



OSNEY LOCK HYDRO



Hydropower Lesson 1



This project was funded by the National Lottery Heritage Fund

This guide is designed to accompany and complement:

- Presentation: **Hydropower**
- Single page lesson plan: **Hydropower**
- Worksheet: **Hydropower** (including activities and possible extension tasks or homework)

The guide goes into greater detail than the single page lesson plan and includes suggested resources and elaborates on each slide in the PowerPoint.

Presentation Tips:

- When opening the PDF presentation, you can select how it is displayed. If you wish to **click through** as opposed to scrolling (which gives you more control as you progress and is more like a conventional ppt) it is best to show it in **'full screen mode'** (press 'escape' to exit).
- All associated documents are attached to the presentation. To find these, click on the **paperclip icon** in the left-hand toolbar.
- When viewing the presentation, presenter notes from this delivery guide are also available for reference if you hover the cursor over the small orange callout icon in the top left corner. **Fig.1**

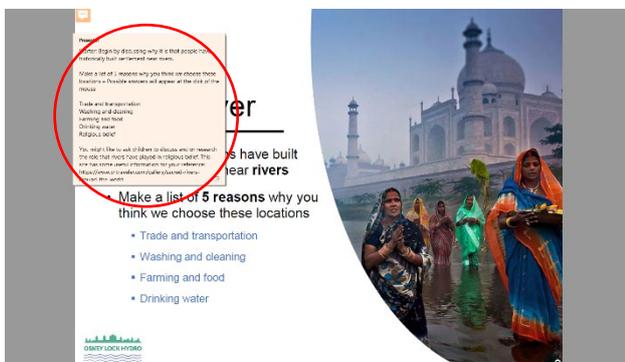
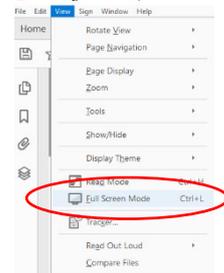


Fig.1

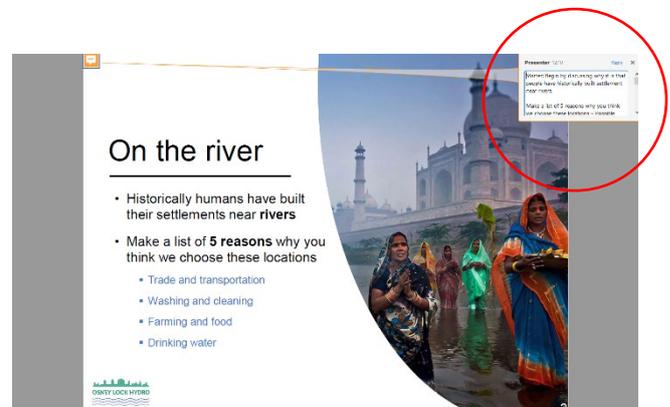


Fig.2

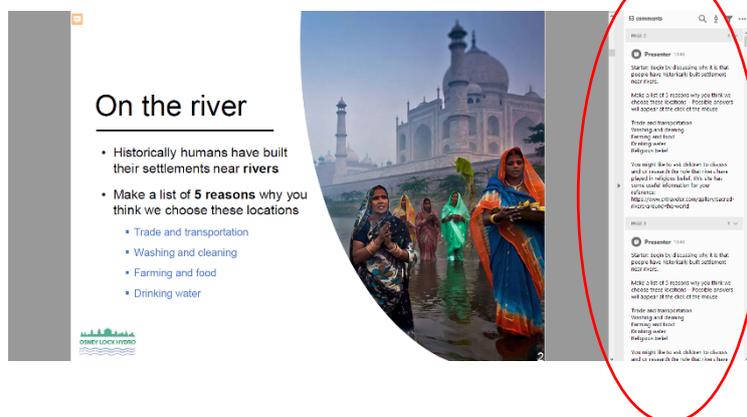


Fig.3

- If you **right click** on that icon it will open a small window showing presenter notes in the top right of the page. **Fig.2** If you right click and scroll down, you can also choose to click **'show comment app'** which opens a panel on the right of the page showing all the presenter notes as you scroll through. **Fig.3**

20 minutes to fill?

