</b> from <b>lesson1.ppt</b>. Ask pupils to work in pairs to suggest the facilities to be offered. Allow discussion time before taking brief feedback.</p> <p>Develop the discussion by asking pupils how they know that their suggestions are the facilities required. Ensure that pupils understand that they have made assumptions about what people want.</p> <p>Show <b>slide 3</b> and say that you have four assumptions to investigate.</p> <ul style="list-style-type: none"> <li>• Most customers want to swim.</li> <li>• Most male customers want to play football.</li> <li>• Female customers want to take part in dance and aerobics classes.</li> <li>• Many customers like to watch sports.</li> </ul> <p>Ask the whole class to consider how they could find out whether these hypotheses are true and take feedback.</p> <p><b>Share objectives</b></p> <p>Introduce the unit and share learning objectives and outcomes with pupils. Make explicit the unit outcomes and the requirements for achieving level 5.</p> <p><b>Model</b></p> <p>Say that you are going to consider asking customers to find out whether the hypotheses are true.</p> <p>With the whole class, model the problem-solving process by identifying the inputs, processes and outputs.</p> <p>For example, ask the class or selected pupils: ‘What information do I need?’ ‘What information do I have?’ ‘How can I collect the required information?’</p> <p>Draw an Input box. Write the responses in the box.</p> <p>Repeat the process for the Output and Process boxes.</p> <p>For example: ‘How will I share the results?’ ‘Who is the output for?’ ‘What is the most appropriate format?’ Draw an Output box and fill in the responses.</p> <p>‘What do I need to do with the information to get the output?’ (Draw a Process box.)</p> <div data-bbox="403 1637 1158 1816" style="border: 1px solid black; padding: 10px;"> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; text-align: center; vertical-align: top;"> <p><b>Input</b></p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> <li>• Gender</li> <li>• Age</li> <li>• Sports played</li> <li>• Sports watched</li> </ul> </div> </td> <td style="width: 33%; text-align: center; vertical-align: middle;"> <p>→</p> </td> <td style="width: 33%; text-align: center; vertical-align: top;"> <p><b>Process</b></p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> <li>• Enter data</li> <li>• Sort data</li> <li>• Search data</li> </ul> </div> </td> <td style="width: 33%; text-align: center; vertical-align: middle;"> <p>→</p> </td> <td style="width: 33%; text-align: center; vertical-align: top;"> <p><b>Output</b></p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> <li>• Charts</li> <li>• Tables</li> <li>• Reports</li> </ul> </div> </td> </tr> </table> </div> <p>Conclude this episode by summarising the process used to analyse the problem.</p>	<p><b>Input</b></p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> <li>• Gender</li> <li>• Age</li> <li>• Sports played</li> <li>• Sports watched</li> </ul> </div>	<p>→</p>	<p><b>Process</b></p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> <li>• Enter data</li> <li>• Sort data</li> <li>• Search data</li> </ul> </div>	<p>→</p>	<p><b>Output</b></p> <div style="border: 1px solid black; padding: 5px;"> <ul style="list-style-type: none"> <li>• Charts</li> <li>• Tables</li> <li>• Reports</li> </ul> </div>	<p><b>5 minutes</b></p> <p><b>5 minutes</b></p> <p><b>10 minutes</b></p>
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	<p><b>Try and apply</b></p> <p>Use <b>slide 4</b> to introduce a different problem. Tell pupils the headteacher has discovered that some pupils are failing to hand in their homework on time. Explain that they are going to investigate the problem and report their findings to the headteacher.</p> <p>Ask pupils to think about the question and take feedback.</p> <p>Show <b>slide 5</b> and discuss the headteacher's hypotheses.</p> <ul style="list-style-type: none"> <li>● Pupils spend too much time watching TV.</li> <li>● Some pupils do not use their homework diaries.</li> <li>● More boys hand in homework late than girls.</li> <li>● Homework is late more often with older pupils.</li> </ul> <p>How will pupils decide whether any of these hypotheses are correct?</p> <p>Explain that pupils now have an opportunity to apply the process you modelled to analyse the problem.</p> <p>Give out <b>pupil resource 1</b> Input, Process, Output framework sheet. Group pupils to enable discussion. Ask pupils to complete the three top boxes in the framework sheet.</p> <p>Circulate to support.</p>	<p><b>20 minutes</b></p>
	<p><b>Secure</b></p> <p>Use examples from pupils to create a sample solution on the whiteboard. The information could look like that shown below.</p> <div data-bbox="405 891 1158 1258" data-label="Diagram"> <pre> graph LR     subgraph Input         I1[● Gender]         I2[● Age]         I3[● Hours watching TV]         I4[● Use of homework diary]         I5[● Time spent on homework]         I6[● Number of late homeworks]     end     subgraph Process         P1[● Enter data]         P2[● Sort data]         P3[● Search data]     end     subgraph Output         O1[● Data analysis with charts]         O2[● Brief report to show whether hypothesis is true or not]     end     Input --&gt; Process     Process --&gt; Output   </pre> </div>	<p><b>10 minutes</b></p>
	<p><b>Homework</b></p> <p>Ask pupils to take home <b>pupil resource 1</b> and to explain how the information will enable them to test the hypothesis.</p>	

