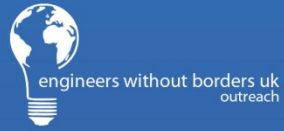


ARUP



WATER FOR THE WORLD

Water Supply & Sustainability Module

A Collaboration between
Engineers Without Borders UK
and Arup Cause

WATER FOR
THE WORLD



Below there is a list of relevant documents contained in this pack. Please check the end recipient and if needed distribute the material to the appropriate recipient at the right time. If the session is being run from a person external to the school please ensure that the teacher(s) responsible receive the appropriate information in time.

Document	Section	Description	For
Table of Contents (p.1)	-	Contents of the Water for the World Pack	Teacher
Session Summary and Requirements (p.3)	-	Introduction to WftW, the Engineering and Sustainability Module, and the materials required	Teacher
Main Session Instructions (p.5)	Preparation (p.4)	Preparation Prior to the Session	Teacher
	Instructions for the Presentation (p.5)	Instructions explaining the overhead presentation and timings for each section.	Teacher
Workshop Instructions (p.12)	Information for the Teachers (p.12)	Information for the teacher(s) on how to run the workshop	Teacher
	Bill of Quantities (p.16)	Sheet to keep track of expenditure to be distributed to each group	Students
	USA Country Sheets (p.17)	Activity sheet containing information regarding USA and instructions on how to build the water filter. To be given to the first group.	Students
	UK Country Sheets (p.19)	Activity sheet containing information regarding UK and instructions on how to build the water filter. To be given to the second group.	Students
	Qatar Country Sheets (p.21)	Activity sheet containing information regarding Qatar and instructions on how to build the water filter. To be given to the third group.	Students
	Sudan Country Sheets (p.23)	Activity sheet containing information regarding Sudan and instructions on how to build the water filter. To be given to the fourth group.	Students
	Zambia Country Sheets (p.25)	Activity sheet containing information regarding Zambia and instructions on how to build the water filter. To be given to the fifth group.	Students
Appendix (p.27)	Water Resources Activity	Supplementary water resources activity	Teacher

	What Can you Do	Supplementary Material for the "What can you Do Section"	Teacher
	Case Studies	Supplementary Material	Teacher

Session Title:

Water for the World: Water Supply and Sustainability

Description and Aims:

Water for the World (WftW) is an interactive classroom session for pupils between the ages of 11 to 18, that aims to stimulate thought on global water sustainability, thus adding an important element to the school curriculum. WftW aims to stimulate critical thinking and encourage pupils to think about global water sustainability via presentations, quizzes, games and through hands-on experience. It highlights to young people issues such as global water scarcity, the challenges people face when sourcing water and maintaining a water supply in developing countries and the role of the engineers in solving these problems.

A key part of each 90-minute WftW session is a hands-on workshop that demonstrates the challenges those in developing countries face to obtain safe drinking water, it highlights global water disparity and the need for water treatment. The students are divided into groups and given the task of building a working water filter; the ease of this task will depend on the country that the group is assigned and the access that they have to knowledge and monetary resources. The countries that students represent are from around the world and vary in their level of wealth and therefore access to resources. In order to build the water filter students must plan, purchase materials, and build a water filter using the materials they have bought and the instructions they are provided with.

The WftW programme is divided into three age-specific modules, ensuring it hits appropriate levels of technical understanding and learning style. Well designed facilitator packs include all the information needed to run WftW in UK classrooms. This document contains the instructions and presentation required to run the Water for the World "Water Supply and Sustainability" module.

Curriculum subjects suited to:

A-Level or equivalent curriculum Subjects: Geography, Science, Citizenship, Functional Skills, General Studies

Suited Age Group:

Age 11 to 14 years old. Curriculum years 5 -9

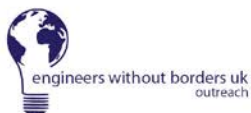
Session Time:

90 minutes (including 45 minutes for the workshop)

Number of Students:

The session is designed for 16 students. However if you want to engage a larger class, arrangements need to be made for workshop materials and relevant printouts. For the workshop the students should be divided into groups of up to 4 students.

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Materials required:

A comprehensive materials list for the workshop, and suggested quantities, are detailed in the table below.

2L Plastic Bottle (1 per group)	Cotton Wool (1 bag)
1L Plastic Bottle (1 per group)	Jar of mud - to mix with approximately 2 litres of water (1 bucket)
Washing up bowl of dirty water, made from mixing tap water with mud (250ml per group)	Gravel - Coarse (2 cups per group)
250ml Beakers/cup (2 per group)	Gravel - Fine (2 cups per group)
Rubber Band (10)	Sand - Coarse (2 cups per group)
Activated Charcoal (1/4 cup per group)	Sand - Fine (2 cups per group)
Sellotape (1 roll)	Iron filings (1 cup)
Latex Gloves (1 box)	Sugar (1 beaker)
Sodium chloride (1 bottle)	Sawdust (Quarter bucket - approx 2 litres)
Cheesecloth (2 x 10cm square per group)	Scrap A3 paper (12 sheets)
Toilet paper (2 rolls)	Plastic drinking cups (40)

Equipment Required:

The following equipment would be required to run the session: **Laptop connected to projector, chemistry clamps, whiteboard markers, access to sink and tap or bucket of water.**

Preparation

General Guidance

The aim is to let the pupils figure things out by themselves. Focus on critical thinking making the session as interactive as possible. Prepare resources needed for the session such as Pens, Quiz sheet, Paper for answers...

1. Ensure that materials and equipment are brought to the class prior to the session
2. The school technicians should be contacted in advance to confirm the materials are available.
3. Prepare the materials and test-run the main session before the presentation day.

Water Filter Workshop

1. Collect equipment and materials required for workshop including PowerPoint presentation on CD or USB stick.
2. Print activity sheets (Design Brief, Bill of Quantities).
3. Explain the steps in the activity and explain how the token system works – poor countries have less, rich have more and rich can donate to poor. Need to emphasize ‘charity’ is not an ideal solution (give a man a fish etc) but reflects real world.
4. Prepare 2 bottles/beakers (1 with muddy water, 1 with clear water). Use labels showing the different water qualities.
5. Organise 4 sets of materials for water filter activity.
6. Organisers need to keep track of how much each group has spent – groups can each have their own pot in the ‘bank’/‘shop’ children can put spent tokens in to avoid confusion/cheating!
7. May need to hint that the bottle can be used upside-down.
8. They need 30mins to make the filter.
9. Just before the end ask them to run clean water through the filter to get it working.
10. Clearing up time is necessary.

Feedback

Try to get as much feedback from students and teachers and include their comments in a feedback form.

Instructions for the Presentation

Introduction to the Class (1mins)

Introductions

Give the name of the presentation (WftW – Water Supply and Sustainability) and the name of the company/organisation that has put this together (Arup/EWB)

Outline objectives of the session:

- To understand where in the world water comes from
- To be able to give examples of different types of water sources
- To be able to explain the differences between countries and their access to water
- To understand issues surrounding water inequality and how to make a difference

Suggested ways to do this:

- Read out and explain the aim and objectives
- Ask students around the room to read out aim & objectives if on flip chart paper, PowerPoint or OHP

Ice Breaker Activity (5mins)

This is optional and depending on time and the type of class you are facilitating this may or may not be applicable. See icebreaker sheet in Appendix for icebreaker ideas.

Quick Quiz (9mins)

Aim

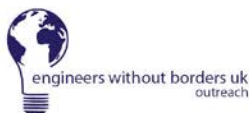
The aim is to introduce students to water and water supply. This is a brief quiz to get students interested in water issues and get them to think about water usage. Any questions that could start a debate or take a long time to explain should be remembered and addressed later on in the session.