You could use slide 4 to elicit discussion about the importance of water and the impact of not having access to clean water looking specifically at drought, the causes of drought and the impact it has on stricken areas and populations.

Slide 4

Slide number	This presentation is designed to allow the presenter/teacher to pitch it as appropriate to KS2 - KS3 age children. Questions that are on the slides have been differentiated by colour in this guide, with red being most challenging. 🏆 Those marked with this icon may not appear on the ppt slide and are optional, higher level questions. 🌀 Points marked with this icon can be used as a starting point for a personal investigation activity and for extension where appropriate. Advisory! All videos are linked to external players (usually YouTube) these have been chosen to complement and reinforce learning and have been chosen carefully. However, we would advise that you watch them yourself prior to showing them to ensure that you are happy that the content is right for your children or class.	Suggested resources	OLH resources
2	<p>Starter: Begin by discussing why it is that people have historically built settlement near rivers.</p> <ul style="list-style-type: none">• Make a list of 5 reasons why you think we choose these locations <p>Possible answers will appear at the click of the mouse</p> <ul style="list-style-type: none">• Trade and transportation• Washing and cleaning• Farming and food• Drinking water• Religious belief <p>🌀 You might like to ask children to discuss and or research the role that rivers have played in religious belief.</p> <p>The linked site has some useful information for your reference.</p>	<p>https://www.cntraveler.com/gallery/sacred-rivers-around-the-world</p>	<p>PPT presentation, worksheet and lesson plan</p>

3	<p>You can choose to show the video clip as it will only commence once you have clicked on the 'play' icon.</p> <p>The clip runs for [4m50s] it looks at why rivers are important focussing particularly on the Thames. It is presented by Sam Lee, a primary pupil from London. You may need to turn the sound up!</p>	<p>https://www.youtube.com/watch?v=ojSFHD_Ce3g [4m50s]</p>	<p>Embedded clip in ppt</p>
4	<p>This is a good opportunity to remind children that water is vital to life.</p> <ul style="list-style-type: none"> Water is also known as H₂O, do you know what this stands for? – H₂O is the chemical formula of water. A water molecule contains <u>one oxygen</u> and <u>two hydrogen</u> atoms <p>Discussing the origin and use of the prefixes hydro and hydra makes the association between words that use these and water – origin is ancient Greek from hydro meaning water.</p> <p> What other 'hydro' and 'hydra' words can children think of and do they know the meanings? - https://www.thefreedictionary.com/words-containing-hydro</p> <p> What is the term used to describe an extreme shortage of water? - Drought</p>	<p>https://www.nationalgeographic.org/article/understanding-droughts/?utm_source=BiblioRCM_Row</p>	
5	<p>Emphasising the power and energy of water is important so that children understand how this can be harnessed. It is also an opportunity to remind them that bodies of water, rivers and open water must be treated with respect and whilst they can be fun and exciting, they can also be dangerous.</p> <ul style="list-style-type: none"> What type of energy does flowing water have? – Flowing water has kinetic energy, the energy of movement (if using the WeSET series of lessons, this is explained in Lesson 1 Energy) 	<p>http://www.weset.org/?page_id=8 43 Lesson 1 Energy</p>	

6	<p>Harnessing the energy of water is not a new practice. With relatively rudimentary tools and materials ancient civilisations were able to make water wheels and turbines to raise and pump water and provide mechanical energy.</p> <ul style="list-style-type: none"> • What type of mechanisms were created to harness the power of water? – Children are most likely to suggest water wheels some may have heard of the Archimedean screw (both will be explained in more detail later) <p><i>👉</i> You might like to ask children to research how ancient Greek, Roman or Egyptian civilisations harnessed the power of water</p>		
7	<p>We begin looking at the way we harness the power of water by looking at water wheels. Some children may have visited obsolete or restored wheels, and some may have seen water mills in action and therefore want to contribute their experiences.</p> <ul style="list-style-type: none"> • How is the wheel made to rotate? – The force of water running into or falling onto the paddles or buckets of the wheel cause it to rotate • How do you think we can control the speed that the wheel rotates at? – By using gates or moveable barriers to restrict or increase the amount of water entering the wheel <p><i>🏰</i> What are these gates called? - Sluice gates</p>		
8	<p>You can choose to show the video clip as it will only commence once you have clicked on the ‘play’ icon.</p> <p>The clip runs for [1m26s] and simply shows how the restored water wheel at Lyme Regis is started up.</p>	<p>https://www.youtube.com/watch?time_continue=3&v=8Y1qWqikPE&feature=emb_logo [1m26s]</p>	<p>Embedded clip in ppt</p>

