



Water for the World

Teacher's Pack



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CONTENTS

| | |
|---------------------------------|---|
| 1. Introduction..... | 3 |
| 2. Preparation | 4 |
| 3. Materials and Equipment..... | 5 |
| 4. Suggested Timings..... | 6 |
| 5. Main Activity | 7 |
| 6. Activity Hand-outs | 8 |

INTRODUCTION

The workshop focuses on the two major challenges associated with the global water crisis:

- Accessibility to water resources
- Safe and clean drinking water

Objectives

For Pupils

- Gain an understanding of water consumption on a local and global scale
- Learn about the main water contaminants and various methods of purification
- Introduction to the role of engineers and their approach to design challenges
- Inspire an interest in water conservation
- Introduction to Technology Justice

For Teachers

- Incorporate global issues and methodologies into science teaching
- Hands-on activity that develops the pupils' STEM skills and ability to work as part of a team.

Suited Age Group

KS3 (11-14 years old).

Session Length

60-90 minutes

Number of Pupils

The session is designed for a standard school class of approximately 30 pupils with the class divided into groups of 5-6 pupils; however the content can be easily modified to suit smaller or larger groups.

Session breakdown and learning outcomes

| Session highlights | Description | Learning outcome |
|-------------------------------|--|---|
| Introduction | Explain to teachers that pupils will be looking at access to water and the importance of clean, safe water for everyone | |
| starter activity | Looking at attitudes to water using a photo and concept cartoon | Encourages critical thinking and self-reflection |
| Estimating water requirements | Pupils estimate how much water people in different countries use. | A better understanding of the inequality of water access around the world |
| Safe water supply | Pupils watch a short video highlighting the importance of clean, safe water. | Classroom learning is given a global dimension |
| Building a filter | A hands on and creative activity for pupils to work in teams to build a water filter. An element of complexity is added by giving different groups different resources based on the country they represent. | Builds teamwork, critical thinking as well as an appreciation for the difficulty of a design task. This element of inequality between groups depending on which country they represent initiates thinking about inequality around the world. |
| Technology Justice | The activities of the day are linked to Technology Justice. | By reflecting on how they performed during their group activity pupils are introduced to ways in which they can act responsibly and contribute to international development by empowering individuals and communities Pupils will understand how access to water is important if we are to achieve technology justice. |
| What can you do? | Simple methods to reduce and recycle water are highlighted | Help pupils understand interdependence and how their actions have an impact on the world |

WaterAid video

Showcases the current water crisis around the world, and how a safe and sanitised water supply system can benefit individuals and communities.

<https://www.youtube.com/watch?v=mVTahkpVabw>

MATERIALS AND EQUIPMENT

Necessary materials and equipment checklist

This is a rough guide of the materials needed for a group of 30. You can use this grid as a check list for what you'll need for the workshop.

| Item | Number Required | Acquired |
|---|---------------------------|----------|
| 2 litre water bottle full or empty as a prop. | 1 | |
| White board markers | 1 | |
| Pens/Pencils | 1 per pupil | |
| Laptop connected to a projector | 1 | |
| Plastic Folder for hand-outs/facilitator pack print out | 1 | |
| Main activity country briefs | 2/3 per group | |
| 2L plastic bottle | 1 per group | |
| Mix of mud and water | 1 bucketful | |
| Plastic drinking cups | 60 | |
| Coarse gravel | 2 cups per group | |
| Fine gravel | 2 cups per group | |
| Coarse sand | 2 cups per group | |
| Fine sand | 2 cups per group | |
| Cheesecloth | 2 x 10cm square per group | |
| Rubber band | 1 per group | |
| Cotton | 1 bag | |
| Safety scissors to cut cheesecloth | 6 | |

SUGGESTED TIMINGS

| Slide numbers | Topics | Time (90 min workshop) | Time (60 min workshop) |
|---------------|---------------------------------|------------------------|------------------------|
| 1-4 | Introduction & starter activity | 7 min | 5min |
| 5-6 | Importance and uses of water | 5 min | 2 min |
| 7-19 | How much water do we use? | 4 min | 2 min |
| 20-23 | Safe water supply | 4 min | 1 min |
| 24-32 | Contaminents and removal | 8 min | 2 min |
| 33-36 | Building a filter and feedback | 55 min | 40 min |
| 37 | Technology Justice | 2min | 2 min |
| 38-42 | What can you do? | 5 min | 3 min |

MAIN ACTIVITY

Aim

To encourage creativity, team work and enhance pupils' STEM skills through the hands-on water filter building activity.

