Filtering Water

To consider how engineers make water fit for human consumption

Subject(s): Science, Design & Technology, Mathematics

Approx time: 60 mins

Key words / Topics:
> clean water
> health
> filtration
> water supply
> treatment systems
> engineers
> measurements
> budgeting

Suggested Learning Outcomes

> Recall the different types of impurities that can contaminate water
> Describe how water filtration equipment acts in a number of different ways to produce potable (drinkable) water

Introduction

Water is crucial to human life, but it can also be a killer.

Drinking or cooking water contaminated with micro-organisms or chemicals is a leading cause of disease and death across the world. Poor facilities for the disposal of sewage and other waste water can quickly lead to the spread of dangerous diseases.

These classroom resources focus on how engineers and scientists work to provide us with safe, clean drinking water, with efficient and clean methods for disposing of our waste water and practical drainage solutions.

Purpose

This activity gets students to investigate different possible ways of filtering dirty water to improve its cleanliness by designing and building their own water filtration systems. The lesson can be extended with a practical session in which students work in small teams to investigate the salinity of different water samples – see the extension activity 'Water Treatment Systems'.

Activity

Students should work in small teams.

Give each team a cut-off drinks bottle (2 Litre). This can be turned upside down to form the body of the filter.

Each team is then allowed to select a maximum of just four materials with which to build their filter. Students

Teacher notes

If you have also used the starter activities related to this activity (see 'Related activities' section below) with your students, they should work in the same teams they were in before.

Explain that now they have designed tests for 'commercially available' filters they are going to design and build their own.

An alternative method of restricting the number of materials students can use is to give each team a

should consider how their filter will work and draw a plan of it.

Once each team has built their filter they can be given a 250 ml beaker of the standard dirty water sample with which to test their filter.

Teams can then collect a sample of filtered water. A set volume of 150 ml can then be taken from each sample for testing. This testing can be done by pouring the samples into glass beakers or conical flasks, placing the beakers or conical flasks onto white tiles and observing the 'cleanliness' of the water samples from above.

If time allows, students could be asked to think about how else they might be able to measure the clarity of the water. They might also be asked to think about whether clear water is necessarily clean.

budget to work within. They then have to 'buy' the materials to put in their filter. The prices can be set at different levels for different materials and can even vary over the course of the lesson to accommodate supply and demand.

Ask students to be careful of spillages as these will make the floor slippery.

It should be stressed to students that they must not drink the filtered water, even if it looks clean.

Differentiation

Basic

Students can be given a labelled diagram of a filter and each team could build a similar filter.

Extension

Use the alternative method of restricting the number of materials students can use by giving them a budget within which they must work within. Students have to purchase their materials and justify the cost of the apparatus.

Resources

Resources required for the class
> A selection of materials which may be useful in constructing a filter. For example, materials such as sand, cloth, cotton wool etc
> A large sample (10 litres should be plenty) of dirty water made up from fine clay, sand etc. This will need to be continually stirred so that it doesn't separate out before students take their samples

Resources required per team
> A two-litre plastic drinks bottle with the base cut off
> A retort stand, boss and clamp arm
> Two 250 ml plastic beakers for collecting samples

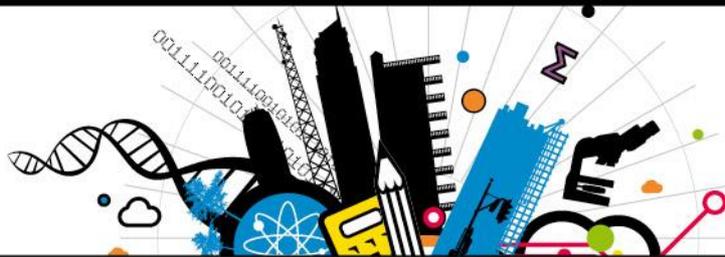### Required files

A budget sheet could be created for students for the extended version of this activity.

Additional websites
> You Tube: The video clip 'Would You?' (http://www.youtube.com/watch?v=77Mv8pauMKc) illustrates clearly the importance of having clean water.