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>develop and list questions that will gather the information we need;</li> <li>understand bias.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson, pupils will: <ul style="list-style-type: none"> <li>have developed and tested a range of questions to collect the required information.</li> </ul>	
<b>Resources</b> lesson2.ppt questionnaire.doc  <b>Key vocabulary</b> questionnaire bias hypothesis	<b>Starter</b> Show <b>slide 2</b> of <b>lesson2.ppt</b> on the screen and distribute <b>questionnaire.doc</b> as pupils arrive. Ask them to fill in the answers. Analyse the results as a whole-class activity, drawing out any ambiguity contained within the questions and ensure they understand the term ‘bias’. For example, use a hands up (or stand up) routine to select responses to: <ul style="list-style-type: none"> <li>‘Which sports do you like to play regularly?’</li> </ul> Use questions to draw out ambiguity, for example: <ul style="list-style-type: none"> <li>‘What does regularly mean? Once a week? Every day? Once a year?’</li> <li>‘Which sports do you like to watch? Or do you not watch sports at all?’</li> <li>‘Does the question mean watch on TV? Or go to a live sporting event?’</li> </ul> Rapidly review responses to the last question. How many variations are there?	<b>15 minutes</b>
	<b>Model</b> Refer pupils to the original hypotheses of the sports centre manager on slide 2 of <b>lesson2.ppt</b> . Ask: ‘Does the questionnaire provide the data to make a decision about whether these hypotheses are true or not?’ Ask pupils to work in pairs to identify what other questions they might need to add. Take feedback. For example, information not collected includes: gender, whether they use a sports centre, variations in age. Use questions to introduce the idea of sample size. For example: ‘Does it matter how many people we ask?’ ‘Should we ask the same number of males and females?’ ‘Should we ask the same number of people in each age group?’ ‘Should we ask only people going into a sports centre?’ ‘What difference will this make to the conclusions we draw?’	<b>10 minutes</b>
	<b>Try and apply</b> Show <b>slide 3</b> of <b>lesson2.ppt</b> and remind pupils of the headteacher’s hypothesis. Ask pupils to work in pairs to develop questions to collect the data to answer these hypotheses. Pupils should alternate questions and ask their partner for a response. The partner should: <ul style="list-style-type: none"> <li>say whether the question was effective;</li> <li>make a suggestion for improving it;</li> <li>explain why the change is needed.</li> </ul> After 5 minutes, group pupils to work on the same hypothesis. Ask pupils to compare questions and to review each other’s answers.	<b>20 minutes</b>

	<p><b>Secure</b></p> <p>Ask the pupils to consider whether or not their questions were effective for collecting the information they wanted.</p> <p>Take feedback to construct a sample questionnaire on the whiteboard (one example question from each group) to identify examples of effective and less effective questions.</p> <p>Review when complete by checking answers with pupils as in the starter activity.</p> <p>Remind pupils of the importance of the sample group.</p>	<p><b>15 minutes</b></p>
	<p><b>Homework</b></p> <p>Pupils review the questions they have developed and, on paper, create a sample questionnaire, annotated to show how the information gained will enable them to decide whether the hypotheses are true or not. This should include who they are going to ask and how many people they are going to ask.</p>	

