

Acknowledgements

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About the Year 9 case studies

These case studies have been developed by schools to show how they have grouped Year 9 objectives and planned how to teach them. They are based originally on Year 9 QCA units. They show how extended projects can be taught, and the structure of lessons might be maintained, **but** they are not fully developed sample teaching units. They exemplify one way to teach some of the Year 9 objectives but you should note that there are other ways. To demonstrate this, two case studies have been provided for Unit 9.2.

The case studies include support materials that have been developed to be used by pupils and teachers. They include starter activities and demonstrations of planning tools. Teachers have used the software that they have available in their schools; you may need to develop similar resources in the software that you have available.

The case studies also include some indicative outcomes but these are not fully developed in all cases. You will need to use these case studies alongside information from the 'Standards and Assessment' training session and the National Curriculum in Action website in order to make judgements about pupils' achievements.

If you wish to use these case studies you will need to do some significant planning and preparation. You will have to consider such things as differentiation and different teaching styles. Alternatively, you might treat the case studies as stimuli for planning your own extended Year 9 projects.

9.1

About this case study

Task

In this case study pupils explore ICT systems within the context of designing a new water ride in a theme park. The ride must be water-based and involve some kind of boat or raft. The design of the boat is not important; the focus is on developing a ride with one or more boats moving through a water channel safely and under control. The system could involve a feedback loop.

Pupils assess the requirements of a new ride, then plan and develop a safety control system. The work provides them with the opportunity to evaluate the use of technology and reflect on its use in other situations. Pupils develop their abilities to plan, build, test, evaluate and document their use of control systems, as well as extending their skills in using sensors and control software.

Pupils might use a variety of input and output devices to test their procedures, without the need to build models.

Finally, pupils consider how to create an appropriate presentation to be shown to the park manager, outlining the features of the ride and how safety components have been included.

Timing

This unit of work is expected to take approximately 10 hours.

Resources used in this case study

TEACHER RESOURCES

- Teacher resource 1.ppt, *System life cycle* Lesson 1
- Teacher resource 2.xls, *Gantt chart (completed)* Lesson 2
- Teacher resource 3.pub, *Log flume schematic* Lessons 2, 3
- Teacher resource 4.pub, *Log flume schematic* Lessons 2, 3
- Teacher resource 5.pub, *Log flume schematic* Lesson 3
- Teacher resource 6.doc, *Input/output card activity* Lesson 3
- Teacher resource 7.doc, *Shape card activity* Lesson 4
- Teacher resource 8.doc, *Output/motor record sheet (answers)* Lesson 4
- Teacher resource 9.pub, *Schematic camera section* Lesson 4
- Teacher resource 10.flo, *Flowol camera section* Lesson 4
- Teacher resource 11.pub, *Schematic fountain section* Lesson 4
- Teacher resource 12.flo, *Flowol fountain section* Lesson 4
- Teacher resource 13.pub, *Schematic bucket section* Lessons 5, 6
- Teacher resource 14.flo, *Flowol bucket section* Lessons 5, 6
- Teacher resource 15.pub, *Schematic fountain extension section* Lessons 5, 6
- Teacher resource 16.flo, *Flowol fountain extension section* Lessons 5, 6
- Teacher resource 17.pub, *Schematic camera extension section* Lessons 5, 6
- Teacher resource 18.flo, *Flowol camera extension section* Lessons 5, 6
- Teacher resource 19.flo, *Flowol bucket extension section* Lessons 5, 6
- Teacher resource 20.flo, *Overall solution* Lessons 7, 8
- Teacher resource 21.doc, *Extension activities* Lessons 7, 8
- Teacher resource 22.flo, *Subroutines* Lessons 7, 8
- Teacher resource 23.flo, *Log flume rides using subroutines* Lessons 7, 8

PUPIL RESOURCES

- Pupil resource 1.doc, *Computers and control (worksheet)* Lesson 1
- Pupil resource 2.xls, *Gantt chart* Lesson 1
- Pupil resource 3.doc, *Input and output activity cards* Lesson 3
- Pupil resource 4.doc, *Peer evaluation form (schematic diagram)* Lesson 3
- Pupil resource 5.doc, *Project diary* from Lesson 3
- Pupil resource 6.doc, *Card shapes (flowchart boxes)* Lesson 3
- Pupil resource 7.doc, *Output/motor record sheet* Lesson 4
- Pupil resource 8.doc, *Peer evaluation form (Presentation to park manager)* Lesson 9

Objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Analysing and automating processes

- Represent a system in a diagram, identifying all its parts, including inputs, outputs and the processes used.