Instructions

Depending on the age group this quiz can either be posed as true/false or you can remove the true false aspect of the question and just ask for instance 'how much of the Earth is covered in water' or provide a couple of possible answers from which students have to guess the right answer.

Do not feel obliged to ask all the questions and if you have additional questions to add into the quiz then do so.

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It is up to you how you present the quiz. It can be as simple as you standing in front of the class reading out the questions and the students writing the answers on pieces of paper or if you want you could adapt this quiz for PowerPoint or hand out the quiz on a sheet of paper. Equally if you have lots of space you could have a running quiz. Possible examples include having two signs (one true, one false) on each side of the room and asking students to guess; or have teams who confer on the answer and then run to a piece of paper and write down the answer.

Depending on age group you may want to make questions true/false, provide different possible answers or get students to guess answers.

Questions

It is useful to have a smallish water bottle (75ml, 1l etc) to provide students with a frame of reference for guessing water quantities.

1. Is it true or false that 40% of the Earth is covered in water?

False – 70% of Earth is covered in water

2. Is it true or false that 10% of water on Earth is drinkable?

False – 0.8% is drinkable, 97% salt water and 2% is stored in ice

3. How many people in the world are without access to drinking water?

a) 1.1 million b) 6.7 billion c) **1.1 billion** d) 2.6 billion

1.1 billion out of 6.7 billion.

4. Is it true or false that on average you use 150l of water a day?

True. *This figure may increase with decrease in household size. In Mozambique use 8l a day and in America 550l a day.*

5. Is it true or false that demand for water increases in the winter?

False – *demand is greatest between May and July (check) – due to garden watering, personal washing, tourists and irrigation.*

6. Is it true or false that it takes 6l of water to flush a toilet?

True *for cisterns installed in the last 5 years. Before than could be 9l or more.*

7. Is it true or false that the average bath uses 100l of water?

False – *thought be 80l or 30l for a shower (not power shower).*

8. Is it true or false that the average washing machine uses 50l each load?

True.

9. Is it true or false that on average you can only survive 1 day without water?

False. 3-5 days.

Source: World water council, http://www.data360.org/dsg.aspx?Data_Set_Group_Id=757,
Waterwise, <http://health.howstuffworks.com/live-without-food-and-water2.htm>

Short discussion on answers:

Can ask questions such as:

- Did you find anything interesting or surprising?
- Ask how many questions students got right – make them see they have lots to learn!

Water Resources Activity (10 mins)

Resources:

- Images for students can be found separately in the Power Point presentation
- Within the Power Point there are the answers for this activity

Identification of images

The aim of this activity is for students to discuss what sources of water they identify as drinkable and non-drinkable sources of water.

Suggested method for activity:

- Split the class into groups and give each group a pack of photos (13 images included in the Power Point presentation).
- Ask each group to look at the images and say whether they think the sources of water represent drinkable or non-drinkable sources of water.
- Have discussion with class asking each group to identify which images they thought were drinkable/non-drinkable sources of water. Possible questions to start discussion include:
 1. Which image do you think shows/represents drinkable source of water? Why?
 2. Which image do you think is of non-drinkable water? Why?

3. Pick an image not identified by students that is of a drinkable water source and ask them if they think the water is drinkable. Ask why/why not depending on response.
4. Discussion around manmade/natural water sources and impact has on their view of drinkable water sources
5. Overground/underground water sources – does this influence views on drinkable/non-drinkable sources of water.

Water filter Workshop (45mins)

Practical activity to make a working water filter. See the **Workshop Instructions** document.

Where in the world is there water? (10mins)

Resource:

Case study sheets

Following on from the water filter activity it should be clear that there is disparity in access to clean water. The aim of this activity is for students to be able to make a direct comparison between their lives and lives of other young people around the world. To aid this there are two case study sheets. One is from the Water Aid website (if appropriate please feel free to discuss the work that Water Aid does) and shows the experience of a girl in Africa, the other is sheet where the students can write about their experiences and directly compare them. There are full instructions on the Arup case study sheet of what the students need to do. Each student should have a go at filling out the Arup case study sheet. The case studies can be found in the Appendix.

Need for Water Treatment (5 mins)

The Water Filter Workshop showed the students that water is dirty and that it needs to be treated. The aim of this activity is to look more closely at what pollutes and different methods that can be used to clean the water to a sufficient standard. The aim of this activity is to alert the students to the wide range of things that pollute water, and the methods needed to clean the water to a sufficient standard.

Cocoa Water Game

Start by asking anyone if they would like a drink. Show them a bottle of water with cocoa powder in it and a bottle with just water in it. Ask students which bottle they would like to drink from? Depending on their reaction will depend where the discussion goes but essentially you want to get the message across that not all pollutants are visible e.g. cholera is not visible but is a waterborne disease, and that not everywhere water is decontaminated and therefore the risk of disease or illness increases. Questions which could help include:

- Would you drink soapy water?
- Or water your animals drink?

Ask what pollutants you can find in water?

This introduction is to lead on a discussion about what you need clean water for and what type of pollutants to may find in water:

- You need clean water to drink and wash and cook etc.
- What makes water unsafe to drink? What are the indicators that tell you water is unsafe to drink?
- Dirt – Dust? Gravel?
- Germs / Microorganism (Bacteria ,Viruses such, as common bacteria spread through water Vibrio cholera also known as cholera, Escherichia coli - E-Coli)
- Colour
- Taste
- Appearance
- Odour
- Industrial pollutants - Inorganic chemicals – such as salt, metals, pesticides, herbicides - Organic chemicals – petrol or those that come from industrial process
- Animal faeces

In the UK the water supply water quality regulations 1989 define the standard our drinking water needs to be at. We are lucky that we have a regulated source of water.

How do you get clean water?

1. Why do you need clean water?

To prevent people becoming sick

- many viruses are carried in water
- Toxic poisoning from chemicals and heavy metals can make people very ill.
- To prevent people then becoming sick water should be treated.
- At any given time almost half the population of the developing world is suffering from one or more of the main diseases associated with inadequate provision of water and sanitation
- (For different age groups going more in depth. Age 11 – germs. Age 14 – virus/bacteria, can they think of any sorts of bacteria or virus? e.g. streptococci (if these appear in water))

Figure 3 in the Appendix - for more detail of various water borne diseases

End activity will be looking at how you can get clean water:

- Take water from a clean source
- Open your tap (but this doesn't always work)
- Clean it yourself

2. How can water be treated?

- Ultraviolet light disinfection – leave the water in a clear bottle in the sun
- Filtration – to remove the solid particles form the water
- Ultra filtration – this requires a membrane with very small pore spaces, the process is more complicated
- Slow sand filtration – this happens on a much larger scale and involves a biological removal of pollutants from a layer called a zoogeal layer growing on the surface of the sand filter

What can you do? (5 mins)

Resource:

This activity has two objectives (see handout, Appendix page :

- Get students to think about what they can do to reduce their personal water consumption
- Get students to think about how they can support work of NGOs overseas/reduce water consumption
- In UK e.g. fundraising and awareness campaigns.

Information for the Teachers

Background information

This workshop forms the practical part of the Water for the World "Water Supply and Sustainability" Module.

The aim of the activity is for the students to build a working water filter however, the ease of this task will depend on the country that the group is assigned to and the access that they have to knowledge and monetary resources. The countries that students represent are from around the world and vary in their level of wealth, literacy, technical knowledge and access to resources. The varied instructions, their clarity and amount of available funds to each group, represent the disparity between the countries. Following the workshop each group should present to the rest of the class (with the teacher's help) the process they went through and the challenges they had. After each group presents, the facilitator should lead a discussion on the differences of experience and explain how these challenges are also met by people in developing countries, where lack of funds and knowledge prevents them from accessing basic services such as drinking water and adequate sanitation.

