



## FABULOUS FILTRATION

### INTRODUCTION

Water pollution is when harmful substance (these can be biological like bacteria or chemical like phosphates or even organic like soil and fertilizer) enter water systems. Water pollution reduces the quality of water system. Water is extremely vulnerable to pollution because substances can readily. Polluted water can be dangerous to people as well as aquatic animals and plants. This is of particular significance in South Africa where large numbers of people rely on untreated water directly from rivers and dam, for basic needs.



#### DID YOU KNOW?

A shocking 3 575 000 people die from unclean water annually. (*World Health Organisation*)

This horrific number is higher than the number of people killed in wars. Globally two billion people drink water contaminated with human faeces (<https://www.who.int/news-room/fact-sheets/detail/drinking-water>). Low- income groups are disproportionately affected by these pollutants due to access to safe water.



#### DID YOU KNOW?

Astoundingly, less than 1% of the earth's water is drinkable.

Many of our water systems are becoming increasingly polluted, because of direct human impact. South Africa faces a myriad of threats to its water health, causing a decrease in the quality of clean, safe water.

## **REVIEW OF TYPES OF WATER POLLUTION**

### **Agricultural Pollution**

Not only does agriculture consume vast quantities of water, but it is also a big contender for worst polluter of water. Farms use pesticide, herbicides, fertilizers and generate animal waste. Rain washes these contaminants into rivers. This can cause nutrient pollution (when too many nutrients enter a system) causing algal blooms (often toxic) that can reduce water quality. Although these nutrients do occur naturally in systems, too many nutrients cause the system to become unbalanced. Phosphate and nitrates are of special concern, because they inhibit growth of certain water plants while increasing growth of blue-green algae. The waterways then become overcrowded, and the plants begin to die. Decomposition of dead plant material uses up oxygen in water that can result in aquatic fauna die-off. This is called **eutrophication**.

**Blue-green algal blooms can also have a direct impact on human health causing diarrhoea, skin irritations and vomiting.**

### **Sewage and Wastewater**

Wastewater is defined as water that is used in our homes and businesses (commercial, agricultural) and then disposed of. Unfortunately, it contains toxic chemicals, like solvents and often human waste. Wastewater also includes water that comes off roadways often containing oil, chemicals, and litter. A large portion of this wastewater remains untreated and simply enters water systems like rivers and oceans.

This pollution can have huge impacts on aquatic animals and plants. Many human diseases are related to sanitation and faecal pollution of water. Diseases like cholera (*Vibrio cholera*), can cause many human deaths. The bacteria are transmitted through faecal matter and causes severe diarrhoea and vomiting.

### **Urbanisation**

Large numbers of people are moving into urban areas. This is resulting in an increased pressure on urban water systems.

Contributing factors to urbanisation-caused water pollution include:

- Poor management of sewage
- Increase in hard surfaces (e.g., roads and concrete lots) resulting in increased stormwater runoff
- Increased need for food supplies resulting in increased fertilizer and pesticides use in agricultural areas

### **Deforestation**

Clearing land of natural vegetation results in increased erosion and soil lost into water ways. This reduces water clarity and can have effects in the abilities of aquatic plants to photosynthesize.

### **Damming of rivers**

Damming of rivers reduces the amount of material suspended in the water. This has effects downstream as the water becomes depleted on nutrients. Dams also contribute to increased evaporation.

### **Industries and Mines**

Industry and mines produce waste material that can have profoundly serious effects on water systems. These chemicals can be toxic to humans, aquatic animals, and plants. Industry by-products can also affect the temperature and the pH of water. Mining and industry can also add heavy metals and minerals to water systems, both causing toxicity in aquatic life as well as humans. Pregnant women and children are especially at risk from heavy metal toxicity.



**Heavy metals are known to concentrate as they move up a food chain. This explains why big fish are showing an accumulation of heavy metals like lead and mercury.**

Fracking in South Africa is a contentious issue, because of its potential effects on sensitive groundwater systems. In the case of fracking (hydraulic fracturing) water often mixed with chemicals and sand is pumped into underground wells to release natural oil and gas.

- <https://www.dailymaverick.co.za/article/2021-06-06-south-africa-swims-against-the-global-tide-puts-controlled-fracking-back-on-the-agenda/>
- <https://afriforum.co.za/en/american-fracking-ban-is-a-loud-and-clear-warning-for-south-africa-botswana-and-namibia/>

### **Wetland destruction**

Wetlands are our natural filter systems, removing toxic chemicals and heavy metals from our water systems. As well as being home to a variety of animal and plants species, wetlands play a crucial role in the regulation of water movement, naturally damming water ways and slowly releasing the water. Damaging or destroying wetlands therefore has serious environmental consequences, such as increasing flooding events and a dramatically reducing water quality.