Teaching sequence	Session notes
<p>Starter 10 minutes</p>	<p>Computers in control</p> <p>Review and build on the control and monitoring work from previous units in Year 7 and Year 8.</p> <p>Ask pupils to write down three examples of how computers are used in control and monitoring in everyday life, for example, at home, at work, in the high street, in school. The worksheet, Pupil resource 1, <i>Computers and control</i>, gives starting points for some pupils, if they need them.</p> <p>Now ask pupils, working in pairs, to explain to each other how one of their stated examples works. Encourage each pair, during this activity, to write down key words involved with control and monitoring.</p> <p>Take feedback from the whole class.</p> <p>Key words for discussion include: input, process, output, feedback, procedures, loops, sensors, control program, analogue, digital.</p>
<p>Main activity 40 minutes</p>	<p>Thinking about the project</p> <p>Introduce the extended piece of work for the term, which falls under the theme of 'control and monitoring'.</p> <p><i>Pupils are to design a water-based ride to be installed at a new theme park. The ride must involve boats or rafts that move safely through a water channel, under computer control. Tenders have been invited for this ride and the bid must be in by the end of term. All bids must include:</i></p> <ul style="list-style-type: none"> • a schematic diagram of the ride; • a complete control system for the ride containing one or more boats; • a presentation to the park manager outlining the features of the ride and how safety features have been included in the system. <p><i>Ongoing evaluation, review and documentation are key features of this work.</i></p> <p>Remind pupils of the system life cycle (Teacher resource 1). Discuss the stages through which pupils will be working and the activities that might be undertaken at each stage of this piece of work.</p> <p>Ask pupils, in groups, to discuss the tasks involved, possible approaches and how these may be broken down. Take feedback and share ideas. Expect pupils who have completed <i>Sample teaching unit 8.5</i> to have encountered Gantt charts.</p> <p>Remind pupils how to construct a Gantt chart and suggest that this would be a useful tool in planning the project and monitoring progress. Discuss how to deal with multiple activities that start and finish at different times.</p> <p>Pupils start planning their work, in general terms, using the Gantt chart. Use and adapt Pupil resource 2, <i>Gantt chart</i>, for pupils requiring more structure.</p>

Plenary <i>10 minutes</i>	Initial ideas Ask one or two pupils to give feedback to the class on their work so far and the issues arising from it. Compare and share ideas, encouraging other pupils to raise questions.
Homework	Ask pupils to print out their Gantt charts so far and complete them, giving reasons for any choices they make.

Objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Analysing and automating processes

- Represent a system in a diagram, identifying all its parts, including inputs, outputs and the processes used.

<i>Teaching sequence</i>	<i>Session notes</i>
Starter 10 minutes	Gantt charts <p>Pupils, in pairs, discuss their homework, justifying the choices they made. As this is taking place, circulate and talk to the pupils. Choose one or two pupils to give feedback to the whole class. Each of the identified pupils needs to explain <i>their partner's</i> solution and give a short explanation of the issues they feel are raised.</p> <p>After the discussion, pupils amend their Gantt charts as necessary. Use Teacher resource 2, Gantt chart (completed), as a simple example to support some pupils if necessary.</p>
Main activity 40 minutes	Features of theme park rides <p>Ask pupils to think about rides at theme parks and consider the types of features currently being used. Draw on pupils' own experiences of rides and their views of what makes them good, exciting or fun. Make sure that pupils are identifying the processes of some of the features. Draw out the safety precautions that they observe for each feature they identify. As extra stimuli they could use videos or websites such as:</p> <p>http://www.somecoasters.com</p> <p>http://www.coasterclub.org</p> <p>http://www.crystalbeachpark.net</p> <p>Ask pupils to write a list of features that might appear on a water ride. Make sure that they also write down safety criteria associated with each feature. Collect and group these ideas together, for example, by using a fishbone, outlining tools or mind-mapping software. This forms the stimulus for pupils to choose and develop their own ideas.</p> <p>From the previous discussion, ask pupils to represent their own ideas for their water ride in diagrams showing all the processes, inputs and outputs. Initially, they could do this on paper or on a computer using, for example, a schematic diagram. See Teacher resource 3, Log flume schematic, for an example of a schematic diagram.</p>
Plenary 10 minutes	Controlling the ride <p>Choose one of the pupils' diagrams (in progress) or use Teacher resource 4, Log flume schematic, as an example to discuss with the whole class. Ask pupils to suggest where computers may be used in the control of the ride, for example, to flash the camera, to activate the fountain, to tip the bucket.</p> <p>Ask pupils to look at their own diagrams and identify where computers might be involved in the control of their ride. Encourage pupils to annotate their plans and diagrams at every stage of the development, and to update the diagrams for the ride, as part of their on-going documentation and future assessment.</p>
Homework	<p>Ask pupils to complete and annotate their diagrams.</p>

Objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Analysing and automating processes

- Represent a system in a diagram, identifying all its parts, including inputs, outputs and the processes used.