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>• create a suitable structure to contain data by choosing appropriate field and data types.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson pupils will have: <ul style="list-style-type: none"> <li>• planned a suitable structure to collect data;</li> <li>• annotated a printout to demonstrate their understanding of structure and data types.</li> </ul>	
<b>Resources</b> lesson3.ppt questionnaire2.doc planning.doc	<b>Starter</b> Show <b>slide 2</b> of <b>lesson3.ppt</b> or distribute copies of <b>questionnaire2.doc</b> . Tell pupils that this is the same questionnaire as used in the last lesson but that it has extra questions added. Ask pupils to work in pairs to construct a table to hold the answers to their questions. Remind pupils that they will need to put a title at the top of each column. After 5 minutes join pairs together to work in groups of four and ask them to compare their tables. Ask pupils to work out what the data in each column have in common. Allow a few minutes for discussion before drawing the class together. Construct a table on the whiteboard. As you do so, select pupils to question and compare your table with theirs. Ensure pupils understand that the columns contain data of the same type. For example, age, date of birth. They should also notice difficulties with questions 5 and 6 as these may contain more than one response. Summarise the activity by reminding pupils that a database stores data in a similar way to their tables by making columns, or fields, for each question and a row, or record, for each piece of data about each pupil. Say that the data in each field is the same type of data.	<b>10 minutes</b>
	<b>Model</b> Model the planning of the database structure with reference to <b>slide 3</b> of <b>lesson3.ppt</b> and the table already on the whiteboard. Remind pupils of the data types available and why it is important to get them right at this stage.	<b>10 minutes</b>
	<b>Try and apply</b> Ask pupils to complete a planning sheet ( <b>planning.doc</b> ) to contain the answers to their questions.	<b>15 minutes</b>
	<b>Secure</b> Allow pupils to complete their planning sheet before pairing them to review the structure of their database. Ask pupils to explain their structure to their partner, reviewing and modifying as appropriate.	
	<b>Model</b> Demonstrate how to create a database structure with the relevant software package for your school.	<b>20 minutes</b>
	<b>Try and apply</b> Pupils should then create the data structure independently using the chosen software. Pupils enter three mock records to test their database and print one record.	

	<b>Secure</b> Select one pupil to show one record on the large screen to explain the selection of fields and data types.	<b>5 minutes</b>
	<b>Homework</b> Pupils annotate their record printout to demonstrate their knowledge of the fields selected and the data types.	

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>• use the data to draw conclusions.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson, pupils will have: <ul style="list-style-type: none"> <li>• searched a database to test a number of hypotheses;</li> <li>• drawn conclusions from the data that answer the original hypotheses.</li> </ul>	
<b>Resources</b> <b>lesson4.ppt</b> <b>data1.csv</b> <b>data2.csv</b>	<b>Starter</b> Show <b>slide 2</b> of <b>lesson4.ppt</b> . Remind pupils that they have seen this questionnaire before. It was designed to find out whether the hypotheses were true. Say that in this lesson they are going to analyse the data to test whether the hypotheses are true. Say that you are now going to check the questions and answers by using the class as a database. Demonstrate a simple search by saying that you want to find all pupils (records) who are male. Ask those pupils to stand up. Count and record on the whiteboard. Ask those who like to play football to sit down. Count and record on board. Does this prove the hypothesis? Repeat the search using database software demonstrating how the physical sort is mirrored by the software. ( <b>data1.csv</b> is provided with dummy data to insert into your chosen application. This will need to be prepared before the lesson.)	<b>10 minutes</b>
	<b>Model</b> Reuse the starter activity to demonstrate a more complex search. For example, sort males first then reduce the number by asking those aged 13 to stand up. Demonstrate the same search using software. Relate searches to the hypothesis. Repeat as necessary to test each hypothesis so that pupils understand the process of searching for data.	<b>10 minutes</b>
	<b>Try and apply</b> Tell pupils that they are now going to apply the process of searching the database to answer their questions. Show <b>slide 3</b> of <b>lesson4.ppt</b> to remind pupils of the hypotheses they are being asked to investigate. Explain that it would be possible to ask the questions from their questionnaire and collect the data but that time is short and that they will be using a database for which the data has already been collected. ( <b>data2.csv</b> is provided with dummy data to insert into your chosen application. This will need to be prepared before the lesson.) Remind pupils of the process before starting them off: they should think about the hypothesis they are trying to test and the information they need to find. How do they display that information? Does it test the hypothesis or do they need to find out something else? Ensure that pupils print out their results, graphs and tables, as they will need them for their homework. As pupils carry out their analyses, circulate to support as necessary and use the opportunity to focus on specific pupils for assessment. Question selected pupils to ensure that they demonstrate what they know, understand and can do.	<b>35 minutes</b>
	<b>Secure</b> Review the process pupils have used by selecting a pupil to explain how their printout tests the hypothesis. Draw out the key points to show that conclusions can be drawn from the results of their questions (information such as graphs, tables and searches) to show if the hypotheses are true.	<b>5 minutes</b>

	<b>Homework</b>	
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Pupils annotate their printouts to show how the information they have gathered allows them to test hypotheses.

