

DITCH THE DIRT

Teacher's Notes

Ditch the Dirt is an exciting STEM challenge for pupils aged 8-14 years to investigate ways of cleaning dirty water through sieving and filtering to remove solid 'dirt'. It can also be extended to investigate ways to make water safe to drink.

The challenge can be used to deliver parts of the formal science, design and technology and maths curriculum in the UK and/or for an enrichment day, STEM/science club activity or transition. Pupils can also gain a CREST Award through taking part in the challenge.

The teacher's guide is accompanied by a PowerPoint (PPT) presentation, pupil activity sheets, a poster and certificates. They can all be downloaded from practicalaction.org/ditch-the-dirt

Content

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Planning outline

The timings offer an approximate guide to the activities. All activities are flexible and can be reduced or extended as required.

Activity	Teaching material	Timing (mins)
Introducing the context Pupils' own water use and how everyone in the world is not on tap	PowerPoint slides (2-3)	5
Starter activity - A daily task Collecting water from ground water holes	PowerPoint slides (4-7) Pupil worksheets <i>Photographs from Turkana</i>	15 - 20
A Global problem Introducing the Global Goals	PowerPoint slide (8)	5
The role of scientists Looking at the role of scientists in analysing water quality and water quality investigation	PowerPoint slide (9) Pupil worksheets <i>Investigating water quality</i> <i>Water grading strips</i>	20
Ditch the Dirt challenge A step by step guide to the challenge	PowerPoint slides (10-14) Pupil worksheets <i>Ditch the Dirt</i> Optional activity worksheets <i>Investigating sieving</i> <i>How much did our water filter cost?</i> Evaluation	60 (excluding optional activities) 20 30
Safe to drink? An activity and research opportunity on making water safe to drink	PowerPoint slides (15-16) Ditch the Dirt poster Pupil worksheets <i>Safe to drink?</i> <i>Research: Safe to Drink?</i>	20-60
Alternate solutions to clean water access Solar water pumping, solar distillation, etc.	PowerPoint slides (17-20)	5

Curriculum links

The curricula in the UK offer many opportunities for teachers to enhance pupils' learning by embedding real life global contexts within science teaching and learning.

To see where Ditch the Dirt supports the delivery of the formal science curricula for England, Northern Ireland, Scotland and Wales please go to practicalaction.org/science-curriculum

Introducing the context

Before launching into the main Ditch the Dirt challenge, you might choose to get pupils thinking about their own use of water before reflecting on what it might be like if they didn't have clean water piped to their homes.

To help pupils estimate the water they use have a 2 litre and/or larger 10/20 litre container to hand. PowerPoint slides 2-3 will guide you through some questions.

Starter activity – A daily task

An activity that helps introduce pupils to the task of collecting and carrying water, as undertaken by millions of people worldwide on a daily basis.

Equipment needed

- Six bowls or containers of varying sizes – washing up, mixing bowl, science tray, etc.
- Water and 'dirt' (coffee granules, soil, sand, leaves, stones)
- Water collecting equipment - plastic cups, small water bottles, spoons, etc.
- Measuring jug (one per group)

Other resources

Photographs from Turkana (one set per group)

Preparation

Create the six 'ground water holes' by pouring varying amounts of water in the bowls and trays. We suggest at least one has the tiniest amount of water in. Then add different amounts of dirt to the bowls and trays to simulate mixed levels of dirty water at the different water holes.

Place the bowls in different parts of the classroom and/or outdoor space. If possible place some of the 'ground water holes' further afield than others.

NB. You might like to put photographs of the water holes close to the bowls.

Divide the water collecting equipment unto different tables or leave in one place for the pupils to select.

Activity

Organise the class into groups of 4/6 pupils. Introduce their task of water collection for their household with PPT slides 3-4. Give the pupils a minute to select their water collecting equipment.

Now, give pupils up to 5 minutes to see how much water they can collect for their household from the ground water holes. If you wanted to introduce a competitive element to see how much water each group collect, ask them to measure their water and feedback their results.

Summarise this activity with some reflective questions shown on PPT slide 5.

Now show pupils the set of photographs from Turkana or PPT slide 6. Ask them to identify any difficulties the people in Turkana might experience when collecting and using the dirty water for everyday tasks, such as washing, cooking and drinking.

Show PPT slide 7 that summarises some of the main problems for people collecting and using dirty water in Turkana.

A Global problem

Now that the pupils have been introduced to the issue that access to water is a big global problem, it is useful for them to be aware that lots of people and organisations are working to find solutions.

PowerPoint slide 8 introduces the United Nations and their work to develop 17 Sustainable Development Goals (SDGs), also called the Global Goals.



Global Goal 6 on Clean Water and Sanitation is the most relevant goal to Ditch the Dirt. It has a target that everyone in the world has access to safe drinking water by 2030.

