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| **How Much Sewage?** | | |
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| Analyse sewage tunnel design | | |
| **Subject(s):** Science, Design & Technology, Mathematics  **Approx time:** 15-30 mins |  | **Key words / Topics:**   * environment * water use * comparison * calculations * civil engineering |
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| **Suggested Learning Outcomes** |  |  |
| * To develop an insight into the representation of large volumes * To determine and select variables, then apply mathematical formulae to solve real-life problems | | |
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| **Introduction** |  |  |
| This activity accompanies the Shifting Sewage film which looks at the sewage tunnels being built under London. These activities have been designed for both mathematics and science and can be delivered either independently or through a planned sequential approach.  ‘How Much Sewage?’ challenges students to move beyond an ‘out of sight, out of mind’ approach to sewage as they use and develop their mathematical process skills within the real-world contexts presented. | | |
| **Purpose** | | |
| This extension activity follows on from the ‘Underground sewage systems’ activity and provides an engaging task to continue the learning focusing on the link between sewage and the underground tunnel system. It encourages students to think about the role of engineers in providing us with healthy sanitation and waste-water disposal systems. | | |

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| **Activity** | |  | | | **Teacher notes** |
| Comparisons to everyday life are often given to support understanding, e.g. ‘32 million cubic metres is enough to fill the O2 almost 15 times.’ Ask students to research different volumes, such as the volume of a bus, and use ICT to create posters that clarify this figure of 32 million cubic metres of diluted sewage each year.  The proposed tunnel is 32km in length – the map shows just how ‘bendy’ the proposed route is.  See the activity handout, as shown below.  A map of a river  Description automatically generated  How long would the tunnel be if engineers could create a tunnel that was completely straight? Why can’t they? | |  | | | Students can research estimated costs for tunnelling through different strata and use geological maps to estimate the cost of different routes for this tunnel, or for a hypothetical situation (which allows for greater simplification), or for a different city, finding the optimal solution. |
| **Resources**film | |  | | | **Required files** icon-docicon-pdficon-ppt | |
| Shifting Sewage film   * Projector/Whiteboard | |  | | | icon-ppt Analyse sewage tunnel design Handout | |
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| **Additional websites** | |  | | |  | |
| * Thames Tideway Tunnel: <https://www.tideway.london> | | | | | | |
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| **Related activities (to build a full lesson)** | |  | | |  | |
| **Starters** (Options)   * ACTIVITY: Expanding Populations * ACTIVITY: Properties of rocks * ACTIVITY: Underground sewage systems   **Main** (Options)   * ACTIVITY: Sewage Tunnels | | | | **Extension** (Options)   * ACTIVITY:   **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** Shifting Sewage/Controlling Floods * **How it works?** Infrastructure Complexity * **Who makes it work?** Sian Thomas |

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| **Curriculum links and PLTS** | |
| **England**  Design and Technology   * KS3 3d   Mathematics   * KS3 1a, 1b, 1e, 1g, 3a, 3b, 4a, 4d, 4l, 4o, 6a, 7a | **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   (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 * Education for Sustainable Development   Learning Outcomes   * Research and manage information effectively to investigate design issues, using Mathematics and ICT where appropriate |
| **Scotland**  Technologies   * TCH 3-02a | **Wales**  Design & Technology   * 3.1 |
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| **Personal, learning & thinking skills (PLTS)** |
| **>** Effective participant |