

# WATER



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## INTRODUCTION

Water is essential to life; without it we cannot survive. Without food we can survive for approximately a month; without water we can only live for a few days. Children have the right to safe drinking water, and climate change is adding to water stress worldwide. Droughts, melting icecaps and contamination caused by flooding are all affecting our water sources.

Water is our most precious resource. It is important that we work with our youth to protect their future supplies. We need to understand the importance of water, and how conserving it and only using what we need is critical to our survival.

The **good news** is we **can** manage our water to provide safe drinking water and we can start by understanding the issues and then doing our part to make a difference.

### **Bangladesh, 2000**

In 2000 in Bangladesh, a smiling two-year-old girl, Richi, splashes water drawn for her bath in a small plastic basin, beside a No. 6 tubewell in the village of Chandai in Manikganj district, west of Dhaka, the capital. The tubewell was installed with UNICEF assistance.

## ACTIVITIES

The curricula links below are addressed in this theme. For an extensive list of relevant provincial expectations/outcomes, refer to Appendices A and B: Curriculum Links on pages 91 and 95, and Appendix I for links in Alberta, Saskatchewan, Manitoba and Quebec. .

Province	Course	Expectation/Learning Outcome
Ontario	SVN3E Environmental Science, Grade 11, Workplace Prep  <i>Human Impact on the Environment</i>	B2. investigate air, soil, and water quality in natural and disturbed environments, using appropriate technology;  B3. demonstrate an understanding of some of the ways in which human activities affect the environment and how the impact of those activities is measured and monitored.
Ontario	SCH3U Chemistry, Grade 11  <i>Solutions and Solubility</i>	E1. analyze the origins and effects of water pollution, and a variety of economic, social, and environmental issues related to drinking water
British Columbia	Science and Technology 11  <i>Natural Resources and the Environment</i>	Discuss the impact of society on natural resource management and the environment.
British Columbia	Geography 12  <i>Resources and Environmental Sustainability</i>	Assess the environmental impact of human activities, including: <ul style="list-style-type: none"> <li>• energy production and use</li> <li>• forestry</li> <li>• agriculture</li> <li>• waste disposal</li> <li>• water use.</li> </ul>

### Setting the Stage

**Objective:** To illustrate the interconnectedness of water and climate change.

**Time:** 15 minutes

**Materials**

- Reused paper for each student (personal white boards or laptops)
- Appendix G: Reflect and Act (page 104)

### ACTIVITY

1. Explain that you will be discussing water and the right that we all have to safe, clean drinking water and proper sanitation, as mentioned in Article 24 of the UN Convention on the Rights of the Child. Children have the right to good quality health care the best health care possible to safe drinking water, nutritious food, a clean and safe environment and information to help them stay healthy. Rich countries should help poorer countries achieve this.

2. Distribute Appendix G: Reflect and Act (page 105) to each student and ask them to journal lessons learned during discussion and activities around the theme.
3. Try a Think-Pair-Share activity. Ask pairs of students to list global water concerns facing children. Discuss what “water and sanitation crisis” might mean and what role climate change could play. Next, join students in larger groups to discuss.
4. Share that water is a basic need that is essential to our existence. Ask students to brainstorm water uses, both for our survival and pleasure. Every child has the right to clean drinking water, but this is not the reality in many developing countries. Access to safe, clean water in many areas is becoming scarce as “climate change dries up the water tables and depletes rainfall, leaving communities to battle the devastating effects of drought.”<sup>1</sup>

## Let it Rain!

**Objective:** To discover successful global water conservation and sanitation practices that are part of the solution to water shortages due to the effects of climate change.

**Time:** 40 minutes

### Materials

- Slide show on Indonesia’s rainwater harvest and media set-up found at <http://www.unicef.org/indonesia/7749.html>
- Student Handout #19: Bio-Sand Filter
- Student Handout #20: UNICEF Basic Family Water Kits

## ACTIVITY

1. Arrange students into six groups.
2. Explain that although some children in developing countries have to walk up to 3km to collect water for their families, this is preferable to having no safe drinking water available. Climate change will result in a shortage of safe drinking water for most of the world. Pollution and improper management of human waste threaten the safe water sources currently available. Incidences of waterborne disease like diarrhoea, cholera and typhoid will increase and will claim the lives of million of children in the developing world. (It is important to note that girls often cannot attend school as they are the ones tasked with collecting water.
3. There are two Water Case Studies ☒ Student Handout #19: Bio-Sand Filter (page 77) and Student Handout #20: UNICEF Basic Family Water Kits on page 78. Distribute the bio-sand filter case study to half the groups, and the UNICEF water kits case study to the other half. Ask groups to discuss the case study and complete the task on the bottom of the case study. The task is to create a one-minute public service announcement or radio jingle.
4. Ask each group to present its findings to the class.
5. Show the photo essay on Indonesia’s rainwater harvest at <http://www.unicef.org/indonesia/7749.html> and discuss. Ask students to consider the fact that climate change will likely bring less rainfall. What can be done to help minimize the effects of less rain?