If you choose to cover the SDGs more thoroughly or have pupils who you want to stretch, then the impact of water access is clearly explored through the Global Goal 1, No Poverty and Global Goal 5, Gender Equality.

For more information, activities and classroom display materials on the Global Goals go to practicalaction.org/global-goals.

The role of scientists

Water scientists and engineers play a major role in helping us to achieve access to clean and safe water. Use PowerPoint slide 9 to give an example of how scientists test the quality of water, in particular to analyse contaminants found in water.

The contaminants are grouped in three main ways: **biological** e.g. bacteria and viruses; **chemical** e.g. cleaning liquids and shampoos; **physical** e.g. dirt, broken glass.

It might be possible to invite a water scientist or engineer into your school. The STEM Ambassadors programme provides links with STEM professionals based in industry and schools. To find out what is available in your area go to stem.org.uk/stem-ambassador-hub-contacts

An optional science investigation, Water Quality is recommended to run with pupils before introducing the hands-on water filters modelling activity. It helps pupils to analyse the physical quality of water before filtering.

Water quality investigation

An investigation to help pupils' analyse the physical quality of water.

Equipment needed

- Containers with 'dirty' water (ideally 4 water samples with different levels of contamination)
- Plastic cups (4 per group)
- Glass water beaker (1 per group)

Pupil worksheets

Water quality (one per pupil) and *Water grading strip* (one per group)

Preparation

Prepare four samples of water with different levels of dirt/soil/leaves. Pour that water into four plastic cups and place them on each table for pupils working in small groups.

Activity

Introduce the investigation with PowerPoint slide 9 stressing that pupils will be investigating the physical quality of water.

Split the class into small groups and hand out the *Water quality* and *Water grading strip* worksheets.

Demonstrate how they need to analyse one sample at a time and record their results. Firstly they need to comment on the odour/smell of the water. Then they need to pour the water into a glass beaker and, using the *Water grading strip*, decide which opacity grade (from clear to opaque) matches the appearance of the water samples.

An optional activity to quantify the opacity of the water would be for pupils to use a computer programme or a data logger.

NB. For older students or more able students you might choose to add in an extension to this investigation that includes a chemical analysis of PH or bacterial analysis.

Ditch the Dirt challenge

Introduce pupils to the main context of the challenge set in Turkana, Northern Kenya.

Ask pupils to recall from the photographs what might be some of the problems for people using 'dirty' water for tasks such as washing and drinking. Then introduce a summary of the problem and their challenge to make a water filter with PowerPoint slide 10.

There is an optional activity on *Investigating Sieving* that you might choose to include before the pupils make their water filters. For guidance see below.

Sieving investigation (optional)

An investigation that helps pupils understand that sieving is a method of separating solids from liquids.

Equipment (per small group)

- A container with 'dirty' water that includes coffee, mud, sand/soil, leaves and small twigs
- Sieves with different mesh sizes
- Measuring jug
- One clear plastic cup or glass beaker

Pupil worksheets

Investigating sieving (one per pupil)

Activity

Introduce pupils to the sieving activity and ask them to record their results. Discuss their findings.

If you choose to get straight into the Ditch the Dirt challenge, you will need the following:

Equipment needed

- Dirty water (the same for the whole class), approximately 4 litres per group

Per group of 4 pupils

- A range of junk modelling equipment, to include 2X2 litre plastic bottle, large plastic tubs, card, plastic piping, Bunsen burner tubing etc.
- Bucket/container (for the dirty water)
- Measuring jug
- Materials for filtration layers (marbles, gravel, play sand, fine sand, cotton wool, cloth, tights, filter paper/paper handtowels)
- Elastic bands

Pupil worksheets

Ditch the Dirt challenge (one per pupil), Optional sheets *Investigating sieving*; *Research: Safe to drink*; *Evaluation* and *How much did our water filter cost*

Preparation

Prepare litres of 'dirty' contaminated water for all of the groups to use.

You may wish to give pupils a free rein to design the style of their own filter using litre bottles, plastic tubs, tubing etc. for younger and less able pupils show them how to design a simple filter, made by cutting approx. 15cm off the base of the 2 litre plastic bottles and placing the base under the neck of the bottle to catch the filtered water.



Making and testing water filters

Divide the class into small groups of 4-6 pupils. Introduce the challenge of making a water filtering system by showing PowerPoint slides 11-13.

You might choose to demonstrate how the pupils can make and test different materials in their water filters. Give each group approx. 4 litres of the dirty water.

Explain that they have a set time (20-30mins) to experiment using different materials to develop their filters before the final challenge. Ask them to record the results of their experiments before and after filtering on the *Ditch the Dirt challenge* sheets. You may like to ask the following prompt questions:

How can you change the rate / flow of filtration?

(e.g depth of layers, materials used to make the layers)

What kind of 'dirt' contaminants will your filter not remove?

