 Water filtration challenge

Stage 4 Chemical World

Outcomes

Values and attitudes

SC4-1VA appreciates the importance of science in their lives and the role of scientific inquiry in increasing understanding of the world around them

SC4-2VA shows a willingness to engage in finding solutions to science-related personal, social and global issues, including shaping sustainable futures

Working scientifically

SC4-5WS collaboratively and individually produces a plan to investigate questions and problems

* WS5.3Students choose equipment or resources for an investigation by:

a. identifying suitable equipment or resources to perform the task, including safety equipment and digital technologies

SC4-8WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems

* WS8 Students solve problems by:

e. evaluating the appropriateness of different strategies for solving an identified problem

CW3 Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques. (ACSSU113)

c. relate a range of techniques used to separate the components of some common mixtures to the physical principles involved in each process, including filtration, decantation, evaporation, crystallisation, chromatography and distillation

d. investigate the application of a physical separation technique used in everyday situations or industrial processes, eg water filtering, sorting waste materials, extracting pigments or oils from plants, separating blood products or cleaning up oil spills

Knowledge and understanding

SC4-17CW explains how scientific understanding of, and discoveries about, the properties of elements, compounds and mixtures relate to their uses in everyday life

Learning across the curriculum

Cross-curriculum priorities

☐Aboriginal and Torres Strait Islander histories and cultures

☐Asia and Australia's engagement with Asia

☐Sustainability

General capabilities

☒Critical and creative thinking

☐Ethical understanding

☐Information and communication technology capability

☐Intercultural understanding

☐Literacy

☐Numeracy

☐Personal and social capability

Other areas of learning

☐Civics and citizenship

☐Difference and diversity

☐Work and enterprise

Teacher notes

This is a challenge based task which is intended to be assessed formatively in class. The task allows students to use their creativity and critical thinking to create a working water filter. Teachers may amend the difficulty of the task by adding or removing equipment for students to use. The task may be set as a take home assessment which would allow students to build a water filter using equipment of their choosing.

The degree of challenge is based around the limitations of the equipment that may be used. Students could be asked to compare the filter they construct with filters used in the real world. They could also research how different countries treat their drinking water. There is scope for links with how Indigenous Australians collect and maintain their drinking water supplies. A challenge could be set by the teacher supplying different samples of unclean water that needs to be treated for drinking.

There is an opportunity to incorporate mathematics outcomes and financial literacy by assigning monetary values to each piece of equipment and giving students a budget to work with. Student may be given the scenario that they are to submit their design to a company director (teacher) with full costing and an evaluation of its efficacy as a functioning filter. The winning filter will be the one judged by the class as being not only the most efficient but the most cost effective. There may be an opportunity to debate how financial costs sometimes outweigh potential benefits. There is potential to discuss different locations around the world and the available means to provide extensive water treatment. Students could be asked to write a persuasive letter to encourage donation to a charity that would provide water filters to a nominated region of the world.

Introduction

Many developing countries around the world have poor water filtration techniques. As a result, many communities do not have access to clean drinking water. Many illnesses and deaths are linked to poor water in developing communities, such as countries in Africa.

These communities usually have limited access to resources, which also means it is hard to build or construct devices to help with cleaning water. All communities need to have access to safe and clean water as it is essential for people to lead a healthy life.

Task

You have been employed as a chemist to develop a water filter to purify dirty water. As a scientist it is important that you work in a team. Your team of people will be collaborating to build the best possible filter.

Your filter must have at least three layers. It will need to filter 1 cup of water (250 mL) which has been mixed with a tablespoon of dirt in less than a minute.

Your team will have the chance to do one trial and will be able to modify the filter before the final go. To assist this process, you will also need to draw a diagram of your designs (a minimum of two is expected), including things that worked and didn’t work.

You will be given the following items to construct your water filter:

* 1 L soda bottle
* 2 L soda bottle
* Gravel
* Sand
* Scissors
* Screen mesh
* Cotton fabric
* Coffee filters
* Hammer
* Measuring cups
* Small bucket
* Clear plastic cups
* Take-out containers
* Cotton balls
* Safety glasses

Group feedback

| Aspect of groupwork | Comment |
| --- | --- |
| Delegation  How fairly did the group divide up the amount of work each student had?  What percentage of the work do you think you think each person did on constructing or offering ideas to your water filter? |  |
| Collaboration  How well did you work together to contribute to the project? |  |
| Problem solving  Did one person come up with all the ideas or was it a group effort? |  |
| Positive feedback  What did the group do well? |  |
| Areas of improvement  What could this group have worked on to improve their overall design |  |

Marking guideline/rubric

| Criteria | 3 | 2 | 1 | 0 |
| --- | --- | --- | --- | --- |
| Number of layers | Uses at least 3 layers to filter the water. | Uses 2 layers to filter the water. | Uses 1 layer to filter the water. | Does not use a medium to filter the water. |
| Effectiveness of design | Selects appropriate materials.  None of the chosen materials pass through the filter into the filtrate. | Selects mostly appropriate materials.  None of the chosen materials pass through the filter into the filtrate. | Selects some appropriate materials.  None or some of the chosen materials pass through the filter into the filtrate. | Selects inappropriate materials.  Some or all the chosen materials pass through the filter into the filtrate. |
| Designs | Drawn two diagrams of their water filter designs using a pencil and a ruler (OR electronic diagram). | Drawn two diagrams of their water filter designs, without using a pencil or ruler. | Drawn one or two insufficient diagrams of their water filter designs. | Diagrams are incomplete or not drawn. |
| Group feedback | Outlined things that worked and have not worked. | Identified some things that worked and have not worked. | Identified one thing that worked or have not worked. | No indication of things that have or have not worked. |
| Water filter challenge – time | Filters the water in under 1 minute. | Filters the water between 1 minute and 1.5 minutes. | Filters the water between 1.5 minutes and 2 minutes. | Filters the water over 2 minutes or more. |
| Water filter challenge – water clarity | Water quality after filtering is clear. | Water quality after filtering clear but contains some particulates. | Water quality after filtering is unclear and contains particulates. | Water quality after filtering is muddy, contains many particulates. |