Summary

Working in groups of five or six, pupils have to design and build their own water filter from a list of available raw materials that can be sourced from the 'shop' or externally (for e.g. trading between groups). Each group receives one country fact sheet, which highlights some information about their countries and has instructions on how to build the filter.

Different countries are given different amounts of credit to source their materials.

The filters are then tested to check if they are able to filter out visible impurities in water. Once completed, labels should be added to the filters with the names of the countries and arranged together at the front of the class. Using the different models, encourage a discussion on the availability and the sharing of resources and technological skills.

HAND-OUTS (END OF THIS DOCUMENT)

There are 5 countries (USA, UK, Qatar, Argentina and India), each with their own credit allocation and filter design specification.

A 'Costings' sheet with information on the cost for materials required is provided; this must be taken to the shop when placing an order.

Additionally there is a 'Key Information' sheet with information on water sources which is required during the activity and 2 filter design instruction sheets which groups have an opportunity to buy in exchange for credits.

Materials

- Main activity country briefs
- 2L plastic bottle
- Mix of mud and water
- Plastic drinking cups
- Coarse gravel
- Fine gravel
- Coarse sand
- Fine sand
- Cheesecloth
- Rubber band
- Cotton
- Scissors to cut cheesecloth

Instructions

- First hand out the 'Country Fact Sheet' and 'Bill of quantities' sheets to all groups.
- Encourage teams to use their budget allocation to plan for materials to buy for building the filter and if possible use alternate sources or materials.
- Encourage them to nominate a member to be the 'trader' who will go to the shop to buy the materials.
- Based on the list from each group hand out the material in plastic cups and ensure you keep a tally of their budget vs materials allocated. You could use the white/black board to display all the team credit points.
- Walk around the class and guide those teams that are struggling specially with limited funds and design brief.
- If a group finishes early allow them to test their filter and carry out multiple repetitions by filtering the same water, and observe it gets clearer after each attempt.

- If a group is running out of resources then give them some more using a phrase such as 'India has received resources as aid from the UN'
- Remind all the groups they have to give a short presentation outlining their country brief and explaining how they planned and designed the filter. They can nominate 1 or 2 members from the group to present on behalf of the entire group.

Conclusion

- Once all of the groups have completed building their filters, place them all at the front of the class with a label of their country.
- Use the group presentation time to discuss the design constraints, challenges faced and how the team worked together.
- The activity is later discussed in the context of Technology Development; this can be brought up at this stage if deemed appropriate.

Things to discuss/promote whilst the activity is on-going:

- Are they effectively using their time and resources?
- Are they following the design brief?
- Can they save on their budget and source material from somewhere else?
- Have you got excess resources? Could they donate them to other groups?

Things to Discuss/Promote After the Activity:

- Which filter was the most efficient and why?
- How is this activity different from the real world?

Cost Sheet

Team: _____

Total Budget = _____ credits

| Material | Unit Cost | Quantity Required | Total Cost |
|---|------------------------|-------------------|------------|
| 2 litre bottle | 10 credits | | |
| Straws | 2 credits each | | |
| Rubber Band | 2 credits each | | |
| Activated charcoal | 30 credits per 1/4 cup | | |
| Cheesecloth | 4 credits per square | | |
| Cotton wool | 2 credits per ball | | |
| Gravel - coarse | 5 credits per cup | | |
| Gravel - fine | 5 credits per cup | | |
| Sugar | 5 credits per cup | | |
| Toilet paper | 1 credit per sheet | | |
| Sand- coarse | 10 credits per cup | | |
| Sand - fine | 15 credits per cup | | |
| A4 paper | 2 credits per sheet | | |
| Information | | | |
| Fully Labelled Diagram | 100 credits | | |
| Unlabelled diagram | 50 credits | | |
| Full instructions (Available if your country has a literacy rate of over 90%) | 40 credits | | |
| Partial Instructions | 20 credits | | |
| Grand Total = | | | |

USA

Country sheet (to be printed for student use)



You have **400 credits** to collect water and build your water filter

Population: 316,668,567

GDP: The USA is one of the wealthiest and most prosperous countries in the world with a GDP of \$15.6 trillion or \$49,800 per capita