In order to build the water filter students must plan, purchase materials, and build a water filter using the materials they buy and the instructions they are provided with. Each group will carry out these tasks following the instructions provided in the respective "Country Sheets". The groups have different amounts of money and information available to them. The teachers/facilitators should familiarize themselves with the different requirements of the groups in order to distribute the monopoly money and answer any questions. The teacher/facilitator will manage the distribution of the material and set up a "shop front". It is important to establish a Rota of queuing for the children to buy materials at the "shop front".

The workshop is intended to take 45 minutes (including set-up and clear-up). Follow up discussions can be tailored to time constraints.

This document includes:

- The task and suggested timings
- Preparation for the task
- Discussion topics

Workshop Execution

1. Split the class into groups of 4 and assign each group a country
2. Supply students with Workshop Sheets (Print and distribute Country Sheets and Bill of Quantities to students)
3. Allow them time to read through (no longer than 5 minutes)
4. Clarify any queries
5. Groups cannot buy supplies all at once, allocate an order to the groups, groups must nominate only one person who can buy materials.
6. Once all have materials allow them time to build and run water through their filter (no longer than 20 minutes)
7. Have muddy water pre mixed, then get each group to come and test filter.
8. Students will present the process and the challenges they had. (no longer than 10 minutes)
9. Explain the relevance of these challenges to the real world
10. Discuss.

Further Discussion

Money/Disadvantage

After the filters have been tested tell the groups (though they should have realized) that they were all given different amounts of money and information depending on what country they represented. This is to:

- Highlight the fact that poorer countries may struggle to provide the money and materials to provide clean water to the population
- With a lower literacy rate it is harder to transmit the information to the populace

Discuss how they felt

- Whether the rich countries feel superior / sorry for the less fortunate / ignorant?
- The less advantaged countries felt unfairly treated/pride in their achievement/jealous of other groups?

How Filter Works

Ask students how filter works:

- Sand + gravel filters keep out solid material, like a number of sieves
- Activated Charcoal acts as a filter, highly porous, and also removes chemicals such as chlorines, dyes and pesticides by adsorbing them to surface. (highly porous therefore large surface area)

What does the filter not remove, and why? How could this be tackled?

- Very small objects e.g. virus and bacteria
- Other forms of filters available that could be used involving ceramics made from clay and local materials such as rice husks or bran, which when fired decompose producing CO₂ –creating tiny porous that traps most things. Adding biocides such as silver improves them
- Boiling water kills most pathogens.

What needs to happen to the materials before being used in a filter?

- Materials themselves would need to be clean

Materials and Equipment

Materials

A comprehensive materials list for the workshop, and suggested quantities, are detailed in the table below. The quantities have been assumed for a class of 20 students (5 groups). For larger numbers of students and groups the materials should be scaled appropriately.

Description	Quantity	Available?
2 litre bottle	5	
1 litre bottle	5	
Jar of mud (to mix with approximately 2 litres of water)	1	
250ml beaker/cup	10	
Rubber band	10	
Sellotape	1 roll	
Iron filings	1 cup	
Activated charcoal (granules) - not essential	2 x 250ml beaker full	
Cheesecloth or equivalent	5 x 10cm squares	
Sugar	1 small bag/beaker full	
Cotton wool	1 bag	
Latex gloves	1 box	
Gravel - coarse	Quarter bucket (approx 2 litres)	
Gravel - fine	Quarter bucket (approx 2 litres)	
Sand- coarse	Quarter bucket (approx 2 litres)	
Sand - fine	Quarter bucket (approx 2 litres)	
Sodium chloride	1 bottle	
Sawdust	Quarter bucket (approx 2 litres)	
Toilet paper	2 rolls	
A3 paper	12 sheets	
Plastic drinking cups	40	

Equipment

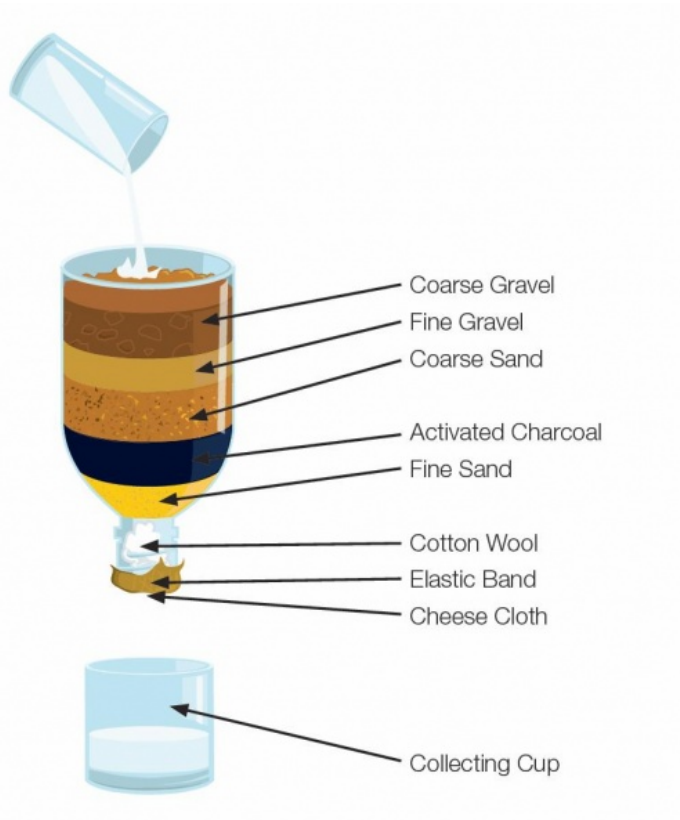
The following equipment would be required to run the session:

Description	Quantity
Clamp	5
White board markers	10
Prit Stick	-
Scissors	-
Access to sink and tap or bucket of water	-
10-14 litre bucket (if possible)	1

NB: Students are not required to use all the materials – some offer no advantage for filtering. Iron filing, sodium chloride, sawdust are not actually required to make the filter but should be provided so that the students have to make a choice of suitable materials. It is advisable to take surplus materials if available. The teams should use the bill of quantities provided to order their materials. Only one representative from each group may come to purchase materials, one group at a time.

Filter diagram (for teachers only)

The filter diagram below includes all the information regarding the filter composition. **Do not make this image available to the groups.** Some of the groups like the USA and UK will have a version of this in their instructions.



The following sheets should be printed out separately and handed out to each group.