### Keep the Discussion Going

List ways in which you use water in your life. What strategies would you employ if you suddenly were restricted to using no more than 20 litres of water per day?

Many feel that water will be the “oil” of this century. Why would people make this statement? Do you agree with it? Why or why not? What consequences could we face by selling Canada’s water in a global market?

Read the following on the topic: <http://www.cbc.ca/news/background/water/> and <http://www.davidsuzuki.org/Oceans/Freshwater/>.

List connections between poverty and water. Explain.

How can you conserve potable water in your life? How does this affect global water issues and help children in developing countries?

## Water Run Clean

**Objective:** To consider how climate change is affecting the availability of clean sources of water in developing countries. To understand the importance of reusing water as an alternative to finding new sources of clean water supplies, you will design and test a water filtration system.

**Time:** 60 minutes

### Materials

- 2 litre empty plastic bottle (pop/water) for each group (no bottle cap)
- Scissors for each group
- Paper and pencil to record design and results
- Various filtering materials such as coffee filter, cotton wool, cheese cloth, sand, gravel. The sand and gravel must be clean (run under water in a sieve or colander). Activated carbon could also be added to the list ☒ this is readily obtainable from pet stores that stock aquarium supplies. You can add other materials to use a filter medium, or alternatively, ask the students to bring their own filtering mediums.
- One TDS (Total Dissolved Solids) Meter (approximately \$40). Here is a link to Canadian distributors: <http://www.tdsmeter.com/products/where-to-buy?id=0001&productId=0001>.
- Mix of tap water with mud to provide a cloudy liquid (enough for 250ml per group approximately 1:10 ratio). Mix this in one batch so students all start with the same water to filter.
- Selection of beakers or equivalent for each group
- Student Handout #21: Water Run Clean

## ACTIVITY

1. Remind the students that when we turn on the taps here in Canada (in most locations!), water comes out. But in many parts of the world, water doesn’t come as easily or as safely. Climate change is impacting our world’s drinking water by drying up our fresh water supplies, altering our rain water patterns (rather than falling overland, rain develops in the rising air above the warm ocean), and causing natural disasters that can contaminate our drinking water. It is becoming more challenging globally to access clean drinking water especially in developing countries where access to clean water is already an issue.
2. Explain that as the impacts of climate change affects our global water supply, it becomes important that we clean and reuse our water and not have to go on increasingly longer searches for clean water. (In developing countries, people, often young girls, walk 3km to get their water. Climate change can make this journey even longer.)
3. Discuss that testing water to ensure it is safe to drink requires several tests. Drinking water should be clear, odourless and colourless.
4. Give the students a scenario that a village in an African country has experienced a mudslide, which has contaminated the local drinking water. Explain to students that there are several tests that need to

be performed before you can determine if water is safe to drink, and one test is the total dissolved solids (TDS). Challenge students to devise a system to clean the TDS from the water.

5. According to the World Health Organization (WHO), the maximum TDS is 1,000ppm (parts per million) and in the US, according to the Environmental Protection Agency (EPA), it is 500ppm. The TDS Meter will be used to measure ppm.
6. Arrange the students into groups of four and explain that they will be designing and testing a water filtration system. Set up stations of the various filtering materials for the students to access, or challenge students to create a design and collect their own materials.
7. Instruct groups to cut the water bottle in half and turn the neck end face down inside the base end of the bottle. The neck of the bottle should not touch the base.
8. Ask each group to design their filter system using the materials to create the most effective solution. Sketch the design on Student Handout #16: Water Run Clean illustrating the gradation and thickness of the striations of the chosen filtering materials.
9. Have each group follow the instruction on Student Handout #21: Water Run Clean starting with collecting 250ml of contaminated water (muddy) to filter and test.

### Class Post-Experiment Discussion

- Have the groups share their results. The top group will be the one with the most effective filtering system, and hence, the lowest (post filtering) ppm reading.
- What materials worked best? Did the order matter?
- Was the quantity of water less after filtering? Why?
- How did the visual quality vary?
- Is clear water safe to drink? Discuss why not? What could be in the water? (Answer: living micro-organisms that can cause disease and harmful chemicals.)