<b>Learning objectives</b>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>• assess the plausibility of our hypotheses and conclusions;</li> <li>• present our findings to a specific audience.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson, pupils will have:</p> <ul style="list-style-type: none"> <li>• assessed the plausibility of their findings;</li> <li>• presented their findings and conclusions to the headteacher.</li> </ul>	
<b>Resources</b> lesson5.ppt	<p><b>Starter</b></p> <p>Show <b>slide 2</b> from <b>lesson5.ppt</b>. Ask pupils to write down what they think the answers will be to the five questions. Allow a few minutes before asking them to discuss replies with a partner. Ask pupils to justify their choice. For example: why do they think more boys like watching football than other sports?</p>	<b>5 minutes</b>
	<p><b>Model</b></p> <p>Use <b>slides 3–5</b> in <b>lesson5.ppt</b> to reflect on the responses from the database used in lesson 4.</p> <p>For each slide, question pupils to establish the key facts from the graph. Ask pupils to consider how these facts compare with their predictions. What are the differences? Why could this be?</p> <p>Explore some of the possible reasons with the pupils. For example:          'The questionnaire does not allow replies other than the suggested ones.'          'Pupils did not take it seriously and made up answers.'          'Perhaps pupils watch a lot of sport but only at particular times (e.g. during the World Cup or Wimbledon).'          'Perhaps some pupils play a particular sport because that is what they do at school.'</p> <p>Remind pupils of the discussions of sample size and composition in lesson 2.</p> <p>Use slide 6 to introduce data from a much larger data set. How does this compare with their predictions? Are their predictions wrong? What reasons led them to make their predictions? Have they changed their minds about popular sports?</p>	<b>15 minutes</b>
	<p><b>Try and apply</b></p> <p>Ask pupils to prepare a presentation of their main findings about why pupils fail to hand in their homework on time. This should address the hypotheses put forward by the headteacher at the beginning of the unit. Show <b>slide 7</b> as a reminder of the hypotheses.</p> <p>Within the presentation they should clearly refer to the evidence they have gathered and how realistic/plausible it is, also referring to bias and sample size.</p> <p>While pupils are working, circulate to provide support as appropriate and use opportunities to assess selected pupils.</p>	<b>30 minutes</b>
	<p><b>Secure</b></p> <p>Select a pupil to show their presentation and ask them to explain their findings.</p> <p>Ask pupils to gather all the material they have created during this unit, complete any annotations, and order and label it for presentation in a form suitable for assessment.</p>	<b>10 minutes</b>



## Aspects of models and modelling

In this unit pupils create and develop models through the context of a school play front-of-house system. They design a simple system to work out the costs involved and then develop the model as new information becomes available.

This unit is based on Case study 9.3. It exemplifies how the unit can be planned to ensure that pupils are given the opportunity to demonstrate their ICT capability in **Models and modelling** within the **Developing ideas and making things happen** theme. It builds on the work pupils will have completed in *Sample teaching units 7.4, 8.4 and 8.5*. The unit provides many opportunities for pupils to demonstrate independently their knowledge, skills and understanding and thus demonstrate their ICT capability at level 5.

The unit exemplifies the core aspects of the case study and is intended to take approximately 5 hours. There are opportunities to extend the unit further to enable pupils to demonstrate aspects of level 6 or 7.

### Framework objectives

#### Models and modelling

- Design and create ICT-based models, testing and refining rules or procedures.
- Test hypotheses and predictions using models, comparing their behaviour with information from other sources.

### Unit outcomes

Pupils will have:

- designed and created a financial model for deciding the cost of tickets;
- used the model to answer a range of what if... questions;
- developed the model to include new information and used it to answer further questions.

### Level 5

Pupils select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. **They use ICT to structure, refine and present information in different forms and styles for specific purposes and audiences.** They exchange information and ideas with others in a variety of ways, including using e-mail. They create sequences of instructions to control events and understand the need to be precise when framing and sequencing instructions. They understand how ICT devices with sensors can be used to monitor and measure external events. **They explore the effects of changing the variables in an ICT-based model.** They discuss their knowledge and experience of using ICT and their observations of its use outside school. They assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.

**Level 5** is characterised by **combining the use of ICT tools** within the overall structure of an ICT solution. Pupils critically evaluate the **fitness for purpose** of work as it progresses.