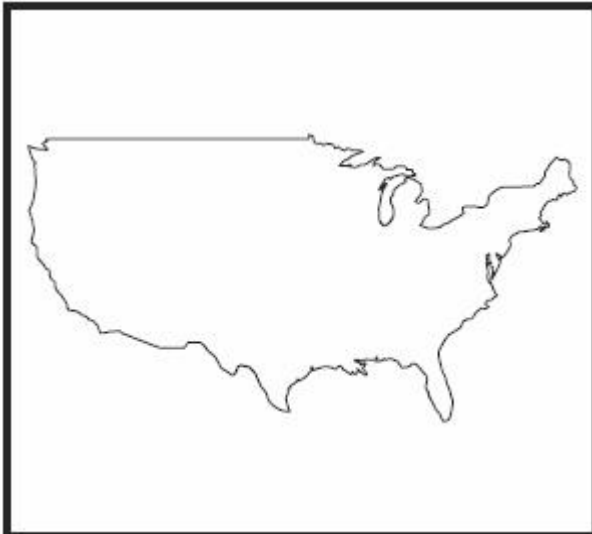
Bill of Quantities (this sheet is meant to be printed for student use)

Team: _____

Total Budget = _____ credits

Material	Unit Cost	Quantity Required	Total Cost
2 litre bottle	10 credits		
1 litre bottle	5 credits		
Capture Cup	2 credits		
Rubber Band	2 credits each		
Sellotape	2 credits/10cm		
Iron filings	15 credits/teaspoon		
Activated charcoal	30 credits per 1/4 cup		
Cheesecloth	4 credits/square		
Sugar	5 credits/cup		
Cotton wool	2 credits/ball		
Latex gloves	10 credits		
Gravel - coarse	5 credits/cup		
Gravel - fine	5 credits/cup		
Sand- coarse	10 credits/cup		
Sand - fine	15 credits/cup		
Sodium chloride	10 credits/cup		
Sawdust	5 credits/cup		
Toilet paper	2 credits/sheet		
A3 paper	2 credits/sheet		
		Grand Total	=

USA Country Sheet (this sheet is meant to be printed for student use)



USA Quick Facts

- The USA is one of the wealthiest and most prosperous countries in the world with a GDP (Gross Domestic Product) of \$14 trillion.
- Population: 314,659,000
- Literacy: 99% of the population have completed 5 or more years of schooling,
- Rainfall: The characteristics of United States rainfall climatology differ significantly across the United States.

Sources:

International Monetary Fund (2009)

<http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/weorept.aspx?sy=2009&ey=2009&scsm=1&ssd=1&sort=country&ds=.&br=1&c=453%2C732%2C112%2C111%2C754&s=NGDPD&grp=0&a=&pr1.x=84&pr1.y=11>

Department of Economic and Social Affairs Population Division (2009)

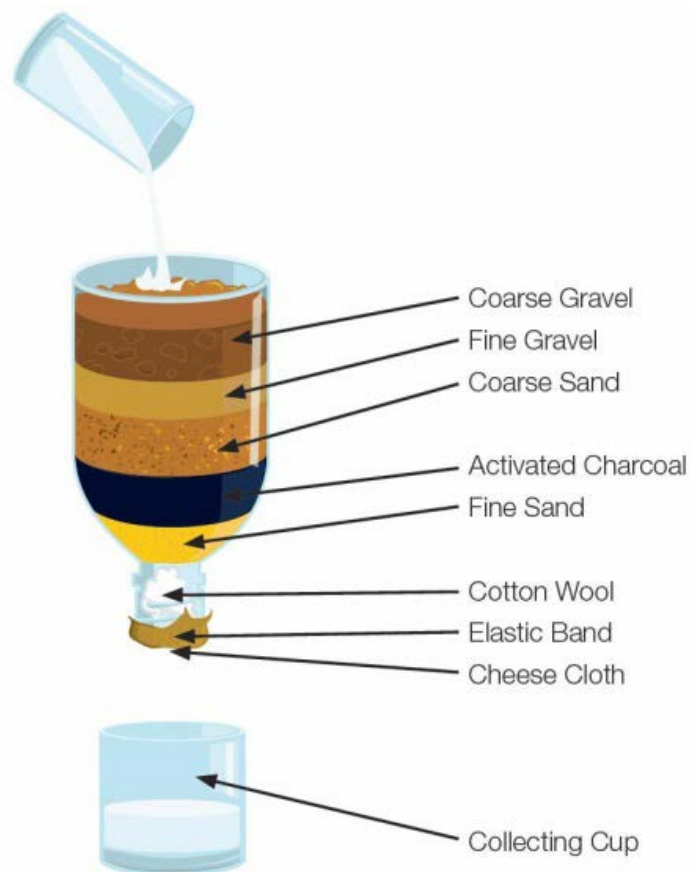
http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf

Central Intelligence Agency Library (Latest Information) <https://www.cia.gov/library/publications/the-world-factbook/fields/2103.html>

The wetter portions of the nation exceed 760 mm per year (World Average 962.7mm)

http://en.wikipedia.org/wiki/United_States_rainfall_climatology

USA Project Brief Sheet (this sheet is meant to be printed for student use)



Instructions

You need to build a filter, to clean your water supply. Use the instructions below:

1. Loosely plug neck with cotton wool
2. Secure cheesecloth around neck of bottle, using an elastic band
3. Pour a 1 cm layer of fine sand into the bottle (as illustrated)
4. Add a layer of activated charcoal
5. On top of this, insert coarse sand
6. The next layer should be made up of fine gravel
7. The upper-most layer should be 1 cm deep with coarse gravel.
8. Remember to pour clean water through your filter to get it working.

You have **400 credits** to build your filter from the resources supplied.

The cost of materials is listed below:

Material	Description	Cost
Cheesecloth	Fine non-water resistant cloth	4 credits/square
Cotton wool	Fine wadding	2 credits/ball
Activated Charcoal	Highly porous carbon with large surface area. Carbon based compounds and chlorine adsorbed to the surface.	30 credits per 1/4 cup
Gravel - Coarse	Act as a sieve, allowing different particle sizes past	5 credits/cup
Gravel - Fine	"	5 credits/cup
Sand - Coarse	"	10 credits/cup
Sand - Fine	"	15 credits/cup
Rubber band	-	2 credits each
Plastic Bottle	-	10 credits
Capture Cup	Collects water	2 credits



UK Country Sheet (this sheet is meant to be printed for student use)



UK Quick Facts

The United Kingdom is a leading trading power and financial centre

- **Population:** 61,565,000
- **GDP:** \$2.198 trillion.
- **Literacy:** 99% of the population have completed 5 or more years of schooling,
- **Natural Hazards:** Winter windstorms and floods
- **Annual Rainfall:** 737mm (World Average 962.7mm)

Sources:

Department of Economic and Social Affairs Population Division (2009)

http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf

International Monetary Fund (2009)

<http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/weorept.aspx?sy=2009&ey=2009&scsm=1&ssd=1&sort=country&ds=.&br=1&c=453%2C732%2C112%2C111%2C754&s=NGDPD&grp=0&a=&pr1.x=84&pr1.y=11>

Central Intelligence Agency Library (Latest Information) <https://www.cia.gov/library/publications/the-world-factbook/fields/2103.html>

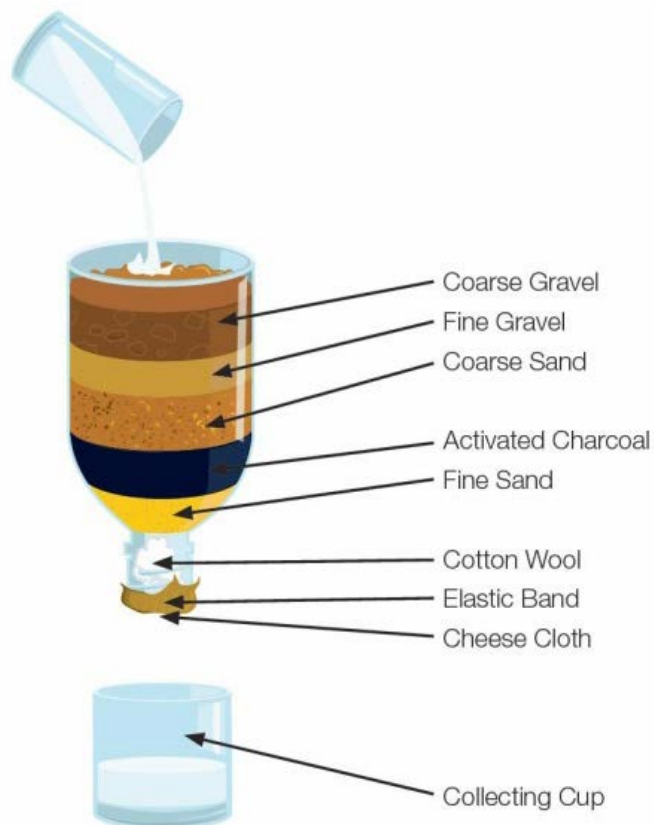
<http://www.skyscrapercity.com/showthread.php?t=349393>

CIA World Fact book

ARUP



UK Project Brief Sheet (this sheet is meant to be printed for student use)



Instructions

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4. Add a layer of activated charcoal
5. On top of this, insert coarse sand
6. The next layer should be made up of fine gravel
7. The upper-most layer should be 1 cm deep with coarse gravel.
8. Remember to pour clean water through your filter to get it working.

