

ACTIVITY TWO: DIRTY WATER, CLEAN WATER, LET'S DESIGN AND BUILD A WATER FILTER

During this TECHNOLOGY exercise, learners investigate, design, make and evaluate a water filtration system, similar to that of a wetland.

Wetlands are one of the most threatened habitats in the world. Many have been destroyed because people did not realise their importance. We used them as dumping grounds, for farmland or built houses on them. Now we know better and are working towards conserving our wetlands.

One of the important things that wetlands do is act as filters.

- **Living filters:** Wetland plants absorb nutrients in the water, using them for growth. Plant roots can also trap polluting heavy metals in the soil, especially in clay soil.
- **Spongy soil:** Wetland soils are often made up of clay and contain lots of organic material. Water passes very slowly through these soils before running into streams. This means that the wetlands stay wet for longer, and keep the streams running for longer too.
- **Silt cleaners:** Floodwaters are often muddy, carrying silt from soil erosion. Plants in the wetlands slow down the flow, and the silt settles out. Water running out of a wetland is often much clearer and cleaner than that flowing in. This can be important to people who drink the water downstream.

Aren't wetlands wonderful! They improve water quality as they are such good natural filters and the water leaving the wetland is cleaner than the water entering it!

It's time for the learners to investigate, design, make and evaluate their own water filters.

What the learners need to do:

1. **Investigate whether wetlands clean visible pollutants out of water**
 - ***Give each learner copies of the enviro fact sheets on wetlands and pollution (at the end of this activity); a copy of the 'A waterworks that works sheet' (they may only use these sheets for ideas and to get them thinking about their own designs, they may not copy these designs).***

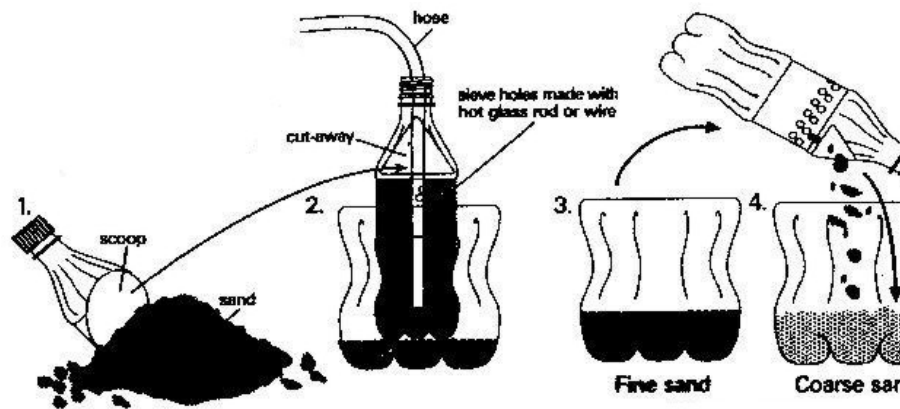
The investigation phase is the research phase. Learners need to look at pictures of wetlands, look at books, the enviro fact sheets provided and any other material that they can find on wetlands. They can also discuss their ideas with friends, in small groups and with you, the teacher. Let the learners write a paragraph on their "research" (what sources of information they used, what they found out, what they think they would like to design).

2. **Design**
 - Each learner will need paper and pencils so that they are able to write and draw their design ideas. The design must be on paper and learners should make rough drawings first. When they are happy with their designs, they need to make a neat drawing with a heading and labels or a colour key. The dimensions

of the design must be written down and the materials that will be used must be listed. Any constraints / restrictions that the learner can see / anticipate in the future must also be noted.

- It is very important that you, the teacher, guide the learners through this design phase. Some of the learners designs may be wonderfully creative but very impractical, so you need to be on hand to make sure that their designs will work.
- 3. Make**
- The learners need to gather together the materials they will need to construct their design. Encourage them to use recycled objects if possible. When they have all they need, the designs need to be constructed!
- 4. Evaluate**
- Test the designs during the next activity, a NATURAL SCIENCES lesson!!