## **Level characteristics for theme**

Typically, pupils:

- select the information they need for different purposes, check its accuracy and organise it in a form suitable for processing. An increased range of quantitative and qualitative information is considered;
- **structure and refine information in different forms and styles for specific purposes and audiences;**
- **explore the effects of changing the variables in an ICT-based model;**
- create sequences of instructions to control events and understand the need for precision;
- monitor and measure external events with sensors;
- **assess the use of ICT in their work and are able to reflect critically in order to make improvements in subsequent work.**

<b>Learning objectives</b>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>break down a large project into smaller tasks;</li> <li>identify the information needed, the processes used to solve a problem and the possible outputs.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson pupils will have:</p> <ul style="list-style-type: none"> <li>identified success criteria for a front-of-house ticket system;</li> <li>started to identify information needed to solve a problem;</li> <li>identified the processes used to solve a problem and the possible outputs.</li> </ul>	
<p><b>Resources</b></p> <p>7.4T3g Disco model.xls 8.4T3e mobyphone extended model answers.xls handout lesson1 Disco stage 6 .xls handout lesson1 memo1.doc</p> <p><b>Key vocabulary</b></p> <p>input output process labels variables formula models profit loss income expenditure costs</p>	<p><b>Starter</b></p> <p>Remind pupils that in Year 7 they completed <i>Sample teaching unit 7.4</i> where they looked at a range of models and how they could be used to answer 'What if?' questions. In Year 8 (in <i>Sample teaching unit 8.4</i>) they looked at developing more sophisticated models that use functions such as Goal Seek to make them more efficient and random data to test the model. Display <b>8.4T3e mobyphone extended model answers.xls</b> on the whiteboard and ask pupils to answer the following questions.</p> <ul style="list-style-type: none"> <li>In this model which tariff option offers the best value for money if you only make 100 calls a month?</li> <li>Is it still the cheapest tariff if you make 500 calls a month?</li> <li>If tariff Talk 45 had a reduced monthly cost of £8.00 will it be the one offering the best value for money?</li> </ul> <p>Use the last question to remind pupils about changing variables and discuss how the model has recalculated as a result.</p>	5 minutes
	<p><b>Share objectives</b></p> <p>Introduce the unit and share learning objectives and outcomes with pupils. Make explicit the unit outcomes and the requirements for achieving level 5.</p>	5 minutes
	<p><b>Model</b></p> <p>Use the disco model from <i>Sample teaching unit 7.4</i> to model the input, process and outputs in this model.</p> <p>Display <b>7.4T3g Disco model.xls</b>. Show <i>Disco stage 2</i> and use it to:</p> <ul style="list-style-type: none"> <li>check that pupils understand the difference between income and expenditure;</li> <li>revise labels, variables and formulae;</li> <li>discuss the simple rules being applied in this model (i.e. <math>\text{income} = \text{number of tickets sold} \times \text{price of ticket}</math>, etc.).</li> </ul> <p>Ask pupils in pairs to write down a question that could be answered using this simple model.</p> <p>Take feedback from some pairs of pupils and use the model to show how the questions might be answered.</p> <p>Ask pupils to identify the following.</p> <ul style="list-style-type: none"> <li>How was the model broken down? What are the main labels? (Information, income, costs, overall profit.)</li> <li>What information did they have to start with? (Ticket numbers and cost, equipment, DJ and caretaker costs.)</li> </ul> <p>Show <i>Disco stage 4</i> and ask pupils to identify additional information (inputs) and rules (processes) that have been changed. Ask pairs of pupils to write down a new question that could be answered using this model. Take some feedback to ensure that pupils have identified changes. Use this as an opportunity to revise adding information to a model.</p>	15 minutes