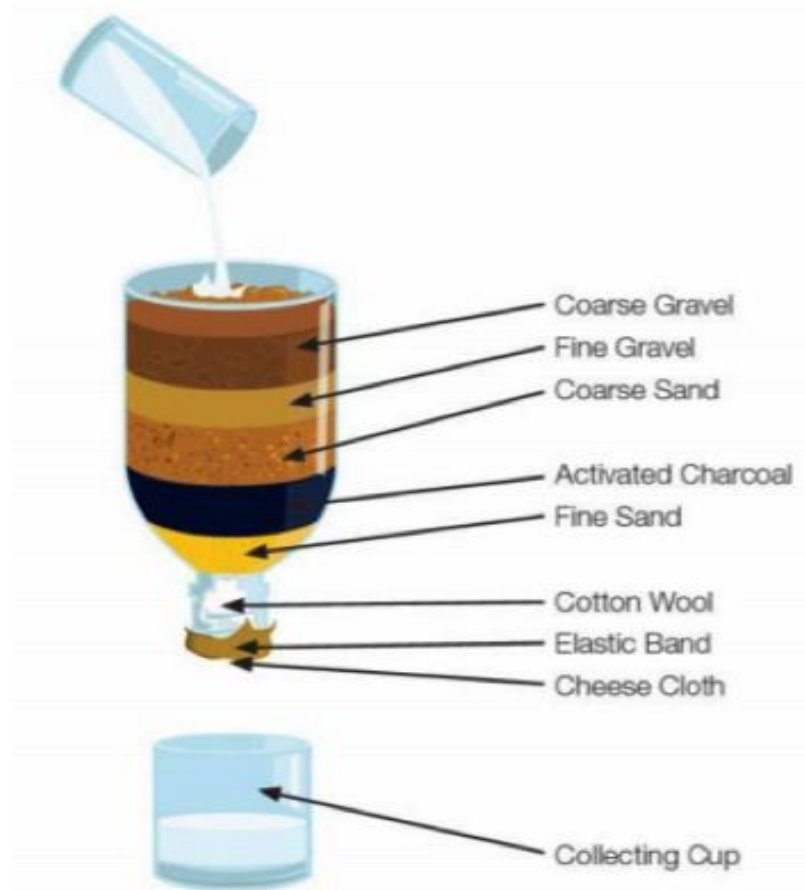
Literacy: 99% of the population have completed 5 or more years of schooling.

Rainfall: The characteristics of United States rainfall climatology differ significantly across the United States.
Average - 1201mm
(World Average 962.7mm)

You must create a clean water supply for your country.
Follow the steps below:

1. Choose a **water source**: rainwater, groundwater or seawater.
2. Choose what **information** and/or **materials** to buy.
3. **Design and build** a water filter.
4. Put **clean water** through your filter to get it working.
5. We will **test** the water filters to see which has produced the cleanest water.
6. Choose one or two members of the group to briefly **present** how you have built your filter, why, and what problems you faced.

USA water filter instructions



Instructions

1. Loosely plug neck with cotton wool
2. Secure cheesecloth around neck of bottle, using an elastic band
3. Pour a 1cm layer of fine sand into the bottle
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 1cm deep with coarse gravel

UK

Country sheet (to be printed for student use)