Good luck with your water filters!!



Enviro Fact : Pollution

Pollution is an unwelcome concentration of substances that are beyond the environment's capacity to handle. These substances are detrimental to people and other living things. In an undisturbed ecosystem, all substances are processed through an intricate network of biogeochemical cycles, such as the nitrogen and carbon cycles. During these cycles, substances are taken up by plants, move through the food chain to larger and more complex organisms, and when the latter die, are decomposed (broken down) into simpler forms to be used again when they are taken up by plants. Biodegradable substances are those that can be broken down by the environment's biological systems. Pollution occurs when the environment becomes overloaded beyond the capacity of these normal processing systems.

Examples include:

- An excess of normally helpful substances, such as the nutrients nitrogen and phosphorus.
- An excess of substances that are harmless, and perhaps even necessary in tiny amounts, but toxic in concentration. Copper, for example, is necessary in small amounts for healthy plant growth, but becomes a pollutant if it occurs in greater quantities.
- Synthetic (human-made) compounds that are poisonous in the environment, often even in trace amounts, such as DDT, dioxin, PCBs and organochlorines.
- Substances that, in any amount, are not biodegradable, such as plastics and highly persistent chemicals like DDT and other organochlorines.
- Some pollutants kill living organisms outright, other sub-lethal pollutants do not kill, but may cause long-term biological damage, interfere with organisms' reproductive cycle, or make them more vulnerable to disease.

Types of pollution. Pollutants can be grouped according to the main ecosystem which they affect. One pollutant often affects more than one ecosystem.

POLLUTANTS AND MAIN SOURCE	HEALTH AND ENVIRONMENTAL EFFECTS
AIR	
Sulphur dioxide – burning of coal	Acid rain and respiratory problems
Nitrogen oxides - vehicle emissions	Combine to form photochemical smog; causes respiratory problems
Volatile hydrocarbons - vehicle emissions	
Carbon monoxide - vehicle emissions	Restricts oxygen uptake, causes drowsiness, headaches, death
Carbon dioxide - burning of coal	Global warming
CFCs - aerosol, refrigeration, air-conditioning and foam-blowing industries	Destroy ozone layer
Methane - feedlots, rubbish dumps	Global warming
Noise - industry, traffic	Affects hearing, stressful
Asbestos dust - construction, mining, industry	Asbestosis, mesothelioma
FRESHWATER	
Sewage – inadequate sanitation	Pathogens cause typhoid, cholera, gastroenteritis; nutrients cause eutrophication
Fertilizers – agriculture	Eutrophication
Silt - agriculture, construction, mining	Smother aquatic organisms; affects light penetration
Pesticides - agriculture, and health services	Toxic; interfere with breeding of mammals and birds
Toxic metals – industry	Health and life threatening
Salinisation – industry, agriculture, landfill	Reduced crop yields; scale and corrosion in domestic and industrial water systems
MARINE	
Sewage – inadequate sanitation	Pathogens cause typhoid, cholera, gastroenteritis; nutrients cause eutrophication
Fertilizers – agriculture	Eutrophication
Oil spills	Smother marine plants and animals
Plastics	Death of marine animals
Pesticides - agriculture, and health services	Toxic; interfere with breeding of mammals and birds
LAND	
Solid waste is classified as hazardous (radioactive, pesticides, medical, poisons), or non-hazardous (domestic, urban, mining, industrial, scrap metal)	Hazardous waste is health- and life-threatening; non-hazardous is unsightly and disposal takes up much space

Dealing with pollution

In the past, most approaches to handling pollution could be summed up by the phrase 'dilution is the solution to pollution'. However, pollution levels have increased so much in amount and toxicity that this approach is no longer acceptable. An alternative approach is source reduction, i.e. a reduction in the amount of pollution where produced.

