<u>ACTIVITY THREE</u>: HOW WELL DO OUR WATER FILTERS WORK?

Following Activity Two, learners test out and evaluate their water filters during this NATURAL SCIENCES lesson.

ACTIVITY

1. Divide the class into groups. Each group must have the equipment listed below.
2. The groups will have as many filters in each group as there are number of learners (in other words if there are five learners in each group, there will be five filters as each learner will have designed and made his/her own filter during Activity Two).
3. Set up the equipment.
4. Each group must test the turbidity of their glass of water before and after filtering.
5. Record the results.

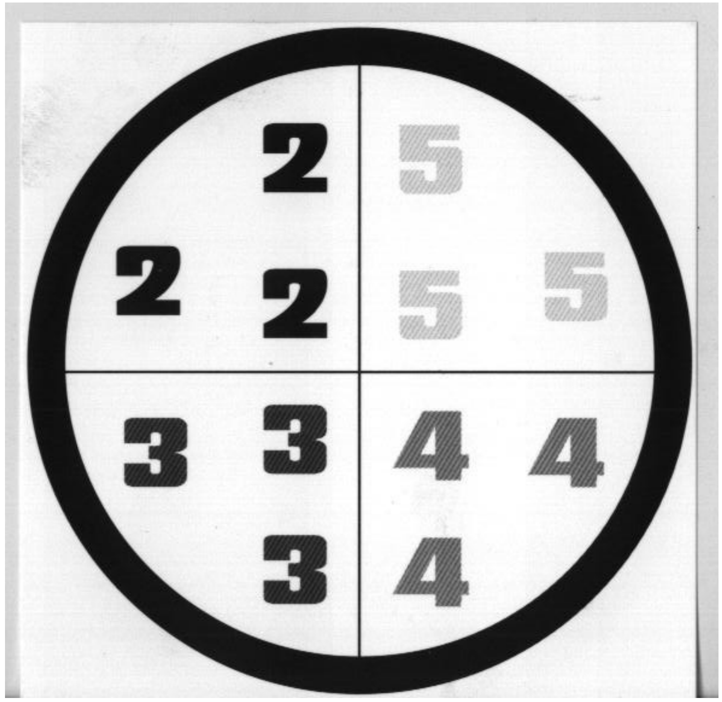
Each group will need the following equipment:

- The water filters constructed during Activity Two, the technology lesson
- Pens and paper
- A glass of dirty water (either collected from a local river or made dirty by adding sand)
- A container to collect the filtered water
- A turbidity disk (to be found on page 12)
- Water clarity (turbidity) information (on page 13)
- Groundwater recharge and discharge (on page 14)
- Enviro fact sheets on “Wetlands”, “Pollution” (use the enviro fact sheets at end of Activity Two) and “Water” (found at end of this activity)

At the end of this activity, groups need to report back on their findings.

Each learner must write up the experiment, the results and their conclusion. *(This could be included into the learner’s portfolio).*

TURBIDITY DISK – to cut out:

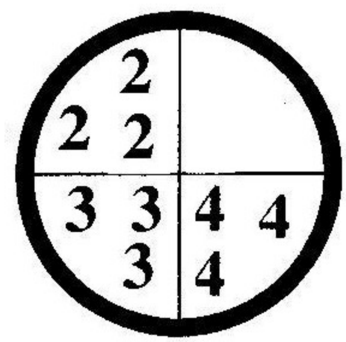


WATER CLARITY (TURBIDITY)

Turbidity refers to the relative clarity of water. Murky water stops light penetration and inhibits water life with a consequent loss of plant and animal diversity. Plants need light to grow and both large and small animals may suffer growth retardation or death because they cannot see to hunt and breed, or their gills may become clogged with particles of silt and organic matter. Suspended solid pollution can be caused by silt from soil erosion, by sewage and industrial waste or by excess microscopic life in the water.

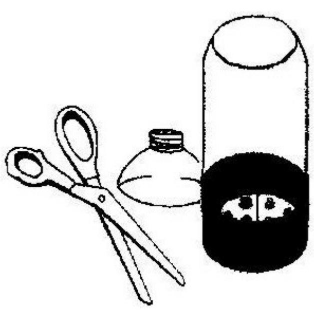
Note: Some rivers are naturally turbid and many organisms can only live in turbid conditions. The key is knowing natural levels in your area especially in Cape and forest 'black water' streams and rivers.

