STEM-ACCELERATORS

CHEMISTRY

LESSON PLAN

Ages 11 - 14

IS IT SAFE TO DRINK?

SKILLS COVERED:

» HUMAN NEEDS » WATER FILTRATION
» CRITICAL THINKING » TEAMWORK » PERSEVERANCE

CLEAN DRINKING WATER IS A BASIC HUMAN RIGHT THAT YOUR PUPILS MAY TAKE FOR GRANTED. IN THIS GRIPPING AND HANDS-ON LESSON, THEY WILL LEARN THE IMPORTANCE OF SAFE DRINKING WATER AND HOW TO PROVIDE IT IN A CRISIS SITUATION

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#ArmySTEM

1 lesson combining **Chemistry with the STEM Accelerator attributes**

Duration: **1 x 60 minute lesson**

OVERVIEW

Chemistry is the science of discovery and invention. By studying chemistry, we can fight disease, solve crimes, protect the environment and change the world in all sorts of interesting ways. It is a core subject which provides a solid foundation in the sciences where real differences can be made.

In this standalone lesson, the class will learn that a hurricane has swept through an area and destroyed its water purification plant. The school is gone, but the pupils have survived. The first thing they need to do is help establish a source of clean drinking water and they will do this by building their own filtration systems.

When disaster strikes and basic amenities cease to function, the Army are usually called upon to provide immediate relief – but supplies are often limited. With the clock ticking and the community suffering, your class will have to quickly learn about making water safe to drink using readily available materials.

By the end of the lesson, your class will have a greater understanding of the basic needs of human beings, what happens when clean drinking water is no longer guaranteed and how to identify both the obvious and hidden dangers present in dirty water. They will also gather a basic understanding of how to make water safe to drink again, drawing on the real-life contributions of the Army to disaster zones to accomplish this task.

In completing this lesson, your pupils will have a greater understanding of how the field of chemistry can be used to save lives and keep people alive. This could ignite a deep fascination with the subject and encourage further study.

PUPIL OBJECTIVES

- I can **describe** and give examples of the basic needs a person has in order to survive and how a disaster can affect these needs being met
- I can **plan** and **carry out** a simple process of using every day materials to purify a dirty sample of water
- I can **identify** and **explain** why the filtration process still may not produce safe drinking water and how further processing may be necessary
- I can **improve** my filtration process and **suggest** ideas of ways to make the water even safer

ATTRIBUTES DEVELOPED

Critical thinking

Pupils will become more confident in their ability to process and analyse information and data in order to make more informed decisions.

Teamwork

Pupils will develop their ability to work in a team thus improving their communication and collaborative work skills in order to achieve a common goal.

Perseverance

Pupils will become more resilient to knock backs as they develop the grit, determination and patience to succeed when previously they may have given up.

LESSON

INTRODUCTION – 15 MINS

This is where the importance of clean drinking water is brought to light - and how easily a source can be cut off.

First ask:

- What are the basic needs of human beings?

You will likely get several frivolous answers (television, the internet etc.) but the ones to focus on will be the most basic, and most critical: **food, water** and **shelter.**

- How long can a person live without water?
- What happens when people don't have water?
- What types of water do people have to drink in disasters?

Discuss with your class the importance of water in our daily lives. Have your pupils brainstorm how many times today they have used water and write their answers on the board.

Examples: drinking, flushing the toilet, taking a bath or shower, brushing teeth, watering the garden, washing dishes, filling a pet's water dish or fish tank, cleaning, doing laundry, swimming, fishing, etc.

Back in our disaster zone, the pupils learn they have 30 minutes to find enough water to survive…

MAIN ACTIVITY – 35 MINS

In this activity, your pupils will assume the roles of the medics and engineers who are arriving first on the scene of a natural disaster. Please see teaching notes for an explanation of how to set up the practical elements.

1. Ask the class:
- How would you make dirty water clean?
- What do you think you would need to do it?

We will introduce the science of filtration and give a brief overview of how emergency filtration works. This part of the lesson focuses on 'physical filtration' – but pupils are exposed to 'chemical filtration' too.