### **Leaching from landfills**

Leachate is a highly concentrated liquid that drains from landfills and is often filled with very toxic chemicals and substances. If these substances contaminate ground water or surface water sources, it can cause large scale pollution and rendering of water unsuitable to human consumption.

### **Oil Pollution**

When we think of oil spills, we often think of the big spills from ships that we see in the news. In fact, an even larger proportion of oils spills are from land-based sources such as, factories, farms, and roadways.

### **Plastic waste**

Annually thousands of kilograms of plastic waste makes its way into our water systems. Plastics clog up water ways, block light for plant photosynthesis as well as impact food chains. It is most acutely felt in marine ecosystems, and many sea animals lose their lives due to choking on plastics.

<https://www.aquarium.co.za/blog/entry/The-plastic-problem-How-much-plastic-pollution-is-in-our-ocean>

## WATER SOURCES AND THEIR MAIN POLLUTANTS

### Groundwater

Water that has seeped underground through porous parts of the earth's crust is known as groundwater. Many people rely on groundwater to supply drinking water, despite it being an invisible resource.

Ground water gets polluted from leachate from landfills, fertilizers from farming practices and leakage from septic systems. Cleaning this water is almost impossible and costly. Once polluted, groundwater can remain so for thousands of years.

### Surface water

Surface water includes oceans, lakes, rivers, wetlands, dams. This is our main source of potable water. Nutrient pollution is in fact the main source of pollution in these systems, followed by industry and municipal waste discharge. Litter is a huge issue in our oceans, blown or washed into the sea from land.

**The access to clean, drinking water is a fundamental human right in South Africa, but at the same time we have a responsibility to ensure that our scarce resource is cared for correctly.**

## LESSON PLANNING

### STEP 1: Introduce the concept

Why not start the lesson by drinking some water together with your learners? You can use this as an introduction as to where the water came from, is it clean, was it easy to get etc.



### EDUCATOR HINT:

**If you have a river  
or water body  
nearby you can use  
this an example.**

You can use this as a springboard to discuss the numerous ways our precious water sources can be polluted..

There is a limited amount of fresh, clean water available on our planet. Sadly, this precious resource is becoming increasingly polluted with bacteria, chemicals, waste, and litter.

Have a look at the following videos:

**Water Pollution Basics**

- <https://www.youtube.com/watch?v=Om42Lppkd9w>
- <https://www.youtube.com/watch?v=MEb7nnMLcaA> (for the younger grades)

**South Africa's water pollution**

- <https://www.youtube.com/watch?v=dQ1kvx0sDIU>
- <https://www.dailymaverick.co.za/article/2021-04-26-south-africas-rivers-of-sewage-more-than-half-of-sas-treatment-works-are-failing/>

**Great pacific garbage patch it is not what you think**

- <https://www.youtube.com/watch?v=6HBtI4sHTqU>

**Ocean clean-up**

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

**Clean Drinking Water Statistics**

- <https://www.who.int/news-room/fact-sheets/detail/drinking-water>



**DID YOU KNOW?**

- 785 million people lack a basic drinking water service.
- At least two billion people use water contaminated by faeces.
- By 2025, half of the world's population will be living in water stressed areas.

Discuss neighbouring water systems- Are they clean? Would you drink them? etc.

Discuss pollution types and what you will be using to represent them (e.g., cooking oil for oil spill, plastic for litter).

Introduce the concept of a **filter system** and how it can remove pollutants from water.

  
**Water filtration is the process of removing matter from a liquid.**

Ask learners what they would do if they only had access to dirty water?  
How would they clean it to drink it?

### **STEP 2: Create a Filter**

You as the educator should demonstrate a basic filter and how to safely make one.

After this lesson, learners should understand the issues of water pollution, discuss different pollutants, design, and evaluate a water filtration system.

This is a problem-solving exercise.

#### **Materials:**

- 2ℓ Coke or similar bottle (recycled please)
- Gravel
- Sand
- Serviettes
- Cotton wool
- Pollution substitute (sand, food waste, bits of plastic, food colouring, cooking oil, spice etc.)



#### **EDUCATOR HINT:**

**IMPORTANT: water should still NOT be considered safe for drinking after filtering!**

**Instructions:**

- Cut an old plastic 2litre bottle in half using scissors or a knife.
- Use scissors or a knife to poke a small hole in the bottle cap.
- Place the bottle upside down into the bottom half that was cut.
- Add the filtrate materials from the bottom up (filter paper/old sock, serviettes, cotton wool, fine sand- 2-3cm-, small gravel stones- 2-3cm-, large gravel stones- 2-3 cm)



**EDUCATOR  
HINT:**

**You can create your own “polluted” water using oil, mud, leaves, bits of plastics, food colour etc.**



**Questions you can discuss with your learners include:**

- Which material filtered which pollutant and why?
- Even if the water looked clean, was it drinkable?
- What contaminants might not get filtered out?
- What about bacteria?
- What does this filter process in nature?