You have **150 credits** to build your filter from the resources supplied. The cost of materials is listed below

The cost of materials is listed below:

Material	Description	Cost
Cheesecloth	Fine non-water resistant cloth	4 credits/square
Cotton wool	Fine wadding	2 credits/ball
Activated Charcoal	Highly porous carbon with large surface area. Carbon based compounds and chlorine adsorbed to the surface.	30 credits per 1/4 cup
Gravel - Coarse	Act as a sieve, allowing different particle sizes past	5 credits/cup
Gravel - Fine	"	5 credits/cup
Sand - Coarse	"	10 credits/cup
Sand - Fine	"	15 credits/cup
Rubber band	-	2 credits each
Plastic Bottle	-	10 credits
Capture Cup	Collects water	2 credits

Qatar Country Sheet (this sheet is meant to be printed for student use)



Qatar Quick Facts

Qatar is one of the driest countries in the world – it receives only 81mm of water each year. As a result, they have built large numbers of water treatment plants to turn salty sea water into fresh drinkable water.

- **Population:** 1,409,000
- **GDP:** \$92.541billion.
- **Literacy:** 89% of over 15-year olds can read and write,
- **Rainfall:** 81mm (World Average 962.7mm)

Sources:

Department of Economic and Social Affairs Population Division (2009)

http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf

International Monetary Fund (2009)

<http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/weorept.aspx?sy=2009&ey=2009&scsm=1&ssd=1&sort=country&ds=.&br=1&c=453%2C732%2C112%2C111%2C754&s=NGDPD&grp=0&a=&pr1.x=84&pr1.y=11>

Central Intelligence Agency Library (Latest Information) <https://www.cia.gov/library/publications/the-world-factbook/fields/2103.html>

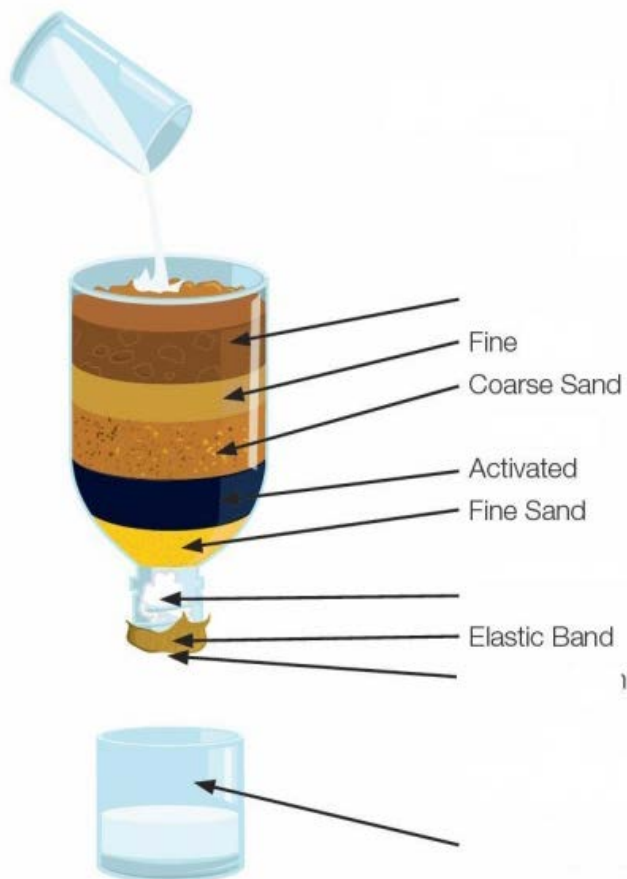
<http://www.qatarembassy.net/environment.asp>

CIA World Fact book

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Qatar Project Brief Sheet (this sheet is meant to be printed for student use)



Instructions

You need to build a filter, to clean your water supply. Use the instructions below:

1. Loosely plug neck with cotton wool
2. Secure cheesecloth around neck of bottle, using an elastic band
3. Pour 1 cm layer of fine sand into the bottle (as illustrated)
4. Add a layer of activated charcoal
5. Add further layers of coarse and fine sand
6. Remember to pour clean water through your filter to get it working.

You have **100 credits** to build your filter from the resources supplied. The cost of materials is listed below

The cost of materials is listed below:

Material	Description	Cost
Cheesecloth	Fine non-water resistant cloth	4 credits/square
Cotton wool	Fine wadding	2 credits/ball
Activated Charcoal	Highly porous carbon with large surface area. Carbon based compounds and chlorine adsorbed to the surface.	30 credits per 1/4 cup
Gravel - Coarse	Act as a sieve, allowing different particle sizes past	5 credits/cup
Gravel - Fine	"	5 credits/cup
Sand - Coarse	"	10 credits/cup
Sand - Fine	"	15 credits/cup
Rubber band	-	2 credits each
Plastic Bottle	-	10 credits
Capture Cup	Collects water	2 credits



Sudan Country Sheet (this sheet is meant to be printed for student use)



Sudan Quick Facts

Sudan is a third world country. It has major problems related to inadequate supplies of potable water; wildlife populations threatened by excessive hunting; soil erosion; desertification; periodic drought”

- **Population:** 42,272,000,
- **GDP:** \$54.294 billion.
- **Literacy:** 61% of over 15-year olds can read and write,
- **Rainfall:** 164 mm (World Average 962.7mm)

Sources:

CIA World Fact book

Department of Economic and Social Affairs Population Division (2009)

http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf

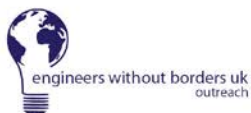
International Monetary Fund (2009)

<http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/weorept.aspx?sy=2009&ey=2009&scsm=1&ssd=1&sort=country&ds=.&br=1&c=453%2C732%2C112%2C111%2C754&s=NGDPD&grp=0&a=&pr1.x=84&pr1.y=11>