### Keep the Discussion Going

How do we translate this experiment into a workable model for safely cleaning water in developing (and developed) countries?

*One example is a natural water filter that first filters the water through ceramic filters (it takes approximately one hour to filter 1 litre), removing all suspended solids including biological contaminants. The water then filters through activated carbon containing nano silver (which inhibits bacteria growth). Silica sand can be used to provide additional filtration and zeolite can be used to remove heavy metals. This is only one example, and is a description of a filter system called Santevia ([www.santevia.com](http://www.santevia.com)). These, and similar filtering systems, are being used in developing countries to provide safe drinking water.*

What happens when we add plants to a filtration system? What do the plants do to help clean the water? Discuss natural and constructed wetlands.

Discuss rainwater collection and filtration systems for various water uses. For what water uses can we employ rainwater in our homes?

What standards does Canada have for drinking water, and how do they compare to those in developing countries? Test your tap water.

*Tests can include pH, total hardness, free chlorine, total chlorine, nitrite, copper and iron. A testing kit can be obtained from [www.safewater.org](http://www.safewater.org). Remember that all children have the right to clean, safe drinking water.*

### **Kisesa Health Centre benefits from rainwater harvesting tank!**

The Kisesa Health Centre, in Tanzania, provides health care for children and mothers, including treatment for diseases.

Before the rainwater harvesting tank was constructed, the centre had no choice but to buy water from a vendor. The amount they could purchase was insufficient to meet their needs, resulting in poor sanitation and the risk of infection for patients.

Flora Emmanuel was brought to the centre after a still birth. Because of a shortage of water, Flora recalled that “my mother had to ask for water from nearby homes for drinking, for my bath and for washing clothes.” Now that construction of the rainwater harvesting tank has been completed, the centre will be able to provide better services and sanitation for its patients.

Adapted from story found at <http://www.unicef.org/nz/article/760/KisesaHealthCentrebenefitsfromrainwaterharvestingtank.html>.



## **YOUTH TAKE ACTION**

### **Challenge for Change!**

Distribute Student Handout #18: Youth Take Action (page 77) and discuss the inspirational profiles. Instruct students (groups, pairs or individuals) to select ONE student project listed under the Challenge for Change Action or invite them to create their own challenge. Set appropriate timelines and criteria. Evaluate each project using Appendix E: Culminating Task Rubric (on page 103).

## BACKGROUND WATER

### What are the issues?

Currently around 1.1 billion people in developing countries have inadequate access to water and 2.6 billion people lack basic sanitation.<sup>2</sup>

Climate change is exacerbating this water stress in the following ways:

- Global warming results in the melting of ice caps causing sea levels to rise. It is estimated that if sea levels increase by about 40cm (roughly in the middle of the expected range for 2050), the number of people in danger of saltwater floods could grow from 75 million (today) to 200 million (2050). Salt water could pollute the drinking water in some of the largest urban centres on the coast such as Shanghai, Manila, Jakarta and Bangkok. According to some hydro-geologists, this could result in the cities being abandoned.<sup>3</sup> “At 1.5°C or less (an increase in global temperature) an extra 400 million people are exposed to water stress.”<sup>4</sup>
- Drought in southern Africa is closely related to the global warming of the Indian Ocean. Rather than falling overland, rain develops in the rising air above the warm ocean. Even a 10% drop in rainfall can reduce river flow by 50%.
- As a result of drought, water tables have not recovered and an increasing number of water points dry up in the summer.<sup>5</sup>

### Impacts on health of unsafe water sources

Pollution and improper management of human waste threaten safe water sources. Each year, waterborne disease like diarrhoea, cholera and typhoid claim the lives of millions of children in the developing world. Diarrhoea spreads readily in environments where there is poor sanitation and where safe water is unavailable.

### Irrigation and agriculture

Water is required for agriculture. Without water, crops will die resulting in loss of livelihood, malnutrition and starvation for the family.<sup>6</sup>

### Access to safe drinking water

In many developing countries, the sources of safe drinking water are far from the villages. Often the children (primarily girls) are tasked with fetching the water. In southern Madhya Pradesh, India, tribal girls spend up to three hours a day collecting and arranging for water. The girls spend more time fetching water than being involved in education.<sup>7</sup>



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### Take action

UNICEF and partners have implemented a program called *Wise-Water Management*. This program includes water solutions such as rainwater harvesting, recycling of grey water, and pumping of water using a roundabout play pump (as children play at school they are pumping the water for later use). Tribal schoolgirls have formed a Water Safety Club and use a water safety plan taught by UNICEF to monitor these initiatives.<sup>8</sup>

Also, UNICEF has water, sanitation and hygiene (WASH) programs active in over 90 countries.

