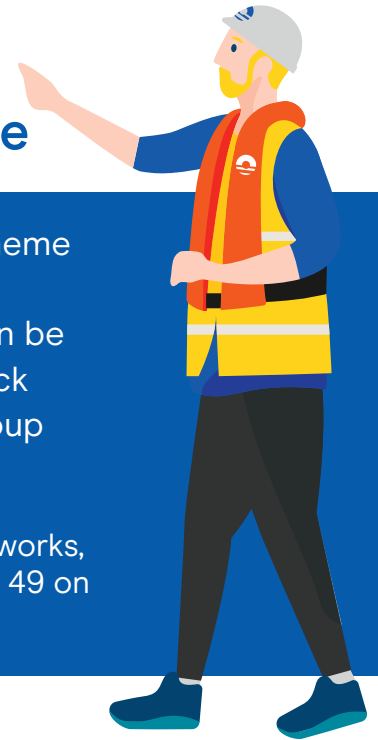


KS3 Teacher's Pack

Knowle Locks Winter Works Learning Bundle

The 'Winter Works' learning bundle is a great way to introduce the theme of engineering and project management to your students. The cross-curricular resources are aimed at 11 to 14 year-olds but can be adapted to suit a variety of age groups and topics. This teacher's pack contains guidance notes on how to support learning with videos, group activities, and independent studies.

The learning bundle is based on a case-study of the Knowle Locks winter works, which involved replacing the lock gates and safety ladders at lock number 49 on the Grand Union Canal in Solihull.



Resources

1. Winter Works Fact File (pdf document of background information).
2. Winter Works Project Introduction (video starter).
3. Winter Works Activity Pack (pdf document of activities suitable classroom and home learning).
4. Winter Works Jobs and Decisions (slides for questions, group discussion and links to videos).

General Learning Objectives

- To gain exposure to STEM based careers related to engineering works.
- To develop an appreciation of team work and specialist skills.
- To think strategically about project time-scales and budgeting.
- To experience engineering problem-solving and decision-making.

Success Criteria

- Children will understand that there are a wide variety of considerations and challenges when planning a large engineering project.
- Children will understand that team members each have their own responsibilities but work together to complete the project.
- Children will understand that there are a variety of career roles involved in engineering projects.

KS3 National Curriculum Links

Science

Current electricity: electric current, measured in amperes, in circuits, series and parallel circuits, currents add where branches meet and current as flow of charge.

Design Technology

Identify and solve their own design problems and understand how to reformulate problems given to them.

Develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools

Understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists.

Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions.

Citizenship

Understand the functions and uses of money, the importance and practice of budgeting, and managing risk.

How to Start The Project

Introduction

Begin by sharing the Knowle Winter Works Fact File with your class and show the Winter Works Project Introduction video. This will provide foundational knowledge about what 'winter works' means and where this case study was located.

Teaching Input

Begin by explaining to the students that to complete work like the Knowle Locks gate replacements, there are many elements to think about and lots of different roles involved from construction managers to ecologists. Explain to the students that projects like this are pre-planned long in advance before the work can begin.



Activity Pack

Activity Pack Preparation

- Share the Knowle Winter Works Fact File with your class.
- Show the Winter Works Project Introduction video.
- Download the 'Winter Works Activity Pack'

Activity 1 & 2: Winter Works & Lock gates

Requirements:

- Display or print 'Winter Works' (page 3 of Activity Pack)
- Display or print 'Lock Gates' (page 4 of Activity Pack)

Learning Objectives:

Activity 1 and 2 can be used as a project starter. The activities explore why the Canal & River Trust choose the winter to do their major maintenance work and introduce the idea of 'problem-solving' in relation to engineering.

Advantages of winter work:

- Least amount of boaters are around so the canal area can be closed off.
- Least number of people walking on the towpaths.
- Less chance of disturbing nesting wildlife.

Disadvantages of winter work:

- Cold, wet weather makes unpleasant working conditions for staff.
- Areas get muddy and dirty.
- Mortar takes longer to dry.

For the Canal & River Trust **care** and **respect** means:

- Using traditional techniques that protect the heritage of the canals for future generations.
- Least disruption to wildlife.
- Keeping the canal closed for the shortest length of time possible.
- Making sure the construction area is kept as tidy as possible.
- Not putting the general public at risk.
- Keeping our members of staff safe.
- Leaving the area as we found it.

Lock Gates:

Discuss possible ideas with your class about how the heavy gates could be transported and put into position. The lock is surrounded by fields and no main roads run nearby.

- The gates were driven on a lorry to a nearby location and lifted onto a boat.
- They were then floated to the lock area.
- A crane was used to lift the gates into position.