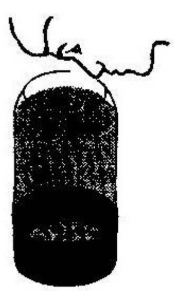
How the test works:



The turbidity sighting disk is based on an early technique of lowering a black washer into a long glass tube of water and noting the depth at which it is no longer visible. The turbidity disk has a circular washer (outer ring scored as 1) and numbers of differing density (scored 2-5). A measure of clear or murky water (turbidity) can be obtained by noting the image density visible in a 20 centimetre column of water.

Testing water clarity / turbidity:





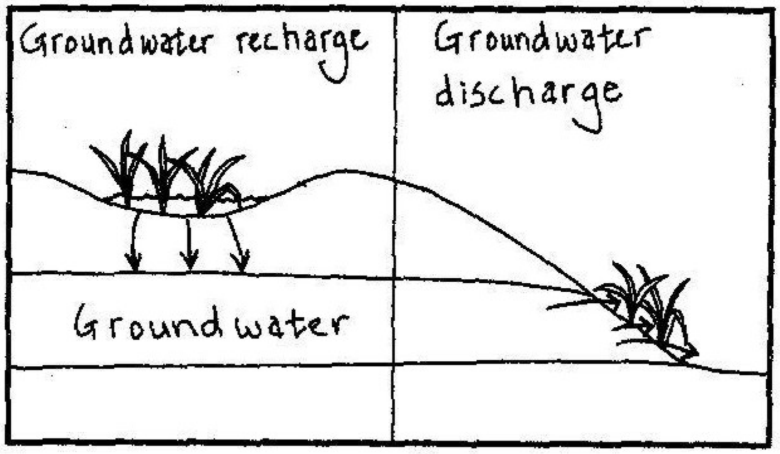
1. Cut down a 1.5 or 2 litre plastic cool drink bottle.
2. Fix the disk to the inside bottom of the bottle.
3. Fill the bottle to 20cm with a debris-free sample of water.
4. **Look** into the bottle and pick out the water clarity number that is visible (outer ring [1], 2, 3, 4 or 5).
5. **Repeat** to get a reliable result.

The water clarity is:

Disk not visible	Score 1-3	All visible
BAD	**NOT SO GOOD**	***OK***

Information Sheet on Groundwater recharge and discharge

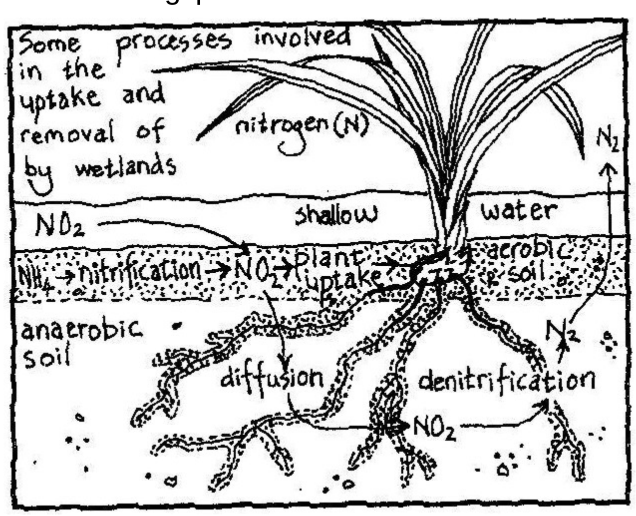
Wetlands may have an important influence on the recharge or discharge of groundwater. Groundwater recharge refers to the movement of surface water down through the soil into the zone in which permeable rocks and overlying soil are saturated. Groundwater discharge, in contrast, refers to the movement of groundwater out onto the soil surface. Although poorly understood, it appears that most wetlands are groundwater discharge or throughflow areas. Wetland areas where groundwater is discharging are often referred to as seepage wetlands because they are places where the water seeps slowly out onto the soil surface.



Water purification

Wetlands are natural filters, helping to purify water by trapping pollutants (such as sediments, excess nutrients [most importantly nitrogen and phosphorus] heavy metals, disease-causing bacteria and viruses and synthesized organic pollutants such as pesticides). Thus, the water leaving a wetland is often purer than the water which enters the wetland. Wetlands are able to purify water effectively because:

- they slow down the flow of water causing sediment carried in the water to be deposited in the wetland. This also results in the trapping of other pollutants (e.g. phosphorus) which are attached to soil particles;
- surface water is spread out over a wide area, making it easier for exchanges between soil and water;
- there are many different chemical processes taking place in wetlands that remove pollutants from the water. For example, wetlands provide a suitable place for denitrification because anaerobic and aerobic soil zones are found close together. Denitrification is important because it converts nitrates, which could potentially pollute the water, to atmostpheric nitrogen which is not a pollution hazard;



- some pollutants such as nitrates are taken up by the rapidly growing wetland plants;
- the abundant organic matter in wetland soils provides suitable surfaces for trapping certain pollutants such as heavy metals; and
- wetland micro-organisms help decompose human organic pollutants such as pesticides.