	<p>Finally, ask pupils to suggest what problem the model is currently showing (i.e. it is currently costing more to run the disco than ticket sales are generating). Ask how this might be remedied without changing the price of the tickets.</p> <p>Give out <b>Handout lesson1 Disco stage 6.xls</b> and ask pupils, in pairs, to identify the changes that have been made in order for the disco to operate at a profit.</p>	
	<p><b>Try and apply</b></p> <p>Introduce the new problem to pupils.</p> <p>Tell pupils that the school drama department wants to stage a production but is unsure of the financial implications. The department would like a model to be developed to explore and investigate the options available to them.</p> <p>Distribute <b>handout lesson1 memo1.doc</b> and explain to pupils that this is from the drama department. Ask them to identify the following.</p> <ul style="list-style-type: none"> <li>● What information have we got to start with? (Hall capacity; overheads, e.g. cost of staffing, lighting; number of nights.)</li> <li>● What new information do we want the model to give us? (Ticket, refreshments and programme costs to provide breakeven point for production; potential income that may be used to purchase costumes, props, etc.)</li> </ul> <p>Ask pupils to create three lists showing inputs, processes and outputs for a possible model. This might include:</p> <p><b>Input</b> – cost of lights, cost of staff, days of performances, possible ticket prices, etc.</p> <p><b>Process</b> – Seat price × number of seats; total expenditure.</p> <p><b>Output</b> – Total costs, seat prices that would generate a profit.</p> <p>As pupils are working:</p> <ul style="list-style-type: none"> <li>● identify pupils who may need extra support during this unit;</li> <li>● use structured questions to support individuals towards completing task;</li> <li>● refer pupils back to the disco model and the requirements from the drama department to ensure they see similarities.</li> </ul> <p>Identify one pupil to share their completed work with the group.</p>	<p><b>25 minutes</b></p>
	<p><b>Secure</b></p> <p>Ask the selected pupil to share their choices and justifications through appropriate questioning. Ask pupils in pairs to review what they have produced in terms of 'input–process–output'.</p>	<p><b>10 minutes</b></p>
	<p><b>Homework</b></p> <p>Using <b>handout lesson1 memo1.doc</b>, pupils should start to design their model, suggesting how it would look on a spreadsheet. Remind pupils of the disco model and the headings and labels.</p>	

<b>Learning objectives</b>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>design and create a simple model using spreadsheet software;</li> <li>use the model to answer some simple questions.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson pupils will have:</p> <ul style="list-style-type: none"> <li>created a model to allow them to decide on ticket costs for the production;</li> <li>used their model to answer simple questions by changing variables.</li> </ul>	
<b>Key vocabulary</b> comment boxes break even rules charge structure	<p><b>Starter</b></p> <p>Remind pupils that in the previous lesson, we started to investigate a problem presented to us by the drama department. We thought about:</p> <ul style="list-style-type: none"> <li>what information we would have to start with;</li> <li>what information we expected the model to produce;</li> <li>the processing involved;</li> <li>what the output would be and how this would be presented.</li> </ul> <p>Ask pupils to work in pairs to share some of the model designs they produced for homework. They should check that labels are clear and discuss accuracy of formulae. Ask one or two pairs to share their thoughts with the group. Make sure the pupils understand that the inputs are different for the three different nights.</p>	<b>10 minutes</b>
	<p><b>Try and apply</b></p> <p>Pupils will now take the outline models they have developed and put them into the spreadsheet.</p> <p>As pupils are working:</p> <ul style="list-style-type: none"> <li>ensure that pupils are structuring the model;</li> <li>use structured questions such as ‘what would the input be for your model?’ to support the development of the model;</li> <li>provide support as appropriate, possibly with helpsheets or through working with an identified group of pupils.</li> </ul> <p>Remind pupils of the use of comment boxes to highlight how annotations are used and the purpose of them, e.g. for pupils to show inputs, processes and outputs.</p> <p>When pupils have completed the task make sure they have a printout of their models.</p> <p>Ask pupils, working in pairs, to use their models to consider the following.</p> <ul style="list-style-type: none"> <li>How much do we need to charge for seats if all seats available are sold and we want to break even?</li> <li>If you charged £1 more for seats on a Saturday night, what would a ticket cost?</li> <li>How will you calculate the profit and loss in your model?</li> <li>Where do you believe the main income is coming from?</li> </ul>	<b>25 minutes</b>
	<p><b>Secure</b></p> <p>The pupils need to be working with their spreadsheet models. Ask a series of ‘What if?’ questions and get pupils to try and answer them using their models. They need to identify the rules and highlight the process. If they cannot answer the questions using their models they need to identify the development needed to find a solution and annotate the models. Examples of questions might be:</p> <p>How much profit would we make if:</p> <ul style="list-style-type: none"> <li>we charged £7 for tickets?</li> <li>the performance nights were doubled?</li> <li>we needed two caretakers per night?</li> <li>the lighting costs were halved?</li> </ul>	<b>20 minutes</b>

	<p>As pupils are working:</p> <ul style="list-style-type: none"> <li>● identify pupils who need support, grouping them to guide them towards a solution through discussion;</li> <li>● increase the complexity by asking further questions to test the model;</li> <li>● help them to amend their model to correct any errors they have found.</li> </ul> <p>Pupils need to have a printout available for the homework task.</p>	
	<p><b>Homework</b></p> <p>Ask pupils to identify and justify the changes they needed to make to their models in order to answer the questions. They should annotate their work to show how the questions were answered.</p>	