Control and monitoring

- Review and modify own or 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).

Teaching sequence	Session notes
<p>Starter 10 minutes</p>	<p>Input or output?</p> <p>Each pupil has a card with 'Input' and 'Output' on it. Read out statements from a prepared list and ask pupils to decide whether each is an input or an output. (The cards and questions can be produced from Pupil resource 3, <i>Input and output activity cards</i>, and Teacher resource 6, <i>Input/output card activity</i>.)</p> <p>To extend the activity, hold up one of the cards, showing 'Input' and 'Output' at random, and ask pupils to suggest examples from their own initial project developments. Make sure that each pair has a chance to give an example. Allow pupils to challenge examples that they think may be wrong. Challenges must be supported by reasons.</p>
<p>Main activity 40 minutes</p>	<p>Controlling the ride</p> <p>Ask pupils, in pairs, to look at their schematic diagrams completed for homework. Ask the pupils a variety of questions relevant to the diagrams and their inputs and outputs, for example:</p> <ul style="list-style-type: none"> • <i>Where would be the best place for a camera? Why? How will the camera know when to flash? Why do you want to take pictures? Why is it important that the camera is in the right place?</i> • <i>How will you ensure that a fountain will be activated at the right time to get the riders wet? Why do you want to get the riders wet?</i> <p>Discuss key terms in control and how they relate to the water ride, for example:</p> <p>Sensors: detect boats arriving, time devices such as the camera and fountains, etc. Sensors can be activated by light/sound, etc.</p> <p>Switches: something that has to be activated by the boat or rider, e.g. the boat activates a switch as it passes over it and, as a result, sets off a device such as a fountain.</p> <p>Timers: used after a sensor or switch has been activated to make something happen, e.g. camera flash, fountain activated.</p> <p>Gates: lock and unlock to allow only one boat at a time into a section. The gate behind must have been locked before the gate ahead will open and there must not be a boat in the section already.</p> <p>Ask pupils to adapt and annotate their schematic diagrams to include sensors, switches, timers and gates (as applicable). Teacher resources 3, 4 and 5, <i>Log flume schematic</i>, show examples of one possible development of the diagram.</p>

Plenary 10 minutes	Evaluation criteria Ask pupils to choose suitable criteria to evaluate the schematic diagrams. Pupils, in pairs, evaluate each other's diagrams. Pupil resource 4 , <i>Peer evaluation form</i> , gives an example of a crude evaluation form that can be adapted.
Homework	Ask pupils to annotate their schematic diagrams for improvements and changes to be made in the light of peer evaluation, and to complete their project diary to date. Pupil resource 5 , <i>Project diary</i> , gives a sample template.

Objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Analysing and automating processes

- Represent a system in a diagram, identifying all its parts, including inputs, outputs and the processes used.

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.
- Review and modify own or 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).

Teaching sequence	Session notes
Starter 10 minutes	Using flowcharts Review and discuss the benefits of using flowcharts. Remind pupils of flowchart conventions. Discuss the purposes of the different shapes of boxes used. For example, read out a series of statements from Teacher resource 7, Shape card activity . For each one, ask pupils to hold up the appropriate card to show the correct shape for the box in which that statement should appear, in a control program or flowchart. (Cards can be cut from Pupil resource 6, Card shapes (flowchart boxes) .)
Main activity 40 minutes	Designing the ride Pupils will now use a control program to design the ride. The software used in this example is Flowol. Remind pupils of the need to be precise and efficient in using the program. Give guidance and support where necessary. 1 Ensure that all elements have unique labels For example, use Pupil resource 7, Output/motor record sheet , and ask pupils to fill in the 'Outputs' and 'Motors' columns for their ride. Pupils also need to assign a number to a description, so that it is easier to identify in a control program. For examples see Teacher resource 8, Output/motor record sheet (answers) . 2 Break the program into smaller elements and use subroutines For example, focus on the camera section and fountain sections, Teacher resource 9, Schematic camera section , and Teacher resource 11, Schematic fountain section , respectively. If necessary, demonstrate how to use your chosen software using, for example, the camera section (see Teacher resource 10, Flowol camera section) or fountain section (see Teacher resource 12, Flowol fountain section). Otherwise, pupils use the software to work on individual sections of their schematic diagrams.
Plenary 10 minutes	Evaluation criteria Discuss and agree criteria for evaluation. Use peer testing and evaluation to draw out how effective completed components are against the criteria.
Homework	Ask pupils to annotate any alterations to their schematic diagrams and to update their project diaries, in the light of evaluation. They should use a fresh printout of the schematic diagram each time so that progressive changes can be seen clearly. Ask them to comment on their progress against the Gantt chart.

Objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

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.
- Review and modify own or 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).

<i>Teaching sequence</i>	<i>Session notes</i>
<p>Starter 10 minutes</p>	<p>Progress check</p> <p>Ask pupils to give three examples of developments in their system from the previous week, for example, <i>flowchart completed</i>, <i>input/output completed</i>. Ask the class to identify and indicate, on the system life cycle, examples of activities they have carried out that fulfil part of the process.</p> <p>Make sure all pupils are aware of the processes they have been through so far and which areas they still need to visit.</p>
<p>Main activities 100 minutes</p>	<p>Implementing and testing the refinements</p> <p>Discuss the need to test and to document refinements at each stage. Discuss ways in which the software allows pupils to test their procedures as individual components of a larger system. This could involve using pre-defined mimics, mimic creators, on-screen controls or attaching external devices.</p> <p>Pupils continue to design, implement and test procedures and develop individual components of the water ride. They evaluate and document progress, using, for example, an ongoing project diary, annotated printouts, evaluation forms.</p> <p>Remind pupils that at this stage they are doing the sections independently of each other and that these sections will be joined up at the end.</p> <p>For some pupils needing support you may suggest particular ideas and components to introduce to the water ride. Other pupils may need support with extending their ideas.</p> <p>The following resources provide examples only, for stimuli:</p> <ul style="list-style-type: none"> ● a bucket section Teacher resources 13 and 14, <i>schematic diagram and flowchart</i>, respectively; ● a fountain extension Teacher resources 15 and 16, <i>schematic diagram and flowchart</i>, respectively; ● a camera extension Teacher resources 17 and 18, <i>schematic diagram and flowchart</i>, respectively. ● a bucket extension Teacher resource 19, <i>flowchart</i>. <p>Pupils may need additional lessons to complete all components.</p>

Plenary 10 minutes	Variations on the theme Identify one or two pupils who have taken interesting approaches to the project. Ask them to tell the class what they have been doing and to justify their choices.
Homework	Ask pupils to complete the annotation of their schematic diagrams and their project diaries to date.

Objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Analysing and automating processes

- Automate ICT processes.

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.
- Review and modify own or 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).

Teaching sequence	Session notes
<p>Starter 10 minutes</p>	<p>Room for improvement</p> <p>Say that in this and the next lesson pupils will look at:</p> <ul style="list-style-type: none"> • testing procedures and ensuring that they are efficient; • putting all procedures (or subroutines) together into a complete system. <p>Identify one or two pupils to demonstrate one of their completed procedures on the large screen. Ask pupils to write down one key factor that makes the procedure work well and one suggested improvement. Take feedback and collect, on the flipchart, ideas for improving procedures and making them more efficient. Discuss the importance of having efficient procedures and encourage pupils to create an agreed set of criteria for evaluation. Alternatively, pupils could create their own criteria for testing efficiency of procedures.</p>
<p>Main activities 100 minutes</p>	<p>Pulling it together</p> <p>In the light of discussion during the last activity, pupils may wish to annotate and amend some of their procedures to make them more efficient. Ensure that all changes are documented and tested before moving on.</p> <p>Once pupils are satisfied that all procedures are completed, tested and efficient, they should begin to put the whole system together. Support pupils who are having difficulties but encourage them to diagnose their own problems and offer potential solutions. An example output showing one potential approach is shown in Teacher resource 20, Overall solution.</p> <p>Encourage pupils to test combinations at each stage. Ask:</p> <ul style="list-style-type: none"> • <i>How efficient is the system now it is all combined?</i> <p>Use the criteria developed in the starter activity to test this. Expect some pupils to extend and refine their work by identifying and writing further procedures to increase the efficiency. Other pupils may wish to extend the scope of the project. Teacher resource 21, Extension activities, provides some further ideas. Teacher resource 22, Subroutines, demonstrates subroutines that could be used.</p> <p>Pupils may need additional lessons to refine, test, document and complete their system. Teacher resource 23, Log flume rides using subroutines, provides indicative outcomes for one approach, using subroutines.</p>

Plenary <i>10 minutes</i>	Using subroutines Ask pupils how using procedures or subroutines has made the system more efficient. Elicit responses including: <ul style="list-style-type: none">● errors can be located and fixed more quickly;● modifications can be made to parts of the system without a complete rewrite;● the procedures are easier to follow.
Homework	Ask pupils to ensure that all parts of the project diary, Gantt chart, annotations and other materials are complete and organised within the project documentation.