- Point source pollution: pollutants are produced from a stationary location, e.g. industrial plants, mines, and municipal sewage works.
- Non-point source pollution: this pollution cannot be traced to a specific spot, and is far more difficult to monitor and control. Common examples are veldt fires, motor vehicle emissions, fertilizer runoff, sediment from construction and erosion, plastic packaging, and gases from aerosol cans. Some non-point sources can be addressed by laws, such as banning CFCs (chlorofluorocarbons), or requiring car manufactures to install emission controls.



Polluter-must-pay principle

This means that a polluter should bear the costs of avoiding pollution, or remedying its effects. This principle is difficult to apply when the source of pollution cannot be identified, as is often the case with atmospheric pollution. The principle can be usefully applied following a pollution disaster, such as an oil spill from a tanker. However, the consumer often pays for such pollution costs. For example, Eskom estimates that the fitting of scrubbers on the chimneys of their power stations will increase the cost of electricity by 30%.

Movement of pollution

Pollution does not stay in one place but is moved around the world by air and water, as well as by living organisms. Even in Antarctica, birds and marine mammals show traces of pollutants such as DDT and PCBs. Some pollution is deliberately moved abroad. Companies restricted by pollution control regulations at home, sometimes move their plants to other less restrictive countries, as was the case with the plant involved in the Bhopal chemical disaster. Or while remaining at home, they may sell products abroad, that are classed in their own countries as too dangerous for sale, such as banned pesticides. In some cases hazardous waste may also be shipped abroad, generally from industrialised countries to developing countries willing to accept such waste for a fee, despite the hazards. When such pollutants turn up again in the originating country, as when food is imported that contains banned pesticides, the process is said to be completing the 'circle of poison'.

What can you do

- *Avoid the creation of waste.*
- *Find out all you can about pollution and protest loudly when you see it happening.*
- *Report air pollution to the Chief Air Pollution Control Officer (CAPCO), Department of Health.*
- *Report freshwater and land pollution to the Department of Water Affairs and Forestry.*
- *Report marine pollution to the Department of Environment Affairs and Tourism, Marine Pollution Division.*

Enviro Fact : Wetlands



Wetlands are difficult to define because of their great variation in size and location. The most important features of wetlands are: waterlogged soils or soils covered with a shallow layer of water (permanently or seasonally), unique types of soil, and distinctive plants adapted to water-saturated soils. Marshes, bogs, swamps, vleis and sponges are examples of wetlands.

Why are wetlands important?

Wetlands associated with streams and rivers slow floodwaters by acting as giant, shallow bowls. Water flowing into these bowls loses speed and spreads out. Wetland plants, particularly reeds and sedges, play an important role in holding back the water. The wetland acts as a sponge as much of the flood water is then stored in the wetland and is slowly released to downstream areas, instead of it all rushing to the sea within a few days. This greatly reduces flood damage, particularly erosion, and ensures a more steady supply of water throughout the year.

Filters: Wetlands improve water quality as they are very good natural filters, trapping sediments, nutrients (e.g. nitrogen and phosphorus), and even pathogenic (disease-causing) bacteria. In addition, pollutants such as heavy metals (e.g. mercury, lead) and pesticides, may be trapped by chemical and biological processes. In other words, the water leaving the wetland is cleaner than the water entering it.

Wetlands and wildlife: Wetlands are filters where sediments and nutrients accumulate, so many plants, such as bulrushes, grasses, reeds, waterlilies, sedges and certain trees grow there. The plants, in turn, provide food and a place for attachment and shelter for many creatures. There is more life, hectare for hectare, in a healthy wetland than in almost any other type of habitat. These productive places support huge numbers of insects, fish, birds and other animals. Some animals are completely dependent on wetlands, whilst others use wetlands only for part of their lives. The wattled crane, for example, is dependant on wetlands for breeding. The rich diversity of waterbirds in southern Africa (totalling 130 species) is possible because of the many wetlands spread across the sub-continent. The wetlands of southern Africa are of international importance as they are the southern destination for many migratory water birds.

