

Late KS3: Skills for Industry Severn Trent	
Systems and Control: Animated Water Display	
Overview	The Skills for Industry programme provides an opportunity to link secondary schools with a local industry partner to help design and technology teachers to develop and teach the industry-relevant knowledge and skills needed by the industry partner. Severn Trent was formed in 1974 as a regional, state-owned water authority based in Birmingham and responsible for water management and supply, waste water treatment and disposal, and will be the partner on this project. They will bring real life experience into the classroom, and aim to develop problem solving skills in the pupils who will be presented with a challenge to develop an animated 'water display' that can be taken to different venues to use as a focal point and present key information about Severn Trent, their work and services. Lessons develop the employability, design and technology skills and knowledge of pupils, and will encourage pupils to pursue a future design and manufacturing related career path. Every lesson, the starter activities and homework will build on this strand. Pupils will be working in teams to improve their ability to solve problems, acquiring knowledge and team work skills through 'mainly making' activities, requiring pupils to find solutions to a variety of challenges.
Suggested time	13 Hours
Learning objectives	Technical knowledge – TK TK9 How to apply computing and use electronics to embed intelligence in products that respond to inputs TK11 How to apply the concepts of feedback in systems TK12 How to control outputs such as actuators and motors TK20 Understand how more advanced mechanical systems used in their products enable changes in movement and force TK13 How to use software and hardware to develop programmes and transfer these to programmable components for example, microcontrollers TK14 How to make use of microcontrollers in products they design and manufacture themselves Designing – DB DB4 Use CAD and related software packages to validate their designs in advance of manufacture Evaluating – EA EA3 Select appropriate methods to evaluate their products in use and modify them to improve performance EA4 Produce short reports, making suggestions for improvements

Assessment objectives	• Create a control system (program & circuit) to operate a system in the required manner. [TK9, TK12, TK13, TK14] • Apply mechanisms to achieve and control movement in system. [TK20] • Use feedback to control the way a system operates. [TK11] • Use CAD/CAM in the creation of a working prototype. [DB4] • Document a system such that others can create copies or other versions. [EA3, EA4]
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Suggested sequence for teaching in hourly sessions	
<i>This is an open task with key points noted only, it is intended to let pupils use all the D&T skills at their command in order to design & make a working solution.</i>	
1	• We have been contacted by Severn Trent, who is looking for an interactive water display that can be used at exhibitions and displays to inform visitors on issues that are important to them and the general public as users of water. They would like to see the following key aspects incorporated into the solution: 1. Use water in an active way – fountain(s) 2. Use a number of jets/pumps to create interesting jets of water 3. Use of multi-coloured lighting to add dynamic lighting effects 4. Use a microcontroller system to control the system, which would link to a key career path of Instrumentation, Control and Automation within Severn Trent 5. Display appropriate ‘water’ related messages / information to and for stakeholders • In this task you are required to design and manufacture of a small-scale prototype animated ‘water display’ as described, you are expected to use your full range of D&T knowledge and skills to realise the display. You have 8 hours to design and make your animated ‘water display’ Slide 19 • The ‘Water display’ will need to be self contained and have one or more ‘water messages’ displayed, create a document/slide or A3 sheet, will shows your ideas for development. Slide 23 • You will need to use computer control in order to operate one or more pumps to control the water jets. Slide 23 • At the end of this lesson pupils should have produced a document/slide or A3 sheet – Interactive water display initial ideas for development. • H/W: Select one of the proposed ideas and develop a possible solution that illustrates how your solution might look and how you would animate and light the ‘water display’. Outcomes should be annotated design ideas with a description of its operation either as a flowchart or a written description. Slide 24
<i>This task can be done either individually or in small groups. This sequence is based upon group working which will help teachers with organising, managing and resourcing the task.</i>	
2	• Based upon the homework done by the pupils, like minded pupils are grouped together in fours.

	- In groups, share each other's ideas and come to a decision as to which one to make as a prototype. Various designing strategies could be employed here e.g. 4x4 - the best design by each individual is used to generate further developments by the group. Slide 26 - Sketch out the final design and create a Gantt chart for the production of the prototype animated 'water display', which identifies the tasks to be done, who's doing them and by when for the group. (A copy of this would be handed to the teacher so that they can see what is needed to prepare for next session.) Slide 27 - H/W: each pupil produces a detailed final design drawing which includes components, mechanisms, description of the 'animation' effect(s) of the display, and a copy of the Gantt chart. This is important so that individually pupils have a clear idea of the group's design and understand how it will be made and gives assessment opportunity. Slide 28
	<i>Guidance: teacher to ensure that at the start of each session pupils have a clear idea of their intended tasks and suggestions have been made to cover problems that might arise.</i> <i>Teacher guidance is critical here to keep things going at the right pace – pre-empt bottle necks, provide troubleshooting for build, coding errors, 3D design issues – using early finishers as mentors is a good way of reducing the pressure in this phase of the unit.</i>
3, 4, 5, 6, 7, 8, 9, 10	- You now have eight hours to design and make your animated 'water display' using all your D&T skills, the list of key technologies below are areas that the pupils need to consider and use in their solutions: - Electric pumps to provide the jets of water. - Lighting and sound systems where appropriate to add atmosphere / life / realism to the prototype. - Use of sensors to add interactivity. - Programmable components as the controller to the system in a manner suitable for its intended application. - Control software that will operate the in autonomous way and that interacts with its environment in a manner suitable for its intended application. - CADCAM, laser cutting and 3D printing as appropriate to manufacture component parts suitable for use in the prototype. Slide 31-40 - It is suggested that pupils progress with their design idea through modelling and refining their solution – iterative design, until a working solution is achieved. - Pupils will now be working using their Gantt chart as the guide through the task moderated by the teacher. It's vital that pupils record their progress using an appropriate method, annotate and evaluate that record. - H/W [Sessions 4-7]: During this phase of the project each pupil writes a short report on the Instrumentation, Control and Automation (ICA) career pathway offered by Severn Trent, using the ICA apprentice who is working with them on the task. This can be done in a number of ways; the outcome could be a document, slide(s), audio or video interview. Slide 34
	At the end of each session, pupils and groups reflect on the progress made, set targets for the next lesson and decide whether alterations have been made to their 'water display' and why – justify.

	At the end of this group of lessons pupils should have produced a working and tested prototype animated 'water display', with supporting documentation, which can be demonstrated. Slides 31 - 40
11	- Using their prototype 'water display' pupils make a short video using a camera or phone, which is to be used in a mini presentation. Slide 41 - Pupils now create a presentation which is a record of the design and manufacture of their animated 'water display' including the video clip of their display. The presentation should be no more than 10 slides long and last no more than five minutes. Slide 42 - H/W: each pupil writes a short report on their role on the project, what new skills, knowledge and techniques have they developed, what worked well, what aspects of the task didn't go so well, and what they would improve upon in future projects/tasks. Outcome should be a document or slide(s). Slide 43
12	The animated 'water displays' are evaluated by a mini presentation to Severn Trent by each group using the prepared presentation, reasons for their choice of 'water display', its development and manufacture, response from the other groups, improvements to be made, the results are recorded in a document/slide and printed to be kept as a reference in pupils' folders/workbooks. Slide 44