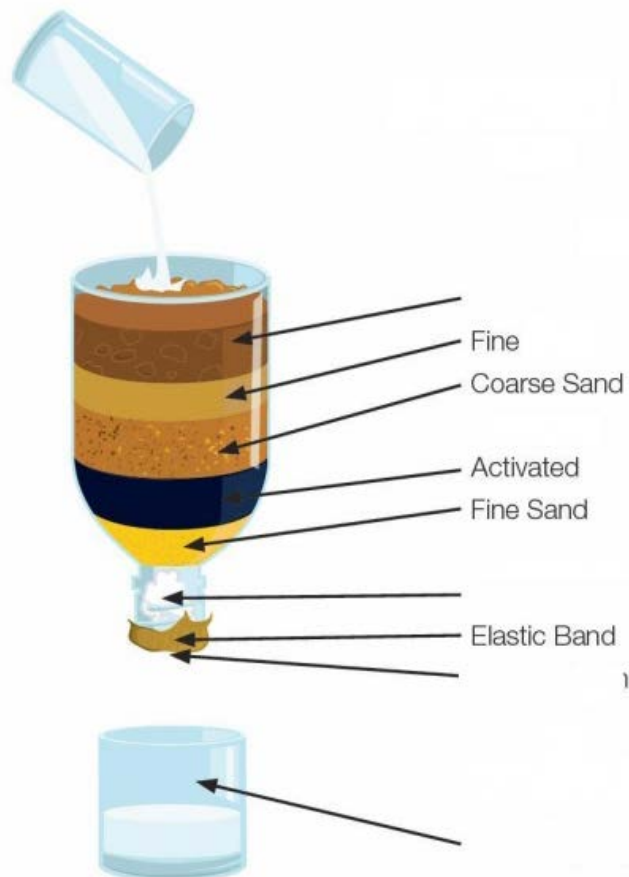
Central Intelligence Agency Library (Latest Information) <https://www.cia.gov/library/publications/the-world-factbook/fields/2103.html>

<http://www.climatetemp.info/sudan/>

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Sudan Project Brief Sheet (this sheet is meant to be printed for student use)



Instructions

You need to build a filter, to clean your water supply. Use the instructions below:

1. Loosely plug n(&&k with cotton wool
2. Secure cheesecloth around neck of bottle, using an elastic banf
3. Pour a \$%& cm layer of fine sand into the bot=le (as illustrated)
4. Add a layer of a(KAS charcoal
5. Add fur()er layers of \$a&d and %ra^el
6. Remember to pour clean water through your filter to get it working.

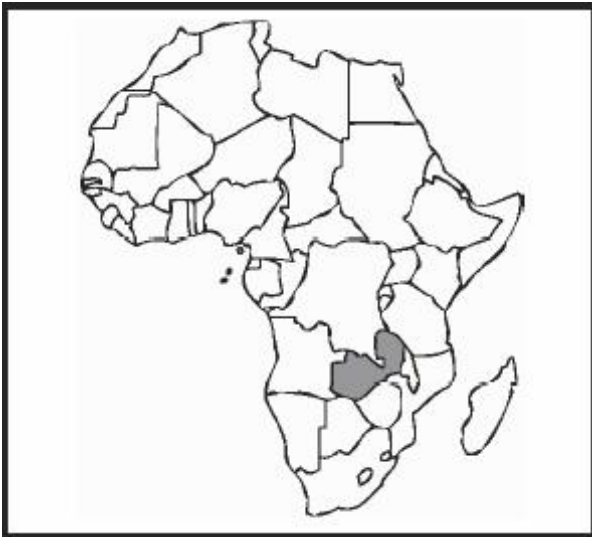
You have **40 credits** to build your filter from the resources supplied.

The cost of materials is listed below:

Material	Description	Cost
Cheesecloth	Fine non-water resistant cloth	4 credits/square
Cotton wool	Fine wadding	2 credits/ball
Activated Charcoal	Highly porous carbon with large surface area. Carbon based compounds and chlorine adsorbed to the surface.	30 credits per 1/4 cup
Gravel - Coarse	Act as a sieve, allowing different particle sizes past	5 credits/cup
Gravel - Fine	"	5 credits/cup
Sand - Coarse	"	10 credits/cup
Sand - Fine	"	10 credits/cup
Rubber band	-	2 credits each
Plastic Bottle	-	10 credits
Capture Cup	Collects water	2 credits



Zambia Country Sheet (this sheet is meant to be printed for student use)



Sources:

Department of Economic and Social Affairs Population Division (2009)
http://www.un.org/esa/population/publications/wpp2008/wpp2008_text_tables.pdf

International Monetary Fund (2009)
http://www.imf.org/external/pubs/ft/weo/2009/02/weodata/weorep_t.aspx?sy=2009&ey=2009&scsm=1&ssd=1&sort=country&ds=.&br=1&c=453%2C732%2C112%2C111%

Central Intelligence Agency Library (Latest Information)
<https://www.cia.gov/library/publications/the-world-factbook/fields/2103.html>

http://www.studentsoftheworld.info/pageinfo_pays.php3?Pays=ZAM&Opt=climate

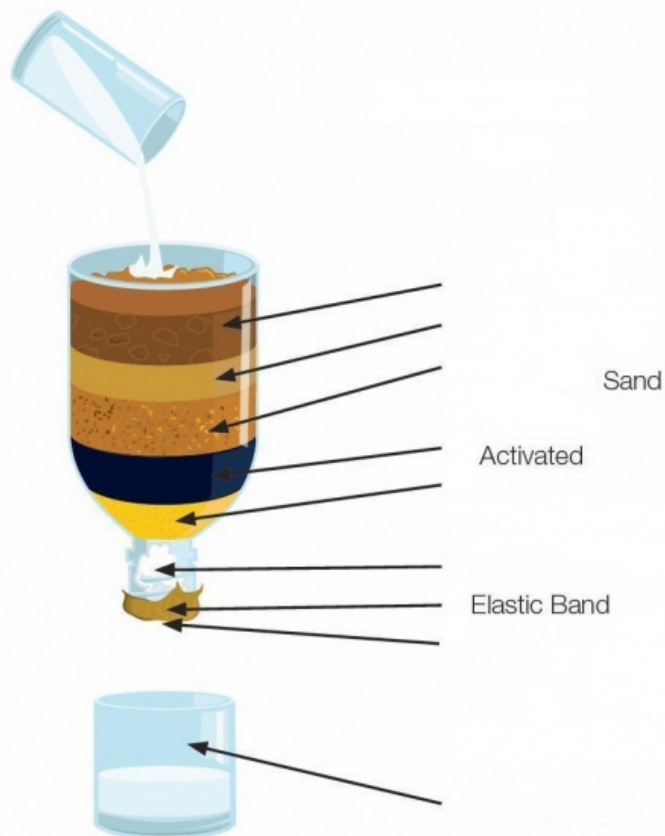
Zambia Quick Facts

- Zambia is one of the poorest countries in the world. 86% of people live below the poverty line. This is over double the world average.
- The risks of contracting a disease are very high.

The most widespread water diseases are:

- *diarrhea (leads to dehydration, hyperactive secretion and death)*
- *schistosomiasis (coughing, fever and fatigue)*
- *typhoid fever (causes internal bleeding)*
- **Population:** 12,935,000,
- **GDP:** \$12.293 billion,
- **Literacy:** 80.6% of the population over 15 can read and write,
- **Rainfall:** 178mm/month during wet season (October - April) (World Average 962.7mm)

Zambia Project Brief Sheet (this sheet is meant to be printed for student use)



Instructions

You need to build a filter, to clean your water supply. Use the instructions below:

1. Cut bottle in half
2. Loosely plug neck with cotton wool
3. Secure cheesecloth around neck of bottle, using an elastic band
4. Add a layer of activated charcoal
5. Add a layer of coarse sand
6. Add a layer of fine sand
7. Add a layer of gravel
8. Remember to pour clean water through your filter to get it working.

You have 20 credits to build your filter from the resources supplied. The cost of materials is listed below

The cost of materials is listed below:

Material	Description	Cost
Cheesecloth	Fine non-water resistant cloth	4 credits/square
Cotton wool	Fine wadding	2 credits/ball
Activated Charcoal	Highly porous carbon with large surface area. Carbon based compounds and chlorine adsorbed to the surface.	30 credits per 1/4 cup
Gravel - Coarse	Act as a sieve, allowing different particle sizes past	5 credits/cup
Gravel - Fine	"	5 credits/cup
Sand - Coarse	"	10 credits/cup
Sand - Fine	"	15 credits/cup
Rubber band	-	2 credits each
Plastic Bottle	-	10 credits
Capture Cup	Collects water	2 credits



Ice Breakers

This page will provide you with a few icebreakers that you may decide to use. The point of an icebreaker is to quickly make everyone feel comfortable in the room (including you). Therefore, an icebreaker is not meant to be an academically challenging activity but something informal that everyone can participate in. If you are going to a school where students may have learning disabilities/other special needs it is worth considering before you arrive the appropriateness of the activity. You want to make sure that everyone feels included and picking an activity that some students cannot participate in will only serve to alienate them.