You have **200 credits** to collect water and build your water filter

Population: 63,395,574

GDP: \$2.323 trillion or \$36,700 per capita

Literacy: 99% of the population have completed 5 or more years of schooling

Natural Hazards: Winter windstorms and floods

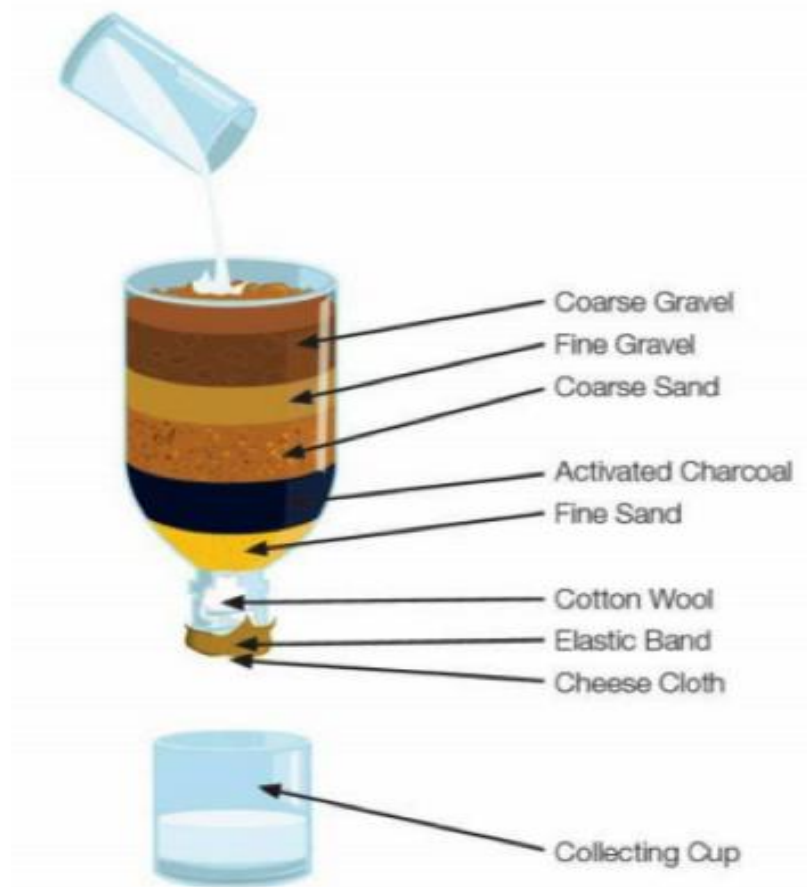
Annual Rainfall: 754mm (World Average 962.7mm)

You must create a clean water supply for your country.

Follow the steps below:

1. Choose a **water source**: rainwater, groundwater or seawater.
2. Choose what **information** and/or **materials** to buy.
3. **Design and build** a water filter.
4. Put **clean water** through your filter to get it working.
5. We will **test** the water filters to see which has produced the cleanest water.
6. Choose one or two members of the group to briefly **present** how you have built your filter, why, and what problems you faced.

UK water filter instructions



Instructions

1. Loosely plug neck with cotton wool
2. Secure cheesecloth around neck of bottle, using an elastic band
3. Pour a 1cm layer of fine sand into the bottle
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 1cm deep with coarse gravel

Qatar

Country sheet (to be printed for student use)



You have **300 credits** to collect water and build your water filter

Population: 2,042,444

GDP: \$189 billion and \$102,800 per capita – highest per capita in the world

Literacy: 96.3% of over 15-year olds can read and write

Rainfall: 75mm (World Average 962.7mm)

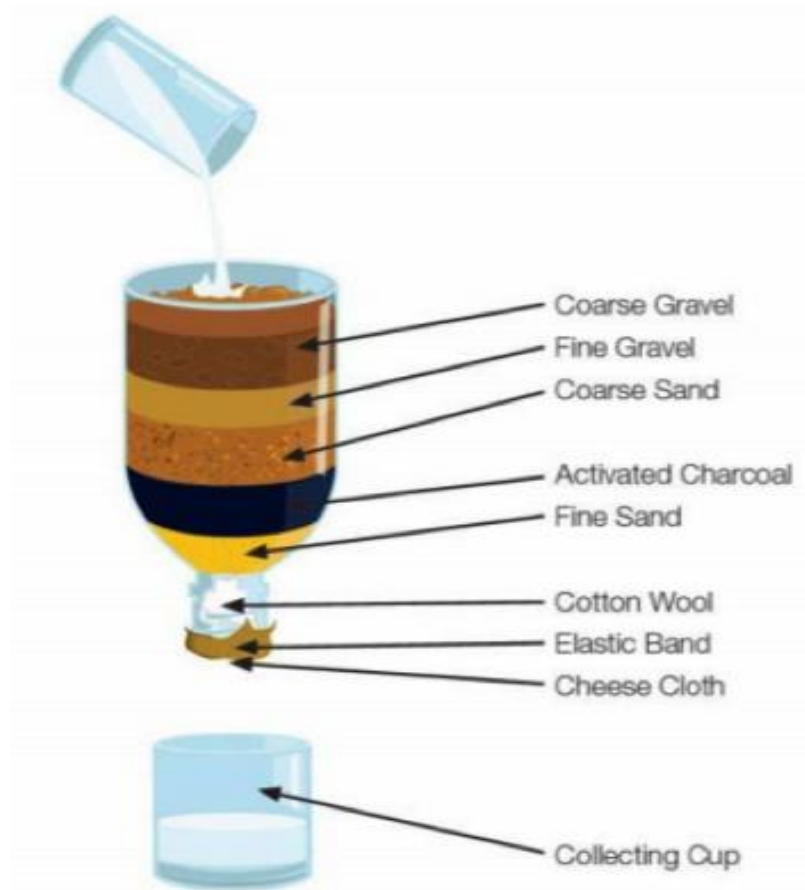
Qatar is one of the driest countries in the world – it receives only 74mm of water each year. As a result, they have built large numbers of water treatment plants to turn salty sea water into fresh drinkable water.