2. Split the class into small groups.
3. Ask each group to make a list of what they have lying around the house, school and neighbourhood to make into water filtration systems.
4. Draw attention to the boxes at the front of the class, which will contain all of the materials the class will need to make a water filtration system, plus a few 'red herrings'.
5. Instruct the class to use the materials available to make the dirty water clear – give minimal instruction on how the material should be used and only assist and prompt if necessary*.
6. Adapt according to pupil ability: encourage multiple attempts until each group has produced a 'clean sample'.
7. Encourage the class to combine two or more materials together to make a 'combination filter' and to boil their samples with a Bunsen burner.
8. Instruct groups to hold each sample up to the light to test its cloudiness.

* Diagram on page 7

PLENARY – 10 MINUTES

Once each group has made the cleanest sample they can out of their combined filter, ask:

- Is it safe to drink?
- If the answer is 'yes', ask the class who would like to volunteer to drink theirs (but don't allow them to drink it)
- If the answer is 'no', ask if they know why, before briefly explaining about micro-organisms, the 'hidden dangers' of water and how they can live in clean-looking water and how they may still cause harm if you drink it

Next, demonstrate the use of water purification tablets and how the Army will use these in disaster zones alongside filtration systems to make water safe to drink for local communities while the water treatment infrastructure is being repaired.

Now ask:

- Is it safe to drink?

The answer should now be **'yes'.**

ASSESSMENT OPPORTUNITIES

- Pupils can identify what the basic needs of human beings are and how a disaster can impact on these needs and give examples
- Pupils can build a functioning water filtration system out of readily available materials
- Pupils can identify that micro-organisms can make safe-looking water unsafe to drink

ADVANCED EXTENDER:

At one of the 'is it safe to drink?' stages, use universal indicators to test the pH balance of their 'clean' samples. Then test their knowledge of pH balances by asking:

- **What is the ideal pH balance for drinking water?**

This can be made into a follow up lesson, where pupils learn how to make their own acid and alkaline indicators out of red cabbage, beetroot, blueberries and other easily sourced vegetables and fruits.

ADVANCED DIFFERENTIATOR

Encourage them to identify different ways of making water 'safe to drink' when water tablets aren't available. This will be an opportunity to introduce concepts of:

- **Distillation**
- **Condensation**
- **Collecting rain water**

TEACHING NOTES

CONCEPTS & APPROACHES

- Pupils are learning about basic human needs
- Pupils are learning about the importance of clean drinking water
- Pupils are learning about the basics of water filtration and purification
- Pupils are using critical thinking to assess human needs and how they can be met and the basics of water filtration and also to identify safe-looking water isn't necessarily safe
- Pupils are using perseverance to use the supplied equipment to build a filtration system with minimal instruction and to test different materials and obtain the cleanest possible sample of water
- Pupils are using teamwork to combine different materials in an orderly and timely fashion

CURRICULUM LINKS

- Scientific attitudes: paying attention to objectivity and concern for accuracy, precision, repeatability and reproducibility
- Simple techniques for separating mixtures: filtration, evaporation, distillation
- Pure and impure substances: the concept of a pure substance, bacteria and micro-organisms
- Chemical vs physical filtration

BEFORE YOU START

This is a very practical, hands-on lesson built around teamwork and perseverance. Make sure you collect the materials and 'equipment' for pupils to build their filtration systems before the lesson and assemble them in small boxes at the front of the class. In the experiment:

- Pop bottles will act as the funnels (when the top half is used)
- Bunsen burner holders will secure the funnels in place with the beakers underneath

For the materials, it is recommended you raid lost property for bits of uniform they can use and ask local hotels for clean ripped bed linen. You can also provide beakers full of rocks and gravel, newspaper, wood chippings etc.