Bombs and Shields (needs a lot of room)

Stand up. Look around the room. Choose two people without telling anyone. One person is your bomb, and another person is your shield. When the facilitator says "GO!" you need to get behind your shield, and move as far away as possible from your bomb.

Physical Pass the message

Split the class into two/three groups (depending on size of class) with all teams facing the front of the classroom. With your finger 'write' a word or acronym on the back of the person at the end of the line, and they need to pass it down the line to the front person, who must write it in pen on whiteboard/blackboard. The winner is the fastest and most accurate team.

Gotcha! (Grab the Finger)

Get students to stand in a circle, arms out to the side. Left hand palm up, right index finger pointing down and touching on neighbour's outstretched palm. "When I say the word go, do two things.... grab the finger in your left hand, and prevent your right finger from being grabbed... 1 ... 2 ... 3 ... [add suspense] ... Go!". Repeat several times. The trick is dramatizing the "Go!" the build up of suspense, and most will jump the gun, adding to the fun.

Zip Zap Boing

Get students to stand in a circle. The idea is to send an energy ball around the circle – this can be done by placing your hands together in the shape of a gun – to pass the energy ball around the circle (to either left or right) you must say zip, to shoot the energy ball across the circle you say zap. If you want to change direction of the energy ball/block the energy ball you hold your hands in front of you and say boing. The person who sent the energy ball to you then gets the energy ball back again and must re-direct it.

What can you do?

Handout to Pupils

To round up the session it's important to empower the students into improving things. So look at what they can do in the UK and what they can do overseas. Could look at fundraising activities – leave things with them so that they can do more once you've gone.

There is also a map of water stress in the UK of which SE/London is in the high water stress area. May be a useful image to start a discussion.

How can students save water in your home?

This will make students aware of what they can do, and what they can tell their parents about. Emphasis will need to be made on how doing a little thing in your house will have a big effect if everyone did it. For example turning the tap off when brushing your teeth.

What you and your parents can do

- Turn off the tap whilst you are brushing your teeth
- Put a 'hippo' in your toilet cisterns – this reduces the water used to flush your toilet– saves 1litre per flush
- Take showers instead of baths
- When you are boiling water, use the minimum amount of water in kettles and saucepans- this also saves energy
- Wait until you have a full load before switching on dishwasher or washing machines
- Wash the car with a bucket and sponge and rinse with a hose.
- Wash vegetables and fruit in a bowl rather than under a running tap. The water in the bowl can then be used to water plants once you have finished with it.
- Wash dishes in a bowl rather than under a running tap. The water in the bowl can then be used to water plants once you have finished with it.
- Collect rainwater in a water bucket, to use for washing the car and watering the garden
- Use low flow fittings on shower heads and hoses.
- Check your house for leaks and dripping taps – a dripping tap is not only annoying, but can waste 15 litres of water a day (8 buckets worth) and almost 5,500 litres a year (416 buckets worth).

DEFRA 2008

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Students in Australia

A recent news article in the BBC outlined the water saving measures most Australian school children have to go to, to save water.

After a drought lasting 10 years they have to be very careful with water use, some things they do include:

- When they wake up they use timers to take two minute showers, and collect the water in buckets so it can be re-used in the garden.
- At school they have “scarecrow monitors” whose job it is to oversee the filling of more buckets from under the drinking taps to water the school vegetable patch.
- People can’t wash their cars; they can only clean your windshield and wing mirrors and side windows.

BBC News

How can you help people in developing countries get access to clean water?

Support charities who help improve water and sanitation in poor countries,

How fundraising could help them achieve this.

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Case Studies

Dushtha Shasthya Kendra (DSK), an NGO partner of WaterAid in Bangladesh helped people living in squatter settlements gain access to public water. They worked by motivating poor communities and building their capacity so that they could manage and maintain new facilities themselves.

'The sense of community cohesion and ownership, previously lacking in the community was crucial to the programme success.'
WaterAid

Gilgil area, east Rift Valley, Kenya

Within a local school Eco-sanitation toilets and rain water harvesting system was set up. This provides a cleaner source of water, and improves the sanitation which will also reduce the spread of disease.

The school was chosen as the location for these systems as they are a focal point of the community, and so provide an excellent way of introducing these ideas to the local people.

Wherever the Need

Eco sanitation toilets

– *These create a fertilizer of sorts from human waste. This can be used on crops once it has digested the waste.*

For the context of this presentation the main idea of these toilets is to reduce contamination of other water sources- therefore reduce the spread of disease.

You can support charities such as WaterAid and wherever the need, to help fund community projects in less developed countries.

Possible fundraising ideas include:

- sponsored swim
- cake sales
- wearing blue one day at school

For more information visit the website where there are ideas and links to charities with information.

Water Supply Systems and Household Water Treatment Systems

After the 2004 Tsunami, the Andaman Islands (in the ocean between India and Thailand) moved upwards by up to 9m from the earthquake. This changed the watercourses throughout the islands and left thousands of people without drinking water. To help bring safe water to the villages, the Emmanuel Hospital Association trained villagers in two technologies. For villages with access to water (dirty or clean), they taught them how to make inexpensive sand and charcoal filters built into a 100mm diameter PVC tube that could be turned over for backwashing. For villages without any source of drinking water in the dry season, the villagers learned how to build rainwater harvesting tanks out of steel sheets (to make the round "frame") and a plastic tank liner that could be patched in the village. Both technologies were successful. (You can email jennifer.mcarthur@arup.com for more details and/or photos of this project).