Objectives

EXCHANGING AND SHARING INFORMATION

Fitness for purpose

- Produce high quality ICT-based presentations by:
 - creating clear presentations, sensitive to audience needs;
 - justifying the choice of form, style and content.
- Use knowledge of publications and media forms to devise criteria to assess the quality and impact of multimedia communications and presentations, and apply the criteria to develop and refine own work.

Teaching sequence	Session notes
Starter 10 minutes	Criteria for a good presentation Remind pupils that they need to present their projects to the park manager. Ask pupils to spend 5 minutes writing the criteria for a good presentation. Ask them to identify and discuss with a partner the messages they are going to be communicating. Ask pupils, in pairs, to discuss how they are going to use the presentation as a means to persuade the park manager to choose their project. Also, make pupils aware that the audience for this presentation could change. Ask them how useful the presentation would be when it is shown to a different audience. Remind pupils that it is more than just the content they need to think about. Expect pupils to suggest a range of presentation media, such as a stand-alone display or one with a commentary.
Main activity 40 minutes	Developing a presentation to the park manager Pupils, in small groups, make lists of what they believe should be included in the content of the presentation for the park manager. From this they develop criteria for what they believe would be essential information. Remind pupils of all the materials that they have already produced in previous lessons and how these can be included in their presentations. The presentation will support the pupils' bid for the contract. It will be evaluated against the criteria in the lesson. Remind pupils that it is important to choose the content and the presentation style that will be most effective.
Plenary 10 minutes	Reviewing the work so far Review the information that pupils should have included in their presentation and how it is presented. For example, refer to peer evaluation of the presentations so far according to the developed criteria. Develop Pupil resource 8 , <i>Peer evaluation form</i> , for inclusion of own criteria.
Homework	Ask pupils to annotate their presentations in the light of the evaluation to show any necessary additions and amendments, and to fill in their project diaries to date.

Objectives

EXCHANGING AND SHARING INFORMATION

Fitness for purpose

- Produce high quality ICT-based presentations by:
 - creating clear presentations, sensitive to audience needs;
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- Use knowledge of publications and media forms to devise criteria to assess the quality and impact of multimedia communications and presentations, and apply the criteria to develop and refine own work.

Teaching sequence	Session notes
Starter 10 minutes	Ideas for evaluation criteria Remind pupils of the evaluation criteria they developed in previous lessons. From these they need to develop an understanding of what an effective presentation would look like in relation to content and presentation style. Ask pupils, in small groups, to combine ideas to form evaluation criteria for the groups' presentations. Allow time for the groups to formulate possible questions they would ask if they were the park manager.
Main activity 40 minutes	Presentation to the park manager Remind pupils that all aspects of their ride are to be presented, with a full understanding of the system development that has taken place. Useful areas to include could be the schematic diagram, safety features, developments and reviews that they undertook, with clear justification for choices they have made. Ask pupils, in turn, to show their presentations to the rest of the class. After each presentation the class should be allowed to ask questions about the content and style of presentation. Questions should be open, to allow the presenters to justify choices and decisions they have made. After each presentation ensure that pupils have an opportunity to evaluate it against the developed criteria.
Plenary 10 minutes	Effective presentations Ask pupils, using the criteria developed, to choose the most effective presentation. Ask individual pupils to justify their choices against the criteria and allow presenters the opportunity to respond. It is important to stress that there is no right or wrong answer to this stage of the project. This part is opinion, based on what people have seen. Draw out features of a range of presentations in the class. After they have presented their work and taken questions, discuss how pupils would review their presentations. They should take into account any difficulties they faced with specific content or messages.
Homework	After the presentations, ask pupils to annotate their work with areas for further development and areas that were successful when presented to an audience. They should make sure that any developments and successes are clearly justified in relation to an effective presentation. All work should be handed in, including rough drafts, annotated work and the final documentation of schematic diagram, control system, presentation notes/slides and completed project diary.