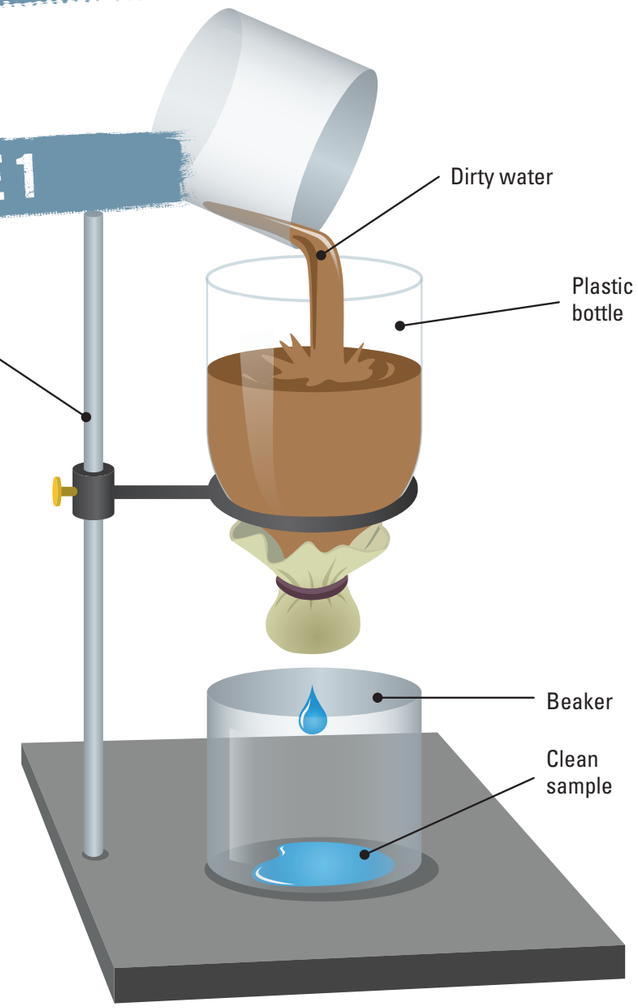
Several 2 litre pop bottles will also be required, you can ask staff members to bring in their discarded ones by leaving a labelled box in the staffroom, or raiding the recycling bin. Failing that, cheap bottled water can be purchased to be made 'dirty'.

RESOURCES

- Download lesson introduction film
- Screen
- Projector
- Several 2 litre pop bottles (enough for one per group, plus spares)
- 10 litres of pre-made dirty water
- Scissors
- Bunsen burner holders
- Glass beakers
- Small cardboard boxes
- Several cuttings of material samples
  (Remember, some of the materials won't work very well at all – your pupils must persevere and experiment with different samples):
  - Newspaper
  - Sand
  - Gravel
  - Rocks
  - Cotton
  - Linen
  - Silk
  - Nylon
  - Acrylic
  - Lycra etc.

HOW FILTRATION WORKS

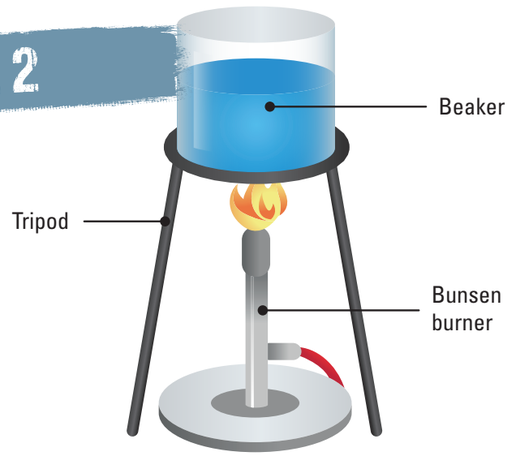
STAGE 1



1. **One upside down pop bottle, cut in half (the funnel)**
2. **Clamp the bottle in position**
3. **Below the funnel, place a beaker for the 'clean sample'**
4. **Have pupils choose their own 'filter materials'**
5. **Have pupils test and record the best, until they find the optimum filtering approach**
6. **Pupils are then debriefed on the best process and share their top ideas**

ADDITIONAL PURIFICATION STEP

STAGE 2



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