You must create a clean water supply for your country.

Follow the steps below:

1. Choose a **water source**: rainwater, groundwater or seawater.
2. Choose what **information** and/or **materials** to buy.
3. **Design and build** a water filter.
4. Put **clean water** through your filter to get it working.
5. We will **test** the water filters to see which has produced the cleanest water.
6. Choose one or two members of the group to briefly **present** how you have built your filter, why, and what problems you faced.

Qatar water filter instructions



Instructions

1. Loosely plug neck with cotton wool
2. Secure cheesecloth around neck of bottle, using an elastic band
3. Pour a 1cm layer of fine sand into the bottle
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 1cm deep with coarse gravel

Argentina

Country sheet (to be printed for student use)



You have **80 credits** to collect water and build your water filter

Population: 42,610,981

GDP: \$474.8 billion and \$18,200 per capita

Literacy: 98.1% of over 15-year olds can read and write

Rainfall: 573 mm
(World Average 962.7mm)

Argentina has a large variation in wealth with 30% of its population below the poverty line. It has large natural resources and the economy is fast growing, the gap between the rich and poor is widening.

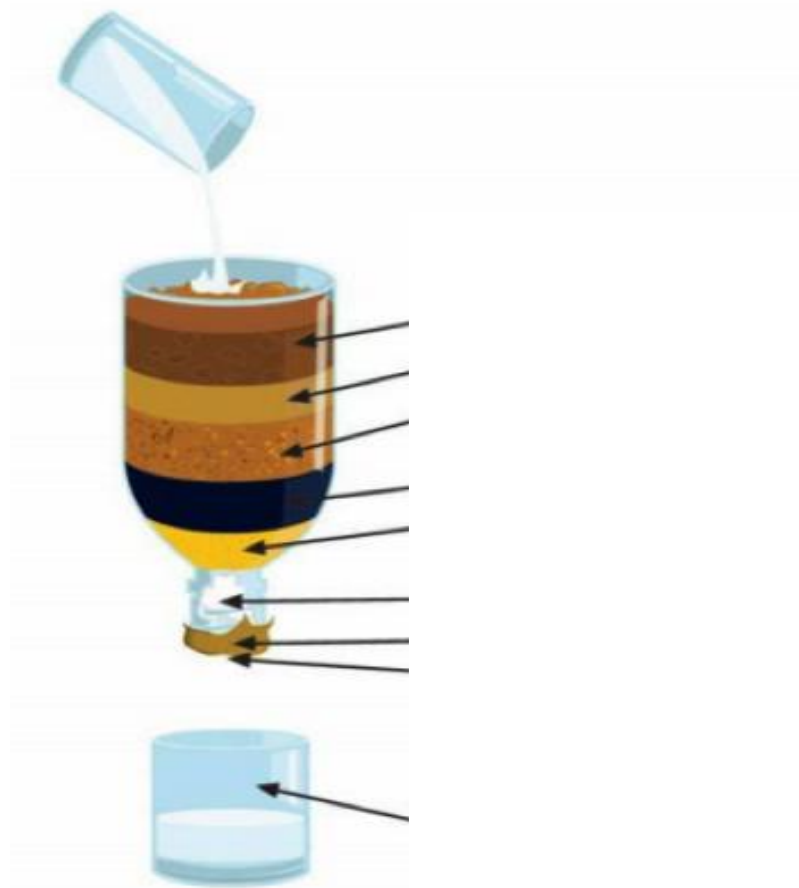
You must create a clean water supply for your country.

Follow the steps below:

1. Choose a **water source**: rainwater, groundwater or seawater.
2. Choose what **information** and/or **materials** to buy.
3. **Design and build** a water filter.
4. Put **clean water** through your filter to get it working.
5. We will **test** the water filters to see which has produced the cleanest water.
6. Choose one or two members of the group to briefly **present** how you have built your filter, why, and what problems you faced.

