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| **Design and build a water treatment** | | |
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| Design and build a water treatment system to produce clean water | | |
| **Subject(s):** Science, Design & Technology, Mathematics  **Approx time:** 2 x 60 mins |  | **Key words / Topics:**   * clean water * water shortage * drought * water supply * health |
| **Stay safe**  Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for:    • ensuring that any equipment used for this activity is in good working condition  • behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others    Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠ | | |
| **Suggested Learning Outcomes** |  |  |
| * To be able to identify the causes of water shortages in Britain * To design, test and evaluate their water treatment plant * To research how recent technological developments offer new ways to solve these problems | | |
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| **Introduction** |  |  |
| Students will be well aware of the global water shortage and may have experienced the effects of water companies imposing drought orders in their towns. This activity is designed to see if they would be prepared to accept radical ideas to alleviate these problems. They will be asked to explore how technological developments can change the way we think and act, and to consider how local activity can contribute to solving a global problem. | | |
| **Purpose** | | |
| This activity sets students the challenge of designing and building a water treatment system to produce a clean sample of water. It encourages students to think about their own water usage and how they may be able to save water at home. | | |
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| **Activity** |  | **Teacher notes** |
| Watch the Pure Water film.  Set students the following challenge. They are scientists who have been asked by their local water board to design and build a water treatment system to produce a clean sample of water. They will need to be able to show how they know that the water is clean.  Students will need to think about what equipment they would need, what stages the dirty water would need to go through in order to clean it, and how they would show the water board that the water was clean enough to drink.  Ask each group to draw out a flow chart, using a large piece of paper, to show each step of their water treatment plant. Students can add diagrams to make their design clearer.  They must show how they are going to test the cleanliness of their end product. Possible areas of research on how to ensure water cleanliness are use of chlorine and ultra violet rays.  Students are then given a sample of dirty water and asked to think how they could make a small-scale water treatment plant in the lab. Students design their model showing how it links to each stage of an industrial water treatment plant.  Students then carry out their test to establish how clean their end sample is — ideas could include putting a sample on agar and seeing if anything grows on the agar plate compared to a sample of tap water, and testing the pH of the water (public water systems have to meet a pH level of 6.5 -8.5).  Students evaluate their method and add a few strengths and weaknesses of their model to their flow chart sheet.  Students put up their flow chart sheets around the room. The teacher then chooses two or three and asks the class to see if they can address any of the weaknesses identified. |  | Discuss what type of things may be dissolved in water, including those not visible to the naked eye, which make the water unfit to drink — bacteria, chemicals such as pesticides, nitrates, and chlorine, and metals like lead.  (Any good textbook would have these types of pictures or look on:  <http://en.wikipedia.org/wiki/Water_purification>.)  Students construct their small-scale water treatment plant, through which they should process the dirty water they need to clean. |

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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| Refer back to the starter activity; ask the students if they have changed their opinion about whether they would consider using cleaned sewage as a possible source of water.  Now that they have looked at how water is treated, in their groups ask students to list three things they would need to know from the scientists and engineers to be sure that the water was safe to use. |  | Using the information from the online survey they have done, students have to design a publicity campaign to encourage homeowners to save water. |

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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| film Pure Water film  **For the filter**   * Possible filtration layers — aquarium gravel, play sand, activated carbon/activated charcoal (granules found with aquarium supplies, wash dust off first), marbles, cotton balls, filter paper, packing materials (Styrofoam balls) * 2-litre bottle with bottom cut off, cheese cloth or other suitable material to cover the neck of the bottle, rubber bands   **Testing purity of water**   * Litmus paper or universal indicator, agar plates and cotton wool buds to infect the plate, adhesive tape * Water-testing pens can be purchased for about £15 * Google ‘ testing water purity’ and you will find a number of sites you can buy kits from * Dirty water and clean water, if you want to do a comparison * Sterilised beakers to collect clean water in * Clamp stands |  | icon-doc Less Water Challenge (Worksheet)  icon-doc Tomorrow’s Water Challenge (Worksheet)  icon-doc Discover More: Running Water (Handout) |

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| **Additional websites** |  | |  |
| * Environment Agency: <https://www.gov.uk/government/organisations/environment-agency> * Water UK: [www.water.org.uk](http://www.water.org.uk) * How much water do you use?: <http://www.uswitch.com/water/how-much-water-use/> * Save Water: <http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/homeandleisure/beinggreen/117266.aspx> | | | |
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| **Related activities (to build a full lesson)** |  | |  |
| **Starters** (Options)   * ACTIVITY: Clean Water 1 * ACTIVITY: How Much Water 1 * ACTIVITY: Design to sell   **Main** (Options)   * ACTIVITY: **Clean Water 2** * ACTIVITY: How Much Water 2 | | **Main (cont.)**   * ACTIVITY: Design to sell 2   **Plenary**   * Opportunities within activity for presentations, peer/self assessment * Reflection on Objectives and PLTS skills used | |
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| **The Engineering Context** film |
| * **The story** Pure Water * **How it works?** Reverse Osmosis Purification * **Who makes it work?** Shivaji Deshmurk |

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| **Curriculum links and PLTS** | |
| **England**  Science   * KS3 2a, 2c, 2d, 2e, 2f , 3e, 3f, 17a, 17b, 17d, 18e   Design & Technology  > KS3 3c | **Northern Ireland**  Technology & Design  (Objective 2) Developing pupils as Contributors to Society   * Explore technical inventions and designs that have met a social need cost-effectively * Design cost effective and appropriate solutions to meet the specific needs of diverse local and global groups.   (Objective 3) Developing pupils as Contributors to the Economy and the Environment   * Identify product needs and pursue sustainable harmonious design solutions in a local outdoor/indoor context   Learning Outcomes   * Show deeper understanding by thinking critically and flexibly, solving problems and making informed decisions, using Mathematics and ICT where appropriate * Work effectively with others * Demonstrate self-management by working systematically, persisting with tasks, evaluating and improving own performance   Communicate effectively in oral, visual (including graphic), written, mathematical and ICT formats showing clear awareness of audience and purpose |

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| **Personal, learning & thinking skills (PLTS)** |
| **>** Effective participant |