WASH is designed to help improve access to water and sanitation, as well as educating children about essential hygiene behaviours such as washing hands with soap to help stop the spread of disease.

### Children take action

*"We here in our community are suffering from a lack of drinking water. Where safe water is available, it is too far away; most times we have to walk 10-15 minutes to places where we can access safe drinking water. I think the solution would be for us to recycle our waste water, as I am told has been done in some countries of the world." Rasheeda, age 13, Nigeria<sup>9</sup>*

To learn more about climate change connected to water, view the UNICEF UK Climate Change Report 2008: *Our climate, our children, our responsibility* found at [http://www.unicef.org.uk/campaigns/campaign\\_sub\\_pages.asp?page=91](http://www.unicef.org.uk/campaigns/campaign_sub_pages.asp?page=91).



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### NOTES

- 1 UNICEF UK, *Our climate, our children, our responsibility*, 2008, p. 10.
- 2 Ibid., p. 15.
- 3 Monbiot, George, *Heat: How to Stop the Planet From Burning*, 2006, p. 8.
- 4 Ibid., p. 15.
- 5 UNICEF UK, *Our climate, our children, our responsibility*, 2008, p. 10.
- 6 Ibid.
- 7 Ibid.
- 8 Ibid.
- 9 Ibid., p. 28.



## Student Handout #18

### YOUTH TAKE ACTION

#### Challenge for Change Action Items

Be part of the solution! Complete ONE project from the list below or create your own! You will be evaluated on criteria including knowledge of the issue, expression of ideas and connections made between personal, local and global views of the issue.

1. Research the environmental impact of disposal water bottles. Most water bottles are made with a petroleum-based plastic that uses a great amount of energy and water to make, and therefore add to climate change. Plus, according to David Suzuki, "the growing demand for bottled water undermines confidence in public drinking water systems."<sup>1</sup>

**PROJECT:** Lobby to remove plastic water bottles from your school and promote tap water instead. Follow the progress of school districts that are looking at whether or not to ban plastic water bottles in schools.

2. Learn what UNICEF is doing to ensure everyone's right to safe drinking water is realized. Research the water, sanitation and hygiene (WASH) program.

*The Water, Sanitation and Hygiene* website ([http://www.unicef.org/wes/index\\_bigpicture.html](http://www.unicef.org/wes/index_bigpicture.html)) and *The Right To Water* website (<http://www.righttowater.info/>), launched on Human Rights Day 2003, have been established by WaterAid and Rights and Humanity, in co-operation with Freshwater Action Network (FAN), as part of UNICEF's contribution to the International Year of Freshwater 2003.

**PROJECT:** Organize a fundraiser to raise money to support the WASH program. Start a competition (with an entry fee) and challenge students to develop a song promoting the WASH program.

3. Research The Tap Project, a campaign aimed at building awareness of clean, accessible water as a global child health issue. During World Water Day 2009, participating restaurants across Canada suggested patrons add a donation of \$1 for the tap water they received. For more information see <http://www.taproject.org/>.

**PROJECT:** Create a YouTube clip, PowerPoint presentation or a song/jingle/PSA to encourage actions to promote the Tap Project. Include the details of the project, as well as statistics such as how many restaurants participated, how much money was raised, etc.

#### NOTES

1 Suzuki, David and David R. Boyd, *David Suzuki's Green Guide* (Toronto: Douglas & McIntyre, 2008), 68.

#### Fraser Heights Secondary School – School District # 36 – Surrey

Students at Fraser Heights Secondary sold reusable water bottles and built a bio-sand water filter to address water issues locally and globally. They also work with local elementary schools to raise awareness of sustainability issues. They are a 2009 winner of the BC Green Games! For more information see <http://www.bcgreengames.ca>.



Lao primary school children working on the mural.

#### Vientiane, Lao People's Democratic Republic

To mark World Water Day 2009, Laotian school children worked together and let their creative sides shine to design a huge mural displayed at a central park. The young artists painted their own impressions and images of life along the Mekong River to raise local awareness about the sustainable management of water. For more information see <http://www.unicef.org>.

## Student Handout #19

### BIO-SAND FILTER

For over 10 years, the Gupta family had been drinking water from a tube well dug right outside their door. Therefore, no member of the family had to walk great distances to gather water. Unfortunately, it was recently discovered that the well water was contaminated with arsenic.