Enviro Fact : Water

Water. South Africa is extraordinarily rich in natural resources - except for water. Water is a vital but scarce resource, distributed unevenly in time (frequent droughts alternate with periods of good rainfall) and space (the eastern half of the country is markedly wetter than the western half). Increasing demand for water, and decreasing water quality, make careful water management a priority in our country. It has been estimated that by the year 2025 South Africa's human population will have doubled, and that there will be insufficient water for domestic use, agriculture, and industry.

Rainfall. Our average rainfall is less than 500 mm a year, with the driest part of the country receiving less than 200 mm/year and the wettest receiving more than 2 500 mm/year! Rain does not always fall where it is most needed, and some areas of high demand, such as Gauteng, receive less water than they need. Most rain falls in the narrow belt along the eastern and southern coasts. The rest of the country receives only 27% of South Africa's total rainfall. In addition, hot, dry conditions result in a high evaporation rate.

Water is thus a very scarce resource in South Africa. Large-scale engineering has been used to store water behind dam walls, and to distribute water from regions of plenty to regions of need.

Rivers. There are few natural lakes in South Africa. We depend on rivers, dams and underground water for our water supply. Approximately 75% of the water flowing from South Africa into the sea occurs along the eastern and southern seaboards, where many short rivers occur. Flowing from east to west is the largest river in the country, the Orange River, which drains most of the rest of the country. Its water comes from sources in the Drakensberg and Maluti Mountains, and it flows into the Atlantic Ocean on the west coast.

Dams. About half of South Africa's annual rainfall is stored in dams. We have about 550 government dams in South Africa, with a total capacity of more than 37 000 million m^3. Dams have both positive and negative impacts. They can be beneficial for people in that they regulate the flow of a river, reducing flood damage and contributing to perennial rather than seasonal flow. In addition, sediment is deposited in a dam, and the growth of aquatic plants means that nutrients are removed from the water. Thus water leaving a dam may be cleaner than water entering it. The riverine ecosystem is usually affected negatively by a dam. Alterations in flow regime (quantity of water and timing of periods of high and low flow), temperature and water quality may cause reductions in biodiversity of riverine organisms below dams. Reduction in water flow reduces the river's scouring ability and this can lead to silting of estuaries.

South Africa's landscape is not well suited to dams. There are few deep valleys and gorges, with the result that most dams are shallow with a large surface area. Together with the hot, dry, climate, this results in much water evaporating from dams. In addition, the high silt load (a result of an arid climate, steep river gradients and poor farming methods) of our rivers means that the capacity of South Africa's dams is quickly reduced as they become silted. The rivers of the western Cape carry relatively less silt than those in the rest of the country.

Water abstraction. A growing problem for South Africa's rivers is a lack of water! Reduction in river flow, owing to abstraction (removal), and damming, has affected many of our rivers, for example those flowing through the Kruger National Park.

Intercatchment transfer of water. This involves the transfer of water from catchments with good supplies and low demand, to those where demand for water is high and the supply is poor. There are numerous intercatchment transfer schemes already in operation, and more are under construction or proposed. A major scheme is the Orange-Fish River scheme, where water gravitates from the Orange River at the Gariep Dam, and is piped through tunnels and canals to the Sundays and then the Fish Rivers in the Eastern Cape.

Transfers of this nature will have far-reaching ecological, political and socio-economic implications. As yet, little research has been carried out to establish the ecological consequences of intercatchment water transfers. However, areas of concern include reducing streamflow and water levels in one system, changes in water temperature and chemistry, and the transfer of invasive species between catchments.

Water pollution. Industrial and agricultural pollutants common in South Africa include: agricultural fertilizers, silt, toxic metals, litter, hot water and pesticides. These pollutants affect aquatic ecosystems and human health. Disease-producing bacteria are common in urban waste water, particularly from informal settlements that lack sewage and water purification facilities. For example, typhoid, cholera and gastroenteritis are transmitted by water contaminated with untreated sewage. Gastroenteritis is one of three main causes of death in South African children under the age of five.

Criteria to assess learners during this natural sciences 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 was able to test the filters in his/her group				
The learner was able to record the results of the filter tests (ie what happened)				
The learner was able to write up the experiment, the results and make a conclusion				