Argentina

Water filter instructions



Instructions

7. Loosely plug neck with cotton wool
8. Secure cheesecloth around neck of bottle, using an elastic band
9. Pour a 1cm layer of fine sand into the bottle
10. Add a layer of activated charcoal
11. Add further layers of sand and gravel
12. Remember to pour clean water through your filter to get it

India

Country sheet (to be printed for student use)



You have **50 credits** to collect water and build your water filter

Population: 1,220,800,359

GDP: \$4.784 trillion and \$3,900 per capita

Literacy: 61% of over 15-year olds can read and write

Rainfall: 2168 mm
(World Average 962.7mm)

India's climate varies from regular monsoons in the north to dry in the south but has a large average rainfall. It has a fast growing economy but still has a very low GDP per capita.

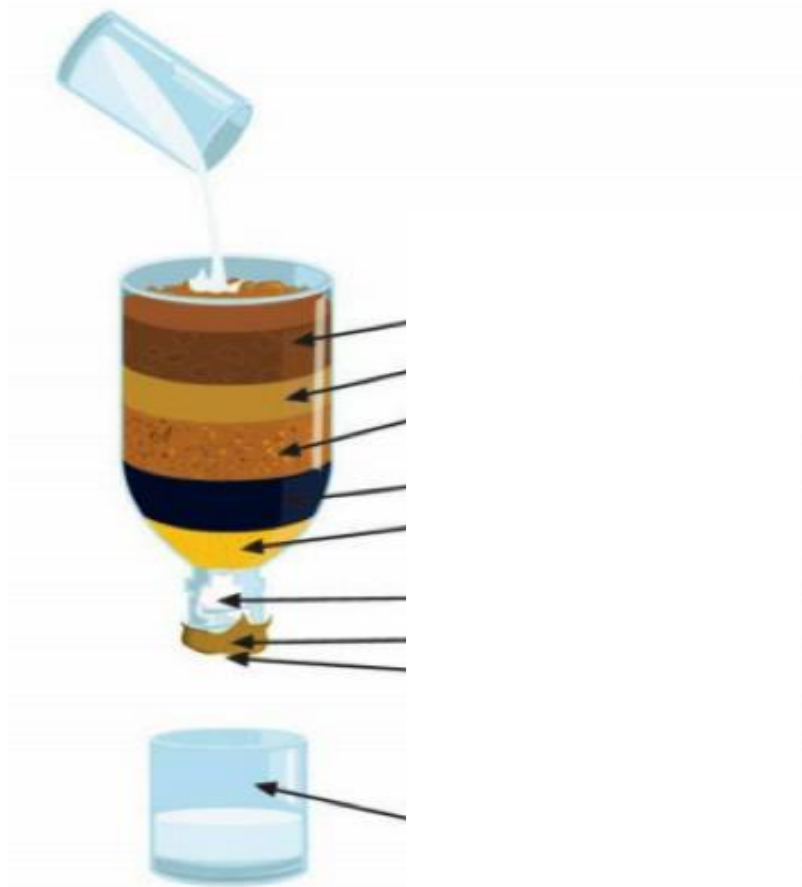
You must create a clean water supply for your country.

Follow the steps below:

1. Choose a **water source**: rainwater, groundwater or seawater.
2. Choose what **information** and/or **materials** to buy.
3. **Design and build** a water filter.
4. Put **clean water** through your filter to get it working.
5. We will **test** the water filters to see which has produced the cleanest water.
6. Choose one or two members of the group to briefly **present** how you have built your filter, why, and what problems you faced.

India

Water filter instructions



Instructions

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

Key Information

Water Sources

All sources will need to be filtered before use:



Rainwater – **Free** if your average **rainfall** is above 60% of the world average.

Ground water – Available if your average rainfall is greater than 10% of the average rainfall. Has to be pumped up from the ground using a **rope pump** (pictured) and costs **20 credits**.

Seawater – Seawater can be converted to fresh water using a **desalination** plant. This technique is very expensive due to transport costs and the large amount of energy required to run the plant. Costs **150 credits**.

Tips:

- Fine material filters small particulates, coarse material filters larger particulates. Think about the order in which you should filter different sized particulates out of the water.
- Activated charcoal removes carbon and chlorine based contaminants.
- Some materials will not help filter the water and may contaminate it more.

Other countries may have more or less credits than you – will you give or receive any charity?