“The symptoms started with nausea and weakness,” said Mr. Gupta, a resident of Thulo Kunwar village in Nawalparasi District. “In time, my skin hardened and small nail-like warts emerged on my palms, and soon I developed tumours, too.”

“There are a few solutions that can be adopted immediately after identification of contaminated wells,” said UNICEF Nepal Project Officer Madhav Pahari. “The first, most reliable option is to find safe water from the nearest tube well for cooking and drinking. Secondly, people can drill a new well in the safe aquifers.”

Due in part to the fact that climate change is creating a global shortage of potable water, finding an alternative safe, clean source is not always an option. If this is the case, a bio-sand filter can be installed to help remove arsenic particles or other sediments and pathogens from the water supply. Installation of the filters is one of the many initiatives supported by UNICEF to reduce the effects of arsenic contamination in Nepal.

Story adapted from *Diluting the Pain of Arsenic Poisoning in Nepal* found at [http://www.unicef.org/infobycountry/nepal\\_35975.html](http://www.unicef.org/infobycountry/nepal_35975.html).

#### Climate Change Connection

Like carbon, there are trace amounts of arsenic in all living matter. “Arsenic may enter lakes, rivers or underground water naturally, when mineral deposits or rocks containing arsenic dissolve. Arsenic may also get into water through the discharge of industrial wastes and by the deposit of arsenic particles in dust, or dissolved in rain or snow.”<sup>1</sup>

Human activities that can add arsenic to our water are the same activities that are contributing to climate change and include burning fossil fuels; mining metals such as gold; using pesticides in agriculture and burning waste.

#### Your Task!

Create a one-minute public service announcement or radio jingle to promote the purchase and use of bio-sand filters so children will have clean water. First, research bio-sand filters further by using the internet to search “bio-sand filters.”

#### NOTES

1 Health Canada, “Arsenic in Drinking Water,” <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/arsenic-eng.php> (accessed May 2009).



Jiuta Gupta draws water for her daughter through a new bio-sand filter, provided by UNICEF that helps eliminate arsenic.

## Student Handout #20

### UNICEF BASIC FAMILY WATER KITS

In Yemen in 2008, thousands of people were affected by a tropical storm and the flooding that followed. Lives were lost and extensive damage to homes, crops and livestock were witnessed.

UNICEF estimated that 68 people are dead and nearly 3,300 households were destroyed in the floods. About 25,000 people have been forced to take refuge in shelters.

UNICEF and its partners were there with emergency aid. As water is essential to human existence, the aid included basic family water kits (items included buckets, soap, towels and purification tablets).

UNICEF representative Aboudou Karimou Adjibadé attributed the rare storm to the effects of climate change. He said this region of Yemen is not accustomed to flooding so many of the homes are made of mud and literally washed away in the flooding. "This kind of tropical storm has not hit Yemen for almost 600 years. It is something very unusual," he said.

Story adapted from

<http://www.unicefusa.org/news/news-from-the-field/tens-of-thousands-displaced.html>.

#### Climate Change Connection

The impact of climate change, is droughts, floods, storms, temperature changes and weather pattern changes. There is increasing evidence of changes in the climate system resulting in an increase in the frequency and severity of natural disasters. This, in turn, will put added pressure on the global supplies of clean, safe drinking water.

UNICEF needs our support to supply clean water in times of natural disasters. With a donation of \$100, you allow UNICEF to distribute a basic family water kit for ten households, with detergent, soap, wash basin, towels, bucket and water purification tablets.

#### Your Task!

Create a one-minute public service announcement or radio jingle to promote the purchase of UNICEF's basic family water kits so children will have clean water.



A boy in the Maldives carries collapsible water containers, which are included in UNICEF basic family water kits. UNICEF has distributed thousands of kits to tsunami-affected families.



Tens of thousands of Yemeni children have been affected by floods that followed a rare tropical storm.

## Student Handout #21

### WATER RUN CLEAN

Sketch your filter design. Provide dimensions and label the materials' striations.

#### Instructions for Testing

- Prior to filtering
  - Collect 250ml of muddy (contaminated) water. Stir well.
  - Observe colour, clarity and odour of the water. Record your descriptions in the chart below.
  - Measure the TDS of the water and record in the chart below.
- Pour your contaminated water into your filter.
  - Record how long it takes to completely filter.
  - Observe colour, clarity and odour. Record your results.
  - Measure the TDS of the water and record your results.

Water volume	Filtration Time (ml)	(in seconds)	Description of water sample			
			Colour	Clarity	Smell	TDS ppm
Water sample prior to filtering	250ml	0				
Water sample after filtering						