Activity 3 & 4: Project Tasks & Project Planning

Requirements:

Print out 'Project Planning - Tasks and Timeline' (page 4 and 5 of Activity Pack).
Students will need scissors and tape/glue.

Learning Objectives:

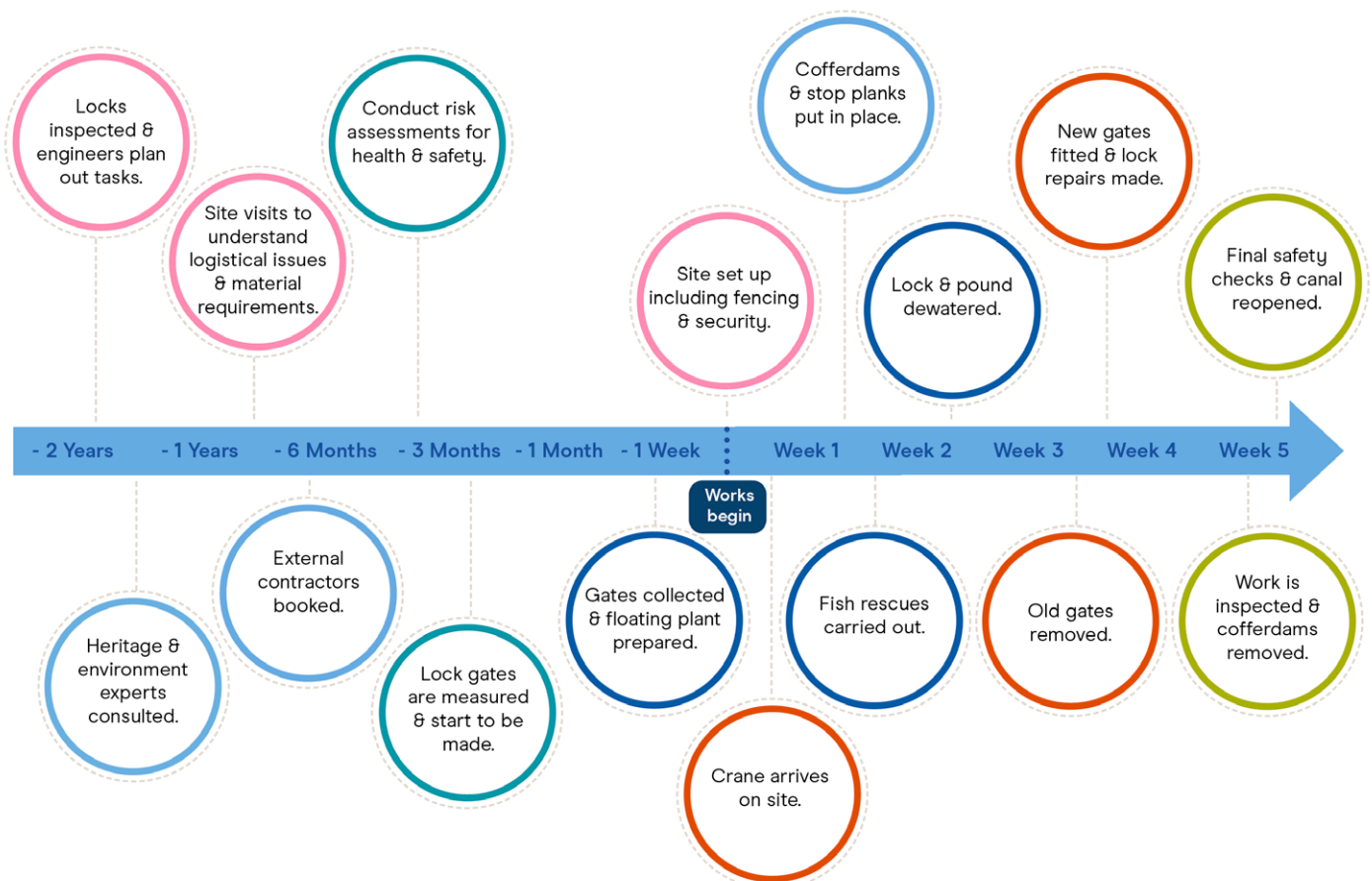
Students will understand that there are many elements involved in planning a large project, and that engineering needs to be done strategically. Planning is essential and tasks will need to be done in order.

About the Activity:

This is a great group activity or suitable for independent learning. Provide each student/group with the task sheet and timeline, where they must take on the role of Project manager to plan the Knowle Locks gates replacement by correctly ordering the project tasks. They must cut and stick the project tasks in the correct order.