Related activities (to build a full lesson)

Starters (Options)
> FILM: Safe Drinking Water
> ACTIVITY: Engineers Can Save Lives
> ACTIVITY: Killer Water
> ACTIVITY: Spreading Disease

Main (Options)
> ACTIVITY: Filtering the Truth
> ACTIVITY: **Filtering Water**

Extension (Options)
> ACTIVITY: Tap Supply
> ACTIVITY: Water Treatment Systems

Plenary
> GAME: Outbreak
> QUIZ: World Water
> Opportunities within activity for presentations, peer/self assessment
> Reflection on Objectives and PLTS skills used

The Engineering Context

> **The story** Safe Drinking Water

Curriculum links

England: National Curriculum	Northern Ireland Curriculum
Science > KS3 2a, 2b, 2c, 2d, 2e, 2f, 17d > KS4 1.1a,b, 1.2a,c, 1.3c, 2.1e Design & Technology > KS3 3d Mathematics > KS3 (extension activity) 1a, 1b, 2f, 3a, 3b, 4a, 4l, 4o, 6a	Science Developing pupils' knowledge, understanding and skills > develop skills in scientific methods of enquiry to further scientific knowledge and understanding: > planning for investigations, obtaining evidence, presenting and interpreting results; > develop creative and critical thinking in their approach to solving scientific problems; > develop a range of practical skills, including the safe use of science equipment; > Organisms and health: Healthy body and mind > Chemical and materials behaviour: Structures, properties, uses of materials (Objective 1) Developing pupils as Individuals > explore physical, chemical and biological effects on personal health. Technology & Design Developing pupils' knowledge, understanding and skills > manufacturing – selecting and using materials fit for purpose; safe use of a range of tools and processes appropriate to materials, demonstrating accuracy and quality of outcome (Objective 1) Developing pupils as Individuals > respond to a personal design challenge in relation to their own lifestyle. > abide by health and safety rules when using tools, machines and equipment (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

Tomorrow's Engineers
Explore engineering careers at
www.tomorrowsengineers.org.uk

www.**ietfaraday**.org

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> Identify product needs and pursue sustainable harmonious design solutions in a local outdoor/indoor context.

Learning Outcomes
> demonstrate practical skills in the safe use of a range of tools, machines and equipment;
> 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.

Mathematics and Numeracy
Developing pupils' knowledge, understanding and skills
> knowledge and understanding of personal finance issues; and skills to enable competent and responsible financial decision making; the application of mathematical skills to real life and work situation

(Objective 3) Developing pupils as Contributors to the Economy and the Environment
> explore how the skills developed through mathematics will be useful to a range of careers
> apply mathematical skills in everyday financial planning and decision making
> understand the need to manage renewable and non-renewable resources

Learning Outcomes
> demonstrate mental mathematical capability with simple problems
> demonstrate financial capability in a range of relevant everyday contexts

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Scotland: Curriculum for Excellence	**Wales: National Curriculum**
Sciences > SCN 3-12b, SCN 3-16a, SCN 2-18a > SCN 4-20a Technologies > TCH 3-01a, TCH 3-13a, TCH 3-13b, TCH 3-14a Numeracy and Mathematics > MNU 2-09a, MNU 3-09b, MNU 2-11b	Science > KS3 Skills (Communication 1, 2, 3; Enquiry 1, 6; Developing 1, 2, 3, 5; Reflecting 1-4) > KS3 Range (Interdependence of organisms 7; Sustainable Earth 2) > KS4 Skills (Communication skills 3; Enquiry and practical skills 1-4; Data, evidence, theories and explanations 1) Design & Technology > KS3 Skills (Making 1, 2) Mathematics KS3 and KS4 Skills: Solve mathematical problems > select, organise and use the mathematics, resources, measuring instruments, units of measure, sequences of operation and methods of computation needed to solve problems > use a range of mental, written and calculator computational strategies KS3 ad KS4 Range: Measures and money > read and interpret scales on measuring instruments and understand the degree of accuracy that is possible, or appropriate, for a given purpose KS3 ad KS4 Range: Understand the use of money > calculate with money and solve problems related to budgeting, saving and spending, and currency exchange

Assessment opportunities

> The design sheet, which the teams prepare to outline their filters could be used as an APP task.

Personal, learning & thinking skills (PLTS)

> Creative Thinker
> Team Worker