People and wetlands: Wetlands have been used for centuries as grazing for domestic stock, and as a source of reeds used for thatching, hut construction and basket weaving. They provide fishing and hunting, and the opportunity to observe wildlife, especially birds. Wetlands are appreciated for their beauty as open spaces and also for their educational value.

Wetlands in trouble: To many people the thought of a marsh, swamp, bog or vlei is associated with dampness, disease, difficulty and danger. Because of this wetlands are often seen as wastelands that should be converted to cropland, dams, commercial timber plantations of alien trees, waste disposal sites and pastures. Many wetlands have been "reclaimed" for industry and the construction of airports, harbours and sewage treatment plants. Historically wetlands have been drained in attempts to control malaria.

All wetlands in southern Africa are threatened. Botswana's magnificent Okavango Delta is threatened by the possible canalisation of the Boro River to supply South Africa with water for both domestic and industrial use. Throughout the region, smaller seasonal wetlands in urban areas have virtually disappeared, while riverine wetlands are constantly under threat of being turned into agricultural land.

What you can do:

- *Get to know the wetlands in your area and list the plants and animals living there. Draw a map of the wetland's position, size and use. Take photographs of the wetlands from fixed vantage points, and at different seasons of the year, to compare the changes between seasons and from year to year.*

Report the abuse of wetlands to your local nature conservation officer, agricultural extension officer or the Department of Environmental Affairs and Tourism. Always make your report in writing to ensure that the officer concerned has to investigate.

Criteria to assess learners during this technology lesson

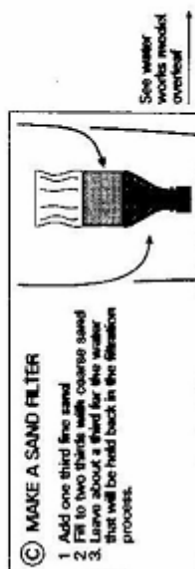
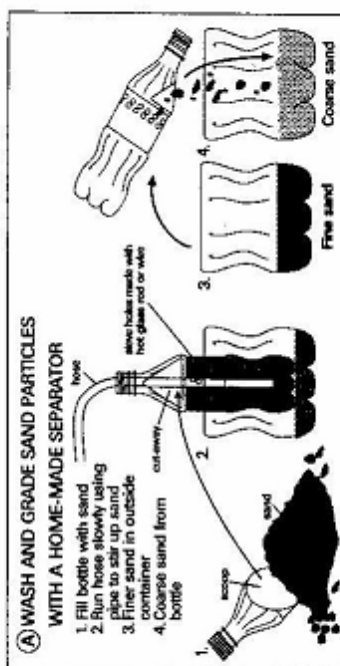
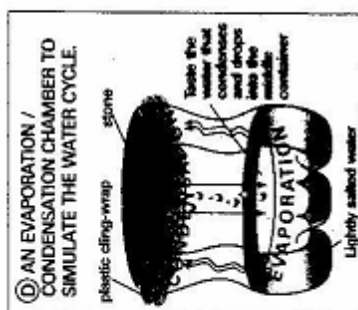
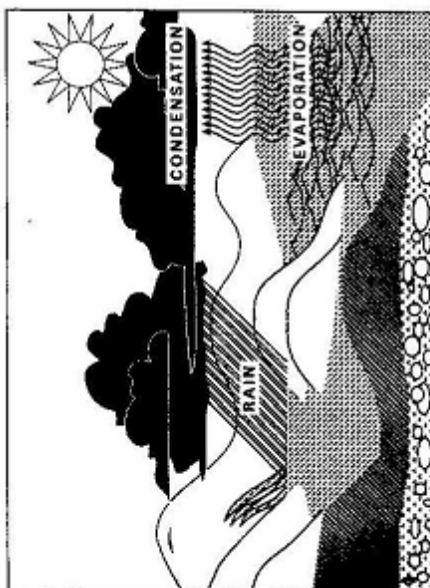
Criteria	Exceeded requirements of the Learning Outcome	Satisfied requirements of the Learning Outcome	Partially satisfied requirements of the Learning Outcome	Not satisfied requirements of the Learning Outcome
The learner wrote a paragraph outlining what he/she did during the research phase				
The learner drew rough and neat designs of his/her water filter. He/she had a heading, labels, or a key and had a list of all the materials needed and their measurements				
The learner built his/her design				

