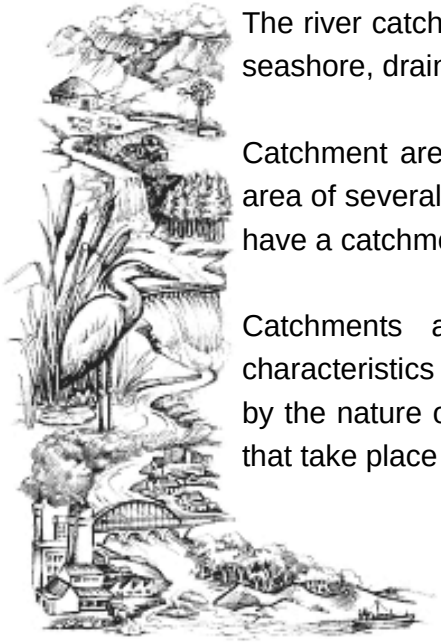
ACTIVITY FOUR: INVESTIGATING WATER QUALITY IN CATCHMENTS

Estuaries are silting up, inland wetlands are disappearing, some perennial rivers are drying up, and rivers, lakes and dams are polluted! Water bodies in southern Africa clearly suffer from many problems – all of which are linked to the way in which the catchment area is used. This PHYSICAL SCIENCES lesson looks at water use in a catchment and encourages learners to look at ways of conserving and caring for our water catchments.

What is the river catchment?



The river catchment, or drainage basin, is all the land from mountain top to seashore, drained by a single river and its tributaries.

Catchment areas vary greatly in size - a big river may have a catchment area of several thousand square kilometres, whereas a smaller tributary will have a catchment area of only a few hectares.

Catchments are separated from each other by watersheds. The characteristics of any river (physical, chemical, biological) are determined by the nature of the catchment and the activities, both human and natural, that take place in it.

The importance of plants

In catchments which have not been cultivated or developed, the ground cover or vegetation is still in place. Ground cover is important for the following reasons:

- Plants slow down water as it flows over the land (runoff) allowing much of the rain to soak into the ground and replenish underground waters (aquifers). Water seeps from these aquifers into rivers, which are therefore usually perennial (flow throughout the year).

- Plants prevent soil erosion as their roots hold soil in position, preventing it from being washed away. In addition, plants break the impact of a raindrop before it hits the soil, thus reducing its erosive potential. Rivers running through an undisturbed catchment are clean, erosion is slow and limited to periods of very high rainfall.

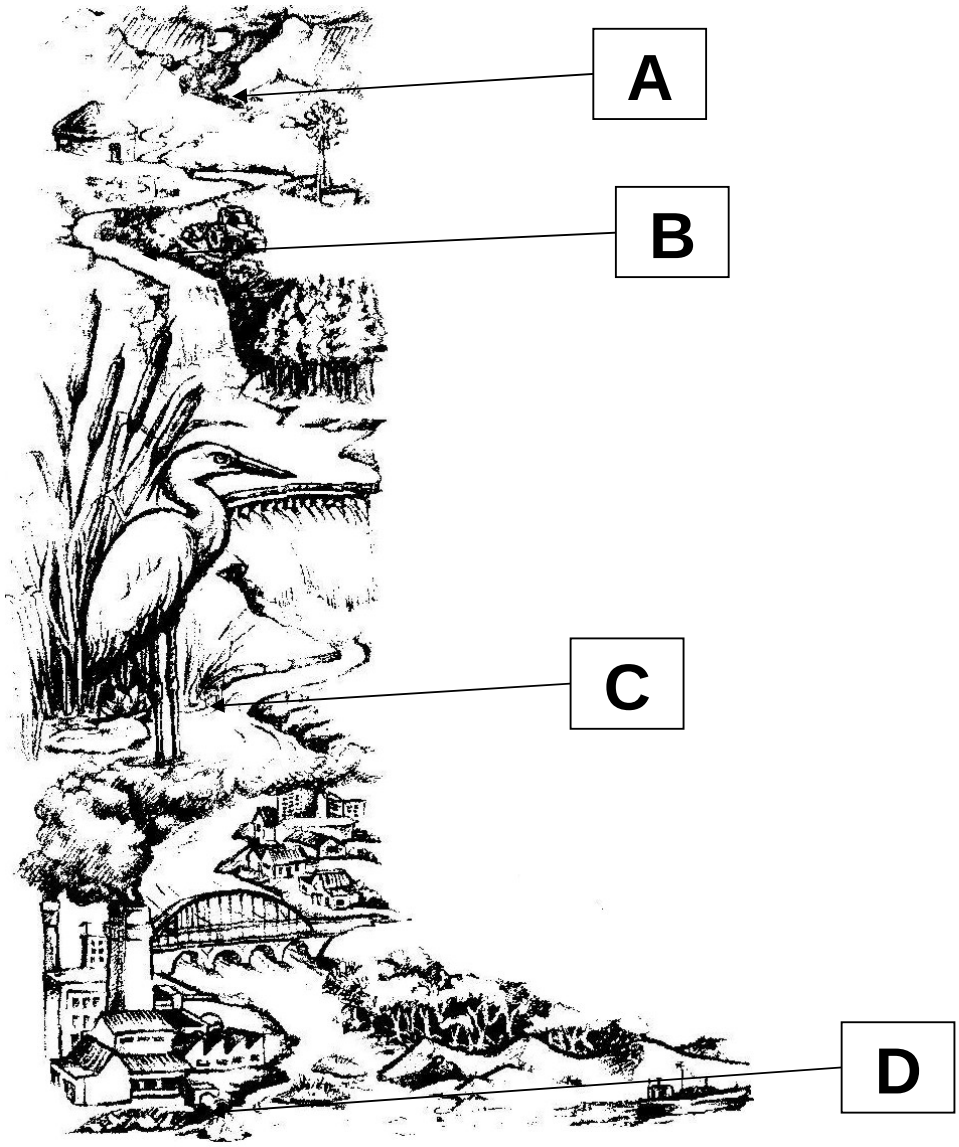
- Vegetation in wetlands and on the banks of rivers is of particular importance. The roots of the reeds, sedges, trees, shrubs and grasses growing in wetlands and next to rivers bind the soil of the riverbank and prevent erosion, whilst cleaning the water and regulating its flow.