Hand out Worksheet Hydropower

9	<p>Task 1 This slide can be used alone or in conjunction with the differentiated worksheet where pupils can draw/plan their designs in the space provided for recorded formative assessment.</p> <p><i>✍</i> In their teams, ask children to design and make a working model of a waterwheel – It is a good idea to have a box of materials available and these can largely be recycled items, off cuts and scraps</p> <p>It is up to your discretion how you run this activity but the resource links show some similar activities and materials used. You will need to rig up a water source to test the designs.</p> <p>There is space on the worksheet for children to plan, and design their waterwheel</p>	<p>https://www.youtube.com/watch?v=AnBj_v4GIVa [2m26s]</p> <p>https://www.youtube.com/watch?v=i7w6g3KIJZY [5m08s] Possible materials: cardboard, paper plates, bottle caps, bottle, paper straws, recycled spoons or cups, lolly sticks, glue, tape etc</p>	Worksheet Hydropower
10	<p>You can choose to show the video clip as it will only commence once you have clicked on the ‘play’ icon.</p> <p>The clip runs for [3m12s] and introduces modern hydropower.</p>	<p>https://www.youtube.com/watch?time_continue=4&v=q8HmRLCqDAI&feature=emb_logo [3m12s]</p>	
11	<p>It is good to differentiate between hydropower and hydroelectricity before we go on to look specifically at hydroelectric generation.</p> <p>There are other types of hydroelectric scheme like pumped storage for example however this requires significant power to pump the water, this is not always renewable energy making it a less sustainable option than the main two we will focus on.</p> <p>The image shows the generators in the plant room of a hydroelectric dam (the turbines are housed in the concrete cylinders directly below).</p> <p><i>🔍</i> What is the word used to describe a wall built to hold back and store water? – A dam</p>		

<p>12</p>	<p>Following the question on the last slide, explain the concept of a dam in more detail. These are huge structures, usually made from concrete. The exact type and shape of dam depends on where it is built, the link elaborates on this.</p> <p> What do we call a body of water or artificial lake held by a dam? – A reservoir</p> <p> Children might like to explore why a dam is like a battery? What is potential energy? (If using the WeSET series of lessons, this is explained in Lesson 1 Energy)</p> <p>The force of the water being released from a reservoir through pipes called penstock pipes into the turbine rotates the blades of the turbine.</p> <p>The turbine is connected to the generator that generates electricity as it rotates. After passing through the turbine, the water flows back into the river on the other side of the dam.</p>	<p>https://britishdams.org/about-dams/dam-information/types-of-dam/ British Dam Society http://www.weset.org/?page_id=843 Lesson 1 Energy</p>	
<p>13</p>	<p>It is useful to point out and discuss the similarities between water wheels and turbines, they work on a similar principle.</p> <p>There are several different types of turbine used in hydroelectric generation and their shapes vary. The one pictured (next to a wicket gate lying on the ground in front – more on those next) is a Francis turbine. Other examples are pictured and explained in the resource link.</p> <p> Why is the turbine in a dam located well below the level of the water? – To create a build up of pressure which creates the force to drive the turbine</p>	<p>https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=73762&section=8 Turbine types</p>	