Activity 3: Other task ideas could include: Site security | Health and safety | Make gates, transport gates, fit gates | Make a dam and pump out water | Clear out rubbish | Rescue fish and wildlife.

Activity 4: Project Planning - Timeline:



Activity 5 & 6: Project Objectives & Career Backpack

Requirements:

Print out or display 'Job Profile Cards' (page 8 of Activity Pack)

Print out or display 'Career Backpack' (page 9 of Activity Pack)

Learning Objectives:

Students will understand and evaluate individual job roles involved within the project.

Using critical thinking, students will confidently discuss the order of priorities involved within the project.

The Activity:

Discuss how the winter works project required a range of experts to complete the tasks.

Split the class into groups of 6, where each student takes on a different role from the 'Job Profile Cards'. Ask students to research their job role using the headings:

- Roles and Responsibilities
- Impact on the project
- Salary

[The Canal & River Trust website](https://www.canalrivertrust.org.uk) is a good starting place for research.

Next students should look at the list of project objectives (page 9 of Activity Pack). In their chosen job role, students should select their **top three objectives** for the winter works project - The choices should be given in order of priority. If the class has been split into groups, the students with matching job roles could work together (ie. all the ecologists together). After the task, compare each group's order of priority.

- Which statement did they decide was the most important? Why?
- Which statement did they decide was the least important? Why?
- Were there any statements that the group could not agree on?

Activity 6 'Career Backpack' could be used as a great homework activity.

Plenary ideas:

Forehead guessing game: Place the 'Job Profile Cards' in the middle of the table. Students take a card and hold it facing out from their forehead. They must ask the group yes or no questions to work out what their job role is.

Activity 7: Fish Rescues

Requirements:

Print out or display 'Fish Rescues' (page 11 of Activity Pack).

[Watch video of Canal & River Trust Ecologist talk about the wildlife at Knowle Locks.](#)

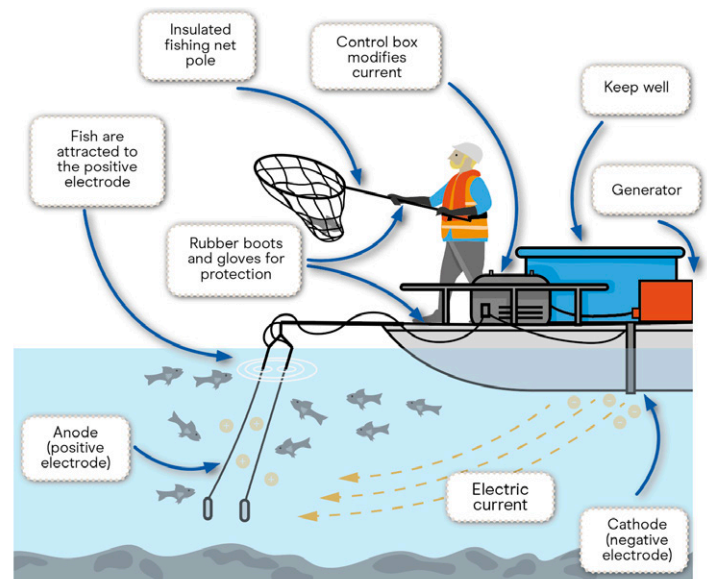
Learning Objectives:

Students will be introduced to the process of electrofishing and understand how it works.

Students will understand how non-native species can impact native fish populations.

The Activity:

The technique that the Canal & River Trust use for catching fish is called electrofishing. It involves passing an electric current through the water to temporarily disengage the ability of fish to swim. They can then be easily netted. The rescued fish are placed in large containers of water. They recover after a few minutes, before being rehomed in a safe section of canal. Catching the fish also allows the Trust to check fish health and assess fish species populations. Ask students to complete the diagram labels.



Plenary ideas:

- Ask students to draw a circuit diagram of electrofishing. Include the equipment; battery, control box, leads, anode and cathode. Remind students to include a key.
- Ask students to write an argument 'for' and 'against' electrofishing'.
- **Native vs non-native species game:** Zander are a non-native species of fish that have found their way into our waterways. Zander are aggressive feeders and are thriving in the murky waters of the canals causing native fish populations to suffer. This fun game shows the process in action:
You will need: 30 pom-poms per group, spoons and chop sticks.
How to Play: Split students into groups of five. Four students start as native fish (and one student starts as a Zander. Spread the pom pom 'food' in the middle of the table. The fish have 30 seconds to collect as much food as they can using the tools. The native fish use chopsticks and the non-native fish use a spoon to collect the food.
Each fish must collect at least 3 pompoms to continue to the next round of the game or they will become extinct. When a native fish becomes extinct they turn in to a non-native Zander.