Disturbed catchments

Where plant cover in river catchments has been disturbed by farming, industry or settlements, soil erosion increases. In addition, without plants, runoff increases and the supply of water to aquifers is reduced because less water soaks into the ground. Consequently rivers do not have a continuous supply of water from the aquifers and flow only in the rainy season. Much of the deposition of silt into estuaries results from erosion of riverbanks. When riverbank (riparian) vegetation is removed, the banks are at the mercy of the erosive forces of flood waters which scour away the river bank allowing the adjacent slope to collapse.

In many catchments the indigenous vegetation has been replaced by alien plants such as black wattle, pine and eucalyptus. These trees use large amounts of water from the rivers and streams that they thrive next to, thus reducing the amount of water available. In addition, invasive plants tend to smother the natural ground cover and this leads to soil erosion, and of course, a reduction in the biodiversity of that area. Invasive plants tend to be bigger than the indigenous vegetation, and when they burn the fires are very hot - this in turn damages the soil and contributes to more severe erosion.

ACTIVITY:



Results of tests carried out on samples of water taken from A, B, C and D are shown below:

Test	Sample A	Sample B	Sample C	Sample D
Temperature (ºC)	11	12	12	16
Dissolved oxygen (ppm)	16	14	16	4
pH	7	9	6.5	4.5

Temperature

Temperature is one of the most important and most influential water quality characteristics to life in water. An important physical relationship exists between the amount of dissolved oxygen in water and its temperature. The warmer the water, the less dissolved oxygen, and the colder the water, the more dissolved oxygen.

For this reason, heat or "thermal pollution" may be a problem, especially in shallow slow-moving streams or rivers. Most fish simply cannot tolerate warm water and/or low levels of dissolved

oxygen. Thermal pollution may also result when industries release the water used for cooling their machines into waterways. Water temperatures, even kilometres away from the release points, may rise dramatically. The result may be dead fish, fish eggs that won't hatch or a total change in the fish population as warm water varieties replace the original trout or other cold water fish.

Dissolved oxygen in fresh water

Waters with consistently high dissolved oxygen are usually considered to be healthy, capable of supporting many different kinds of water organisms. Much of the oxygen in water comes from the atmosphere through rainfall, through tumbling water in fast moving streams and from water plants (photosynthesis). In some dams dissolved oxygen may increase owing to photosynthesis during the day but at night it may decrease owing to plant respiration. Large daily fluctuations in dissolved oxygen may be found in rivers and dams choked with invasive water plants. Water temperatures also affect dissolved oxygen levels as oxygen is more easily dissolved and retained in cold water. Effluent and agricultural chemicals enrich water, promoting the growth of algae and other water plants. Sewage effluent promotes large populations of bacteria which consume oxygen as they decompose organic matter. Low oxygen levels are often associated with sewage effluent enrichment.

Ppm stands for parts for million and is a measure of concentration. This is a way of expressing very dilute concentrations of substances. Just as per cent means out of a hundred, so parts per million or ppm means out of a million. It usually describes the concentration of something in water or in soil. One ppm is equivalent to 1 milligram of something per litre of water (mg/l) or 1 milligram of something per kilogram soil (mg/kg).

pH

The "p" stands for "potenz" (this means the potential to be) and the "H" stands for Hydrogen. So you must write pH with a lower case (little) p and an upper case (capital) H.

Water (H_20) contains hydrogen ions (H^+) and hydroxyl ions (OH^-). Pure deionised water contains equal numbers of H^+ and OH^- ions and is considered neutral (pH 7), neither acid or basic. If the sample measure has more H^+ ions it has a pH less than 7 and is considered acid. If it has more OH^- ions than H^+ ions it is considered basic and has a pH greater than 7.

Rainwater is naturally slightly acidic but the type of rocks and minerals in a catchment usually determines the pH. Atmospheric pollution (nitrogen oxides and sulphur dioxides) from vehicles and thermal power stations usually produce acid rain, a serious threat to aquatic systems. Sewage and industrial effluent discharges can also affect the pH balance of rivers.

ANSWER THE FOLLOWING QUESTIONS:

1. What would you imagine the water to be like at A?
2. What would you imagine the water to be like at D?
3. Suggest why the town's water supply is taken from the river at C and not D.
4. What is the most likely reason for the high water temperature found D?
5. At B, the river is becoming choked with water plants. Suggest a reason why this is happening.
6. Why do you think the dissolved oxygen has increased at C?
7. Do you think you will find the same species of water creatures at D and A? Explain your answer.
8. What does ppm stand for?
9. If the pH at point D is 4.5, will it be acidic or basic? Will it have more hydrogen ions or more hydroxyl ions?
10. Do you think there is a human impact on this river catchment? Discuss.

Criteria to assess learners during this physical sciences lesson

Criteria	Outstanding	Meritorious	Satisfactory	Adequate	Partial	Inadequate
The learner was able to adequately answer all the questions in the exercise						
The learner was able to see the impact of human settlements and technology on a river catchment (question 10)						