<b>Learning objectives</b>	<p>In this lesson we are going to:</p> <ul style="list-style-type: none"> <li>develop the models to incorporate new information;</li> <li>use the models to answer further questions.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson pupils will have:</p> <ul style="list-style-type: none"> <li>developed their model to include new information;</li> <li>used their model to answer questions about ticket prices.</li> </ul>	
<p><b>Resources</b></p> <p>model1.xls handout lesson3 memo2.doc</p> <p><b>Key vocabulary</b></p> <p>totals development</p>	<p><b>Starter</b></p> <p>Remind pupils that in the previous lesson they started to develop the structure of the model, by creating relevant headings and adding the data from the drama department's memo.</p> <p>They thought about:</p> <ul style="list-style-type: none"> <li>how to identify the income and expenditure;</li> <li>each piece of information and which section it should go in;</li> <li>where the totals should be placed;</li> <li>developing a clear layout;</li> <li>making the headings relevant to the content;</li> <li>developing a structure that is easy to follow.</li> </ul> <p>Use one pupil's model to identify these features or use the example provided (<b>model1.xls</b>).</p> <p>Identify the costs and how much you will have to charge for tickets to break even and make a small profit.</p> <p><b>Model</b></p> <p>Using <b>model1.xls</b>, explain to pupils that the drama department has suggested that they might run a raffle during the interval to raise money for the new school minibus. It will cost £5 per night to buy the tickets and the prizes have been donated so they have cost nothing. Last year they charged £1 per ticket and everyone at the performance bought at least two tickets.</p> <p>Model how to add this information to the spreadsheet, talking through the thought processes required as you do so.</p> <p><b>Try and apply</b></p> <p>Give out <b>handout lesson3 memo2.doc</b>.</p> <p>Ask pupils to develop their model by adding the additional information and the formulae necessary to carry out the processing. Ask pupils to annotate using comment boxes.</p> <p>As pupils are working:</p> <ul style="list-style-type: none"> <li>ensure that they are structuring the model correctly;</li> <li>use structured questions to support the development of the model;</li> <li>provide support as appropriate and use help sheets where required;</li> <li>support them with the development of formulae using percentages.</li> </ul> <p>Ensure that models are saved and annotations are included. The models will now be used to answer a range of questions relating to the original problem.</p>	<p><b>10 minutes</b></p> <p><b>10 minutes</b></p> <p><b>25 minutes</b></p>

	<p><b>Secure</b></p> <p>Ask pupils, working in pairs, to consider the following questions.</p> <ul style="list-style-type: none"> <li>● What will the profit be just from the sale of tickets?</li> <li>● What will the profit be if 300 people attend each night?</li> <li>● What will the profit be from refreshments on a night when all the tickets are sold?</li> <li>● How much would you save if you didn't produce posters?</li> </ul> <p>Ask pupils to annotate their models with the answers.</p> <p><b>Check with pupils:</b></p> <p>'Can you answer these questions on your model?'</p>	<p><b>15 minutes</b></p>
	<p><b>Development</b></p> <p>Bring pairs into a group of four and ask each pair to pose a question for the other pair that they think the drama department might want answered.</p>	
	<p><b>Homework</b></p> <p>Pupils should ensure that they have answered all the questions correctly and annotated their work to show how this was done. Ask them to think of three new questions they could use their models to answer. They should bring these questions to the next lesson with their annotated work.</p>	