(e.g soluble and dissolvable materials such as salts)

Can you think of other ways to remove solid dirt from water?

(e.g distillation methods such as evaporation and condensation)

Pupil worksheets

When pupils have finished their testing, ask them to develop their final model of the filter and record their design.

A maths activity *Costing our water filter* can be added in here as an extension or supplementary activity.

For the competitive part of the challenge, give the groups 5 minutes to filter a minimum of 100ml of water. Once the time is up, ask each group to measure out 100ml of their filtered water into a glass beaker. Then pupils should analyse the appearance and odour of the water and grade it on their *Ditch the Dirt challenge* sheet.

NB. If you are entering the pupils for a CREST Discovery Award and/or would like them to present their challenge results, give the pupils enough time to prepare a short presentation. Suggested areas for the pupils to cover are highlighted on PowerPoint slide 14.

Pupil *Evaluation* sheets are also available for pupils to record their comments when listening to the different groups' presentations.

If you choose to have a Ditch the Dirt challenge winning team, then either use the criteria and score from the pupil *Evaluation* sheet or award the team that filters the cleanest water.

Certificates are available to give to the winning team and to the pupils who took part in the challenge.

Safe to drink

Ask the pupils if they think that now the water has been filtered it is 'safe' enough to drink.

Use PowerPoint slide 15 and the pupil sheet *Safe to Drink?* that enables pupils to identify the contaminants that often remain in water after filtering. You might choose to remind them of the three main groups of water contaminants, biological, chemical and physical. You could ask the pupils for their ideas on how to remove biological, e.g. bacteria, viruses; chemical, e.g. cleaning materials; and smaller physical contaminants e.g. paint that have not been filtered out.

Research opportunity

If you decide to include a research opportunity within the challenge then task the pupils to carry out research to find out different ways to make dirty water safe to drink. They can record their findings on the *Research sheet*.

You might suggest that they include researching into water filters that not only remove the physical dirt from water but also make it safe to drink. This would make a good extension activity as they could make suggestions as how to adapt their own filter to make the water 'safe' to drink, and include this in their presentation back to the class.

The site www.epa.gov/ccl/types-drinking-water-contaminants is useful.

NB. **Crest Award** - If you have pupils who are entering into the CREST Discovery or Bronze – Gold awards, then they will need to complete a research task.

Bio-sand water filters in action

Summarise the challenge with PowerPoint slide 16 and the Ditch the Dirt poster that show how bio-sand water filters can remove biological and/or chemical contaminants from water making it safe enough to drink.

To find out more about bio-sand filters and other ways to remove contaminants from water go to answers.practicalaction.org/our-resources/collection/water-quality-and-treatment-1

Alternate solutions to clean and Safe water access

Finally, show pupils alternative solutions to filtering that provide access to safe drinking water for the community in Turkana. PowerPoint slides 17-20 shows how Practical Action has supported the villagers to install a solar water pump, that provides 30,000 litres of clean water to the school and surrounding area.

For further information about this project go to practicalaction.org/pumping-water-by-solar-power

Making the most of the challenge

CREST Awards

Taking part in the Ditch the Dirt challenge is a great way for pupils to gain a CREST Award. The challenge is particularly aligned to the CREST Super Star and Discovery Award, but can equally be used as a context for a Bronze, Silver or Gold Award.

CREST Super Star Award is designed for 7–11 year olds. Introducing the context, modelling and testing a water filter can be condensed into an hour and enables the pupils to gain one star to add to their Super Star passports.

CREST Discovery Award is generally undertaken by 10 –14 year olds so can be carried out by top end primary and secondary. It offers a great opportunity for project work and can be achieved in between three to five hours. The Ditch the Dirt challenge therefore makes for an ideal Discovery Award that can be run as part of the curriculum, in a STEM/science club, enrichment day or as a transition activity.

CREST Bronze and Silver Awards are designed for secondary aged pupils. To achieve these awards pupils need to complete project work of 10+ hours (Bronze), 30+ (Silver) or 70+ hours (Gold). The Ditch the Dirt challenge makes a good starting point for pupils to identify an independent project based around clean and safe water. Further ideas here practicalaction.org/global-project-ideas

For more information on CREST Awards and how to enter your pupils visit the CREST Awards site crestawards.org

Water and sanitation project ideas

For older or more able students the Ditch the Dirt challenge can be extended in a variety of ways. They include investigating other separation techniques and methods for identifying and removing bacterial contamination from water, including solar distillation.

Global project ideas based on Water and Sanitation are suitable for CREST Bronze-Gold Awards, A level extended projects and the Duke of Edinburgh awards practicalaction.org/global-project-ideas

Technical information from Practical Action's international water projects (including solar distillation) practicalaction.org/technical-briefs-schools-water-and-sanitation

Banana skins as water filters survivalcampingstore.com/banana-peel-water-filters