Were the native species able to compete with the non-native species for the food? Why/Why not? What is the impact?

Activity 8 & 9: Cofferdams & Stop Plank Design

Requirements:

Display 'Cofferdams' (page 12 of Activity Pack).

[Watch video of Canal & River Trust Construction manager talk about the Knowle project.](#)

Display or print 'Cofferdams: Stop Plank Design' (page 13 of Activity Pack).

Foamboard/Cardboard and scissors to make prototypes.

Learning Objectives:

Students will understand the role of cofferdams and will investigate the effectiveness of different interlocking shapes in stopping water. Students will reflect on the effectiveness of a new stop plank

The Activity:

Begin by explaining to the students that in order to complete tasks like the Knowle Locks winter works, stop planks must be installed to block off the canal water so that the lock can be drained or 'dewatered'. The Canal & River Trust currently use timber stop planks which are heavy and often have an inadequate seal.

Ask: How could we improve the current stop planks?

What would the advantages/disadvantages be of using a different material?

Explain to the students that their task is to improve the current 'cofferdam' design. They could either work in pairs or individually.

Encourage students to think about interlocking shapes to stop the flow of water and create a better seal. The students should communicate their design idea using annotated sketches and then create the interlocking shapes out of materials.

Test the students' prototypes to investigate whose design is the most effective at locking together or stopping the flow of water. This could be done using cardboard or foamboard and timing how long it takes for the water to pass through their design.

Plenary ideas:

Ask students to reflect on the effectiveness of their design.

Whose design was the most effective? Why?

How the students' improve their own design?



Decision Making – Classroom/Group Session

Resource Preparation

Share the Knowle Winter Works Fact File with your class

Show the Winter Works Project Introduction video.

Download the 'Knowle Winter Works Jobs & Decisions' PowerPoint.

Print out the 'Pick a Job' sheet (slide 2), one for each group.

Instructions

1. Provide each group with a 'Pick a Job' sheet (slide 2).
2. Ask each group member to choose a role.

3. As a class, work through each of the 5 'Decision Time' tasks in turn. On each 'Decision Time' slide, the teams should choose which job role(s) would be involved in the decision-making. The person representing the job role should lead the discussion within the group.

4. After each 'Decision Time' slide, move on to the accompanying slide where solution information is provided. This offers details about how this problem was dealt with at Knowle. They include links to Canal & River Trust YouTube videos and estimated costs.

5. The final slide prompts students to think about **budgets**. The Knowle Winter Works cost over £170,000. Ask students to make a spreadsheet/table of the costs they have found out so far. In their teams they should think of other items that might be added to the table and give a cost estimation. Can they make the figures add up to £170,000? They could include:

- waste contractors (skips)
- materials, diving contractors
- pump hire
- specialist tool hire

Pick a Job

<p>Job Profile: Ecologist Key words: protect, wildlife and biodiversity. I conduct wildlife and plant assessments around the lock/energy. I provide advice on soil, land use, biodiversity strategies and environmental protection.</p>	<p>Job Profile: Craft Operative Key words: skilled, craft and teamwork. I work within a team of skilled craftspersons on-site around our canals and locks. We conduct maintenance and repair work like chipping and carpentry on heritage structures.</p>	<p>Job Profile: Construction Manager Key words: organise, manage and safety. I coordinate and supervise the construction and maintenance works. I make sure that the operations are done safely, on time and within budget.</p>
<p>Job Profile: Engineer Key words: design, technical and specialist. I design and manage the maintenance, repair and renewal of our heritage assets like bridges and locks. I provide guidance and technical advice to teams and contractors.</p>	<p>Job Profile: Heritage Advisor Key words: protect, conservation and history. I ensure that any work that the Canal & River Trust do on the waterway conserves and maintains the integrity and authenticity of the historical assets.</p>	<p>Job Profile: Mobilisation Supervisor Key words: solutions, technical and safety. I coordinate and supervise the delivery and movement of machinery, equipment and supplies around the project site. I make sure the work can get underway smoothly.</p>

Decision Time 1

We need to hire **equipment** to lift the heavy gates. Who will help to decide what method we use for the job?

- Ecologist
- Craft Operative
- Construction Manager
- Engineer
- Heritage Advisor
- Mobilisation Supervisor

DISCUSS: Which method should we choose and why?

Gantry

vessel crane

Spider crane

Decision 1 – Finding a Solution

Here is our Mobilisation Supervisor talking about how we solved the problem at Knowle.

<https://www.youtube.com/watch?v=NH-q-Vuyh7w>

At the Knowle Winter Works, crane hire cost **£44,600!**