<b>Learning objectives</b>	In this lesson we are learning to: <ul style="list-style-type: none"> <li>use the model to test a number of hypotheses and answer some specific questions.</li> </ul>	
<b>Learning outcomes</b>	At the end of this lesson pupils will have: <ul style="list-style-type: none"> <li>used their model to answer questions and try out a number of solutions.</li> </ul>	
<b>Resources</b> <b>handout lesson4 memo3.doc</b> <b>handout lesson4 memo4.doc</b> <b>handout goalseek.doc</b> (if required)  <b>Key vocabulary</b> numeric minimum report queries	<b>Starter</b> Remind pupils that in the previous lesson they started to develop their model by entering formulae and adding information. Working in groups of three and using the printouts of their models, they should use the questions they prepared for homework for the groups to answer. The focus is on how they would answer the question rather than specific numeric answers. You might also use the following questions: <ul style="list-style-type: none"> <li>If the income was from ticket sales only, what is the minimum price we could charge to break even?</li> <li>If the income was from ticket sales only, what is the minimum price we could charge to make £100?</li> <li>If tickets at the front of the auditorium (175) were 1.5 times the price of other seats and they sold out, what size audience would be needed to break even?</li> <li>If income was based on programme sales and ticket sales, what is the minimum price we could charge to make a £200 profit?</li> </ul> Remind pupils how to use Goal Seek and give out <b>handout goalseek.doc</b> if needed.  Ask groups to record the process needed to answer the questions. Use groups of pupils to ensure that all pupils have a full understanding of the processes involved.	<b>20 minutes</b>
	<b>Try and apply</b> Give out <b>handout lesson4 memo3.doc</b> . Pupils should work through the questions on the memo, making notes as they proceed. Their answers will be used to produce a final report. While pupils are working: <ul style="list-style-type: none"> <li>use structured questions to support the development of the answers;</li> <li>provide support with mathematical functions as needed;</li> <li>support pupils with the use of techniques.</li> </ul> When pupils have completed this work, ask one or two pupils to share their findings with the rest of the class. Then give out <b>handout lesson4 memo4.doc</b> and ask the pupils to use their models to answer the final queries. They should ensure that they make notes as they do so.  Identify three pupils to share their answers and processes with the class both during the rest of the lesson and in the final plenary.	<b>30 minutes</b>
	<b>Secure</b> Use examples of pupils' models to review the questions and then review models in pairs.  Ask pupils to consider how they have used the model to solve the drama department's initial problem.	<b>10 minutes</b>
	<b>Homework</b> Ask pupils to start organising their annotated work and printouts into a portfolio of evidence related to the initial problem. They should also consider what is to be included in the final report.	

<b>Learning objectives</b>	<p>In this lesson we are learning to:</p> <ul style="list-style-type: none"> <li>• present the information in an appropriate format;</li> <li>• review performance and evaluate the financial model against criteria;</li> <li>• report back to the user making recommendations about future developments of the model.</li> </ul>	
<b>Learning outcomes</b>	<p>At the end of this lesson pupils will have:</p> <ul style="list-style-type: none"> <li>• produced a report that combines information from a variety of queries and responses;</li> <li>• used the model to investigate a number of scenarios and reach conclusions.</li> </ul>	
<p><b>Resources</b></p> <p>handout lesson4 memo4.doc</p> <p><b>Key vocabulary</b></p> <p>evaluation calculate final report</p>	<p><b>Starter</b></p> <p>Say we should now be able to use the model to:</p> <ul style="list-style-type: none"> <li>• calculate income;</li> <li>• calculate costs;</li> <li>• adjust prices to explore different incomes;</li> <li>• identify how to get the largest audience in while covering costs.</li> </ul> <p>Say as a result of this we now need to present our findings to the drama department so that they can start to make some decisions on ticket prices, refreshments, programmes, etc. Tell pupils that we need to present our findings in a suitable report.</p> <p>Ask pupils to work in groups of three to reflect on the kind of report they are going to develop.</p> <p>Take feedback and share with the group.</p> <p><b>Development</b></p> <p>Explain to the groups that they are going to report in three sections, with each person in the group contributing towards the final report.</p> <ol style="list-style-type: none"> <li>1. Highlighting the ticket price needed to <b>break even</b>: <ul style="list-style-type: none"> <li>• with just the ticket sales;</li> <li>• with ticket sales, drinks and posters;</li> <li>• with ticket sales, drinks, posters and programmes.</li> </ul> </li> <li>2. Identifying the <b>costs</b>: <ul style="list-style-type: none"> <li>• of posters;</li> <li>• of programmes, posters and refreshments;</li> <li>• of programmes, posters, refreshments and caretakers.</li> </ul> </li> <li>3. <b>An overarching report that identifies</b> breakeven point and costs and the income from a range of variables so that you can assist the drama department in making the right decisions. The final report needs to answer the specific questions asked on <b>handout lesson4 memo4.doc</b>.</li> </ol> <p>The group of three pupils will need to combine their work into one report.</p> <p><b>Secure</b></p> <p>Ask pupils to gather all of their work from this project and to arrange it in order. This activity is intended to develop a portfolio of evidence related to the initial task – they need to be clear that their evidence shows that they have developed the model and produced a written report of findings. This should build on the work done for homework following lesson 4.</p> <p>Ask one group of pupils to share their report with the rest of the class, making sure that they demonstrate the processes they used both to solve the problems and produce the final report.</p>	<p><b>10 minutes</b></p> <p><b>30 minutes</b></p> <p><b>20 minutes</b></p>

	<b>Homework</b>	
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Pupils should produce a short written account of the project to attach to their portfolio. The account should include a description of the development of the model as well as some evaluation of how the pupils feel that they have done.





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