14	<p>The numbered part names will appear at the click of the mouse.</p> <p>Explain that the blue arrow represents the flow of water into the turbine.</p> <ol style="list-style-type: none"> 1. The turbine – pressurised water flows from the dam down pipes into the turbine 2. Turbine blades – the water passes over the turbine blades, its kinetic energy moving the blades and transforming into mechanical energy 1. Wicket gates – what do you think the function of the wicket gates might be? - The wicket gates can be closed and opened to regulate the flow of water 2. The turbine/generator drive shaft – mechanical energy from the turbine rotates the drive shaft which is connected to the generator 3. The generator - the hydroelectric generator then converts this mechanical energy into electric energy 4. Generator rotor – the generator rotor rotates past a series of electromagnets creating a current 		
15	<p>You can choose to show the video clip as it will only commence once you have clicked on the 'play' icon</p> <p>The clip runs for [3m57s] and explains clearly how dams and turbines works.</p>	https://www.youtube.com/watch?time_continue=2&v=dmlsZ2CUZS4&feature=emb_log [3m57s]	Embedded clip in ppt
16	<p>Task 2 This slide can be used alone or in conjunction with the differentiated worksheet for recorded formative assessment</p> <p>An example has been given to help children understand the activity</p> <ul style="list-style-type: none"> • Ask children to match the facts on the sticky notes with the appropriate named images below – arrows will appear one by one on the click of the mouse 		Worksheet Hydropower

17	<p>Moving on to ‘run of river’ hydroelectric. Its interesting to discuss with children why rivers and streams have a current – where do rivers start (the source of the Thames is just beyond Cricklade in Gloucestershire and at some times of year is little more than a trickle), do rivers change depending on gradient (rapids, waterfalls etc) which ways are up and down stream for example.</p> <p>🦧 What force creates river current? – The force of gravity</p> <ul style="list-style-type: none"> • How do you think weirs could be used to prevent flooding? – Weirs can be used to control the flow rates of rivers especially when rivers are high and flowing fast. Sluice gates (like those used in water mills) or the height of the weir can be adjusted to increase or decrease the amount of water flowing downstream 		
18	<p>There are similarities between run of river and storage schemes in that they both use turbines and generators. Run of river schemes however use the movement of the downstream flow to drive the turbine.</p> <p>Change of height plays an important part in RoR schemes.</p> <ul style="list-style-type: none"> • What manmade structure is used to enable boats to navigate a river as it runs downhill? – A lock 		
19	<p>Children may have some experience of locks but not all may appreciate that they exist to enable boats to essentially pass ‘downhill’ safely on a river by doing it in stages.</p> <ul style="list-style-type: none"> • How is a lock different from a weir? – A weir largely enables the river to flow over the barrier constantly (although as previously mentioned, flow can be adjusted if necessary) whereas lock gates when shut temporarily contain the water and when opened, let it out in a slow and controlled manner <p>🦧 Ask children if they can describe step by step the process of navigating a lock downstream? – “Going Downstream: 1. Close all gates 2. Ensure bottom paddles shut 3. Open Top paddles to fill lock 4. Open doors and enter 5. Close doors and top paddles 6. Open bottom paddles to empty lock 7. There is a sill (step) behind you under the top gate 8. As the boat falls, stay forward in the lock or your boat may strike it as the water level falls 9. Open bottom gates and exit”</p> <p><i>Taken from the Inland Waterways Society website</i></p>	https://www.waterways.org.uk/boating/navigating_your_boat/operating_a_lock	

20	<p>The Archimedean or Archimedes screw is named for Archimedes although some argue that it dates back to ancient Egypt. It is a type of spiral or cylindrical helix.</p> <p>Wound anticlockwise it will move water fed in at the base of the screw upward in its channels.</p> <ul style="list-style-type: none"> • Can you think of any other applications for an Archimedes Screw? – They can also be used for moving grains or powders for example, in plastic injection moulding, an Archimedes screw is used to move measured amounts of plastic powder along a tube to the injector <p>The linked animation illustrates this simply.</p>	https://www.youtube.com/watch?v=0PgA6DzZf_M [0m46s]	
21	<p>Task 3 This slide can be used alone or in conjunction with the differentiated worksheet where there are suggested materials and a step by step guide.</p> <p><i>✍</i> In their teams, ask children to make a working model of an Archimedes Screw to move lentils or beads from a lower bowl to a higher one – It is a good idea to have a box of materials available and these can largely be recycled items, off cuts and scraps but a suggested list is on the worksheet</p> <p>It is up to your discretion how you run this activity but the resource link shows some similar activities and materials used. You will need to rig up a support to test the designs (this could just be a pile of books).</p> <p>There are clear instructions on the worksheet</p>	http://stemacademymiddleschool.weebly.com/uploads/21/07/21079612/making_an_archimedes_screw.pdf Useful example https://www.primarivict.co.uk/dr7972/primary-science-archimedes-screw-learning-lsp2836-uk?gclid=EALaIQobChMI_qDKreve6wIVid3Ch3MoQ5IEAQYASABEgJBZPD_BWE	Worksheet Hydropower
22	<p>A Reverse Archimedes Screw simply works in reverse i.e. it is turned clockwise so that it moves the substance (in this case water) downwards.</p> <ul style="list-style-type: none"> • What type of energy is the rotation of the screw an example of and how do you think this is then turned into electricity? – Mechanical energy which in turn turns a shaft which drives a generator (If using the WeSET series of lessons, this is explained in Lesson 1 Energy) 	http://www.weset.org/?page_id=843 Lesson 1 Energy	