WOW!



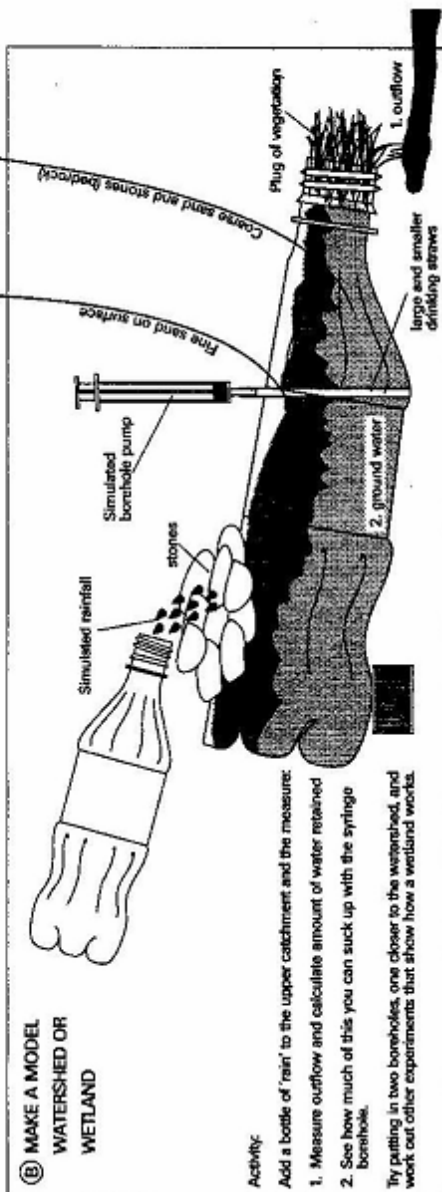
A WATERWORKS THAT WORKS

- Use this activity sheet to make and use:
- the apparatus to clean and grade sand,
 - a working model of a watershed or wetland,
 - a sand filter and the other apparatus for a water works that works, and
 - an evaporation / condensation chamber to simulate the water cycle.

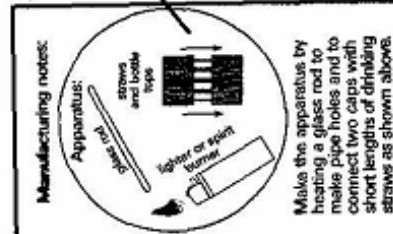
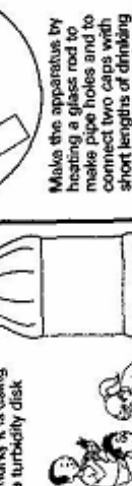


APPARATUS:

- Plastic Coke bottles;
 - a glass rod;
 - drinking straws;
 - small syringe,
 - fish-tank plastic tubing;
 - plastic pipe clamp;
 - gas lighter or spirit burner;
 - turbidity disk;
 - propettes;
 - Jik;
 - Alum flocculant.
- Optional:
- coffee filter paper and fish-tank activated carbon to make a carbon filter; Microchem water test kit to test the various stages of the water purifying process.



© MAKE A WATERWORKS THAT WORKS



2. See how murky it is using a turbidity disk



1. Collect a bottle of river water