**STEP 3: Brainstorm with the learners on how to reduce water pollution.**

What can you do to help reduce water pollution?

- Stop littering in its tracks. This is a two-fold issue, one we need to reduce the amount of waste that is produced and two we need to prevent the waste from entering water systems.
- Avoid excess fertilizers



- Mulching prevents loss of soil (and whatever is in the soil) into water systems.
- Do not pour oil down the drain. This includes cooking oil. Instead, a clever trick is to add it to kitty litter and dispose of it in the dustbin.
- Use less plastic.
- Reduce, re-use and as a last resort, recycle.
- Try and use environmentally friendly cleaning products that break down naturally.
- Dispose of toxic chemicals correctly, many need to be taken to a drop-off site.
- Never flush medicines or dispose of them in the kitchen sink. Products in medicines can cause serious issues for aquatic wildlife.
- Use phosphate-free cleaning materials (phosphate can lead to algal blooms).
- Avoid using pesticides in the garden, because they can be toxic to water fauna.
- Protect your soil and prevent it getting into water systems.
- Service your car regularly to reduce oil leaks. Oil that ends up on the road is washed into stormwater drains that ends up in our water systems.
- Save water.
- Plant indigenous flora around water bodies to protect the system, by reducing erosion.
- Choose your food wisely, farming methods can have huge impacts on the environment, from chemicals uses to grow food to the transportation of crops to our cities.
- Report sewage and effluent flow into water systems.
- Join a conservation society and take part in their action events
- Pick up dog poop.
- Use your voice- protest, report, speak out.

**LESSON IDEAS**

**FABULOUS FILTRATION**

<b>GRADE</b>	2-3
<b>SUBJECTS</b>	Life Skills, Natural Science and Technology
	Educator will demonstrate how a bottle water filter works, lead a discussion on filtering water and guide learners through completing worksheets on the topic
<b>DURATION</b>	45 minutes – 1 hour
<b>RESOURCES</b>	The educator will need to make the filter to demonstrate to the class. Worksheets for learners to complete are available to download.

**FABULOUS FILTRATION**

<b>GRADE</b>	4-6
<b>SUBJECTS</b>	Life Skills, Natural Science and Technology
	The learners will design and make their own water filters.
<b>DURATION</b>	1-2 hours (or over 2 lessons/days)
<b>RESOURCES</b>	Water filter materials for each learner and printed worksheets (available to download)

## FABULOUS FILTRATION

<b>GRADE</b>	7-9
<b>SUBJECTS</b>	Life Science, Natural Science and Technology
	The learners will design and make their own water filters, testing different materials to identify the most effective filter options.
<b>DURATION</b>	1-2 hours (or over 2 lessons/days)
<b>RESOURCES</b>	Internet access, downloaded and printed learner worksheets, materials for each learner to make their own water filter.
<b>ADDITIONAL NOTES</b>	See Lesson Plan for more resources and notes on this lesson.

### CROSS- CURRICULAR ACTIVITIES:

#### MATHEMATICS

Run a litter collection on your school grounds. Present your results in graphic forms (bar graphs, pie charts).

#### ART

Design posters to educate on conserving water sources. Have a litter collection and use litter to create art, highlighting the importance of reducing river and ocean pollution.

<https://teachheart.org/2014/04/02/heart-kids-make-art-to-show-danger-of-pollution/>

## THEMATIC

Access old aerial photos of your local river systems and compare them to current aerial photos. Research the changes and the environmental impacts.

## ENGLISH

There are a variety of visual literacy sources for this theme. Encourage learners to come up with their own inventive copywriting for an anti-pollution campaign. See the following links for inspiration:

<https://articulateart.wordpress.com/tag/pollution/>

<https://themarketingbirds.com/7-creative-water-pollution-ads/>



### ADDITIONAL RESOURCES AND REFERENCES

<https://www.conserve-energy-future.com/25-simple-and-easy-ways-to-reduce-water-pollution-now.php>

[https://wwf.panda.org/discover/knowledge\\_hub/teacher\\_resources/webfieldtrips/water\\_pollution/](https://wwf.panda.org/discover/knowledge_hub/teacher_resources/webfieldtrips/water_pollution/)

<http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/facts-and-figures/all-facts-wwdr3/fact-15-water-pollution/>

<https://www.greenpeace.org/africa/en/blogs/49015/what-are-the-causes-and-effects-of-water-pollution-in-africa/>

<https://www.randwater.co.za/CorporateResponsibility/WWE/Pages/WaterPollution.aspx>