23	<p>You can choose to show the video clip as it will only commence once you have clicked on the 'play' icon</p> <p>The clip runs for [3m59s] and explains clearly how hydropower screw turbines work.</p>	<p>https://www.youtube.com/watch?v=1Nm0aacZ4iY&feature=emb_logo [3m59s]</p>	Embedded clip in ppt
24	<p>This slide introduces Osney Lock Hydro which the next lesson will focus on in much more detail.</p> <p>Osney lock stands out as the first community owned scheme on the River Thames. Because it is a relatively small scheme it is also known as 'micro hydro'.</p> <ul style="list-style-type: none"> • What benefits do you think this scheme has for the local community? - It generates green energy for the local community reducing carbon emissions, it brings people with a common goal together and ultimately it can create an income stream to fund local environmental projects 		
25	<p>Task 4 This slide can be used alone or in conjunction with the differentiated worksheet for recorded formative assessment.</p> <p>This can be done individually, in pairs or larger teams for brain storming.</p> <p><i>✍</i> Invite children to find out the following information about Osney Lock Hydro:</p> <ol style="list-style-type: none"> 1. Where is Osney Lock Hydro located? Set by the bank of the River Thames at Osney Lock, Oxford 2. When was OLH constructed? Building work started in the summer of 2013 3. The power generated by OLH could provide electricity for how many homes? 55 homes 4. How many kWh (kilowatt hours) of electricity did OLH generate during first 12 months of operation? 143,365 kWh <p>Ask if they can find out any more important information to add to their investigation</p>	<p>All answers available on the OLH website http://www.osneylockhydro.co.uk/about-us/</p>	Worksheet Hydropower

26	<p>Plenary Quiz - What have you learnt?</p> <p>This can be done as a quick-fire hands up quiz or pupils can be given time to write down their own answers for formative assessment.</p> <ul style="list-style-type: none"> • Can you suggest 2 reasons why throughout history, humans have chosen to settle near rivers? – Access to trade and transportation, washing and cleaning, farming and food, drinking water, religious beliefs • Water is also known as H₂O, what do the 'H' and the 'O' stand for? – Hydrogen and Oxygen • How is a waterwheel made to rotate? - The force of water running into or falling onto the paddles or buckets of the wheel cause it to rotate • What do we call electrical energy that has been generated using water and is this type of electricity renewable or non-renewable? – Hydroelectricity, it is a renewable source • What type of screw is used in a run of river hydro? – An Archimedes or Archimedean screw 		
27	<p>All images used are royalty free, 'Creative Commons' and free to use for non-commercial purposes</p> <p>Sources include: https://www.freeimages.com https://pixabay.com https://unsplash.com www.osneylockhydro.org.uk</p> <p>Microsoft online pictures search (Creative Commons only) Further information about self-guided and guided tours of Osney Lock Hydro is available at www.osneylockhydro.org.uk</p> <p>These materials are free to use and reproduce however we respectfully ask that you do not edit them</p> <p>Further resources can be found at: WeSET educational resources https://www.weset.org/ks-2/ WeSET virtual tour https://www.youtube.com/watch?v=af3oOd1LgyE Sandford hydro virtual tour https://www.youtube.com/watch?v=RvyLVKqnPml</p> <p>Osney Lock Hydro Limited is a registered society under the Co-operative & Community Benefit Societies Act 2014, registered in England and Wales, registration no. 31983R, VAT Registration no. 165 3322 22.</p>		