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Additional Information

Figure 1

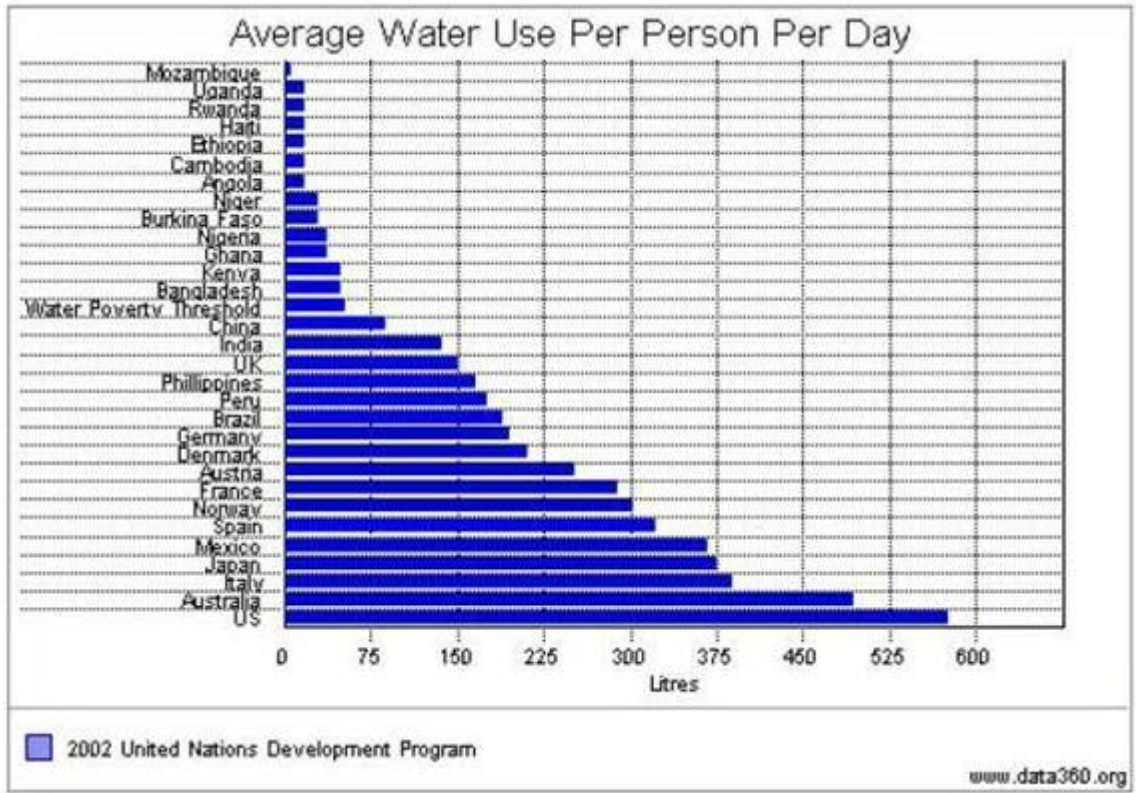


Figure 2

WATER CALCULATOR (BBC)		
Appliance	Consumption	Source
BATHROOM		
Shower	7 litres/min	Waterwise
Power shower	12 litres/min	Waterwise
Bath	80 litres	Waterwise
Toilet	6 litres/flush since 2001 4.5 litres/flush (average) dual flush models 7.5-9 litres/flush models before 2001 11-13 litres/flush very old models "Hippo" or other displacement device saves 1 litre/flush	British Bathroom Manufacturers Association
Running tap	6 litres/min	Thames Water
KITCHEN		
Washing up	10 litres (2x5 litre bowl)	Various
Dripping tap	300 ml/hour at rate of 1 drip/second	Observation
Dishwasher	15 litres/cycle if under 10 years old 25 litres/cycle if more than 10 years old	Waterwise
Washing machine	50 litres/cycle if under 10 years old 100 litres/cycle if more than 10 years old Half load uses 55% of water of full load	Environment Agency
GARAGE & GARDEN		
Hosepipe	500 litres/hour	Waterwise
Watering can	4 litres	Various
Bucket	5 litres	Various
Pressure washer	450 litres/hour	Various

Waterborne diseases Gastro-intestinal rout of exposure (drinking contaminated water)

Figure 3

Diseases	Responsible pathogen	Route of exposure	Mode of transmission
Cholera	Vibrio cholerae bacteria	gastro-intestinal	often waterborne
Botulism	Clostridium botulinum bacteria	gastro-intestinal	food/water borne; can grow in food
Typhoid	Salmonella typhi bacteria	gastro-intestinal	water/food borne
Hepatitis A	Hepatitis A virus	gastro-intestinal	water/food borne
Dysentery	Shigella dysenteriae bacteria or Entamoeba histolytica amoeba	gastro-intestinal	food/water
Cryptosporidiosis	Cryptosporidium parvum protozoa	gastro-intestinal	waterborne; resists chlorine
Polio	polioviruses	gastro-intestinal	exposure to untreated sewage; may also be waterborne
Giardia	Giardia lamblia protozoa	gastro-intestinal	waterborne

<http://www.mwra.state.ma.us/germs/germ10.htm>

Figure 4

How Much Water Is There in the World?

Reservoir *	Volume (x10 ⁶ km ³)*	% of total *	Equivalent No. of Olympic sized swimming pools+	No. of Loch Ness's #
Oceans	1370	97.25	548,000,000,000,000	
Ice caps and glaciers	29	2.05	11,600,000,000,000	
Deep groundwater (9750-4000m)	5.3	0.38	2,120,000,000,000	
Shallow groundwater (<750m)	4.2	0.30	1,680,000,000,000	568,000
Lakes	0.125	0.01	50,000,000,000	16,900
Soil Moisture	0.065	0.005	26,000,000,000	
Atmosphere (water vapour)	0.013	0.001	5,200,000,000	
Rivers	0.0017	0.0001	680,000,000	230
Biosphere	0.0006	0.00004	240,000,000	
Total	1408.7	100	563,500,000,000,000 Lots of swimming pools!	

Based on Berner, E.K. & Berner, R.A. (1987) The Global Water Cycle: geochemistry and environment. Prentice-Hall, Englewood Cliffs, New Jersey.

+ Based on a swimming pool with a volume of 2500 m³ of water.

1. volume of Loch Ness - 7.4x10⁹ cubic meters = 2 960 000 Olympic sized swimming pools

Figure 5

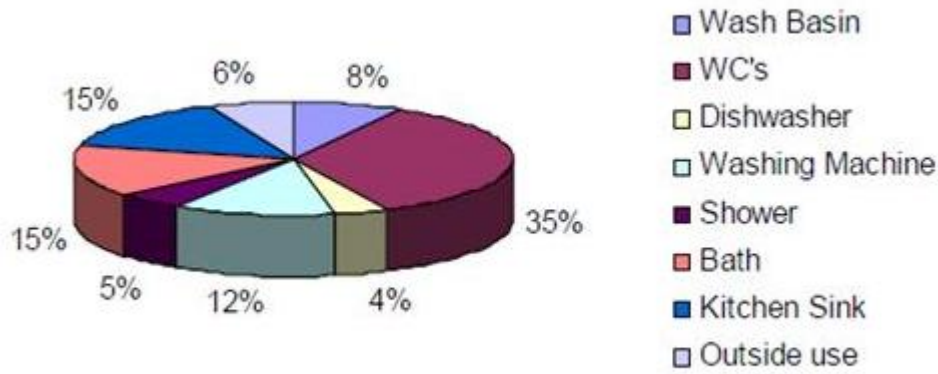
Country	GDP per capita	Rainfall per annum (mm)	Water	Water	Life expectancy	Infant mortality (under five, per 1,000)	Adult literacy	HDI rank
Argentina	\$14,280				74.8	18	97.2%	
Australia	\$31,794	Sydney – 1242.7; Melbourne -606.4			80.9	6	-	3
Bangladesh	\$2,053				63.1	73	47.5	140
China	\$6,757				72.5	27	90.9%	81
Mongolia	\$2,107				65.9	49	97.8%	114
Indonesia	\$3,843				69.7	36	90.4	107
Tanzania	\$744				51.0	122	69.4	159
Solomon Islands	\$2,031				63.0	29	76.6	129
Egypt	\$4,337	Cairo – 24.8			70.7	33	71.4	112
Iceland	\$36,510				81.5	3	-	1
Spain	\$27,169				80.5	5	-	13
United Arab Emirates	25,514				78.3	9	88.7	39
Albania	\$5,316				76.2	18	98.7	68
Philippines	\$5,137				71.0	33	92.6	90
Morocco	\$4,555	Fes – 546; Marrakech – 247.4			70.4	40	52.3	126
Cote d'Ivoire	\$1,648				47.4	195	48.7	166
Sierra Leone	\$806				41.8	282	34.8	177

From UNDP HDI <http://hdrstats.undp.org/countries/> and water from <http://www.worldclimate.com/>



Figure 6

Water Use in the UK household



Total volume of 150liters/person/per day, in a 4 person household.

Source: http://www.dwrcymru.co.uk/welsh/waterefficiency/school/_pdf/waterfacts.pdf