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| **ACTIVITY ONE: WATER AND OUR HEALTH** |

#### This LIFE ORIENTATION lesson encourages learners to consider

#### safe and healthy living in our communities.

**CLASS ACTIVITY:**

After reading the following short article to your learners, divide your class into groups of 4 learners and give each group a photocopy of the newspaper article “Dusi Guts hampers the Drak” and accompanying questions.



### Precious Water – every drop counts!

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 water management a priority for our country.

Industrial and agricultural pollutants common in South Africa are agricultural fertilizers, silt, toxic metals, litter, hot water and pesticides. Some of the most common pollutants come from urban wastewater, particularly from informal settlements which lack sewage and other purification facilities. The resulting pollution contributes to serious health issues.

’Dusi Guts’ hampers the Drak

Sapa Published: Feb 12, 2008

Several elite canoeists’ preparations for the Hansa Powerade Drakensberg Challenge at the end of the month are being hampered by ongoing after effects of the notorious “Dusi Guts” picked up during the three day Dusi marathon.

Hank McGregor and Jacques Theron are amongst those that are still struggling to get over the effects of the crippling stomach complaints picked up from the dirty water in the Umsindusi and Umgeni Rivers. “I would love to do the Drak — it’s one of my favourite races — but I am still battling with “Dusi Guts”,” said McGregor. “I still had it when we raced the Umkomaas Marathon two weeks later, and I am still really weak now, despite two courses of antibiotics.”

McGregor, like many others, fell prey to the gastric problems from the dirty Dusi water shortly after the three-day race.

“I really want to try and win the Drak, because I have had my fair share of bad luck in this race over the last three years. Especially with the river being so full and clean, I want to be able to say that I will be there.”

Theron, who was runner-up last year and has been a perennial star performer on the Umzimkulu, is also a doubtful starter. He was an early victim of the “Dusi Guts” and first fell ill two weeks before the big race in January.

“I am still not right,” admitted the Gauteng star. “This might be my last chance for a serious challenge because I have other priorities in the year ahead, but I am still flat from my “Dusi Guts” problems,” he said.

Surveys conducted shortly after the Hansa Powerade Dusi showed at just less than 50% of the participants in the race experienced stomach ailments from the polluted water. Since the race survey was completed, more paddlers have gone down with similar ailments triggered by bacteria ingested during the race.

“Fortunately the Umzimkulu in Underberg is very clean, to the point that canoeists happily drink the water straight out of the river,” said Canyon Canoe Club chairperson Patrick Reid.

Entries have been pouring into the race office in Underberg, with the eventual entry likely to top 1000 canoeists, particularly with the news that the steady rainfall in the Southern Drakensberg has left the Umzimkulu at a superb racing level.

While the Dusi problems have left several top class paddlers as doubtful starters, most of the top river racers have indicated their intentions of being on the startline at Castleburn bridge on Saturday 23 February.

Five times winner Ant Stott returns to the race after a two-year lay-off caused by his pursuit of a place at the Beijing Olympics with the national K4, and will start as a popular favourite to bag a sixth Drak title.

Defending women’s champ Abbey Miedema will also be there, while her Dusi partner and chief K1 rival Alexa Lombard has also indicated that she would like to be there as well.

*Source: The Times newspaper*

***Additional information for the teacher:***

Dusi Guts is caused by high amounts of bacteria called *E.coli* in the river water. E. coli is a common type of [bacteria](http://www.kidshealth.org/kid/word/b/word_bacteria.html) that can get into food, like beef and vegetables and is short for the medical term Escherichia coli. The strange thing about these bacteria — and lots of other bacteria — is that they are not always harmful to you.

E. coli normally lives inside your intestines, where it helps your body break down and digest the food you eat. Unfortunately, certain types (called strains) of E. coli can get from the intestines into the blood. This is a rare illness, but it can cause a very serious infection.

Someone who has E. coli infection may have these symptoms:

* bad stomach cramps and belly pain;
* vomiting;
* diarrhoea, sometimes with blood in it.

If someone has symptoms of E. coli poisoning, the doctor will run some blood tests and take a sample of the person's stool (poo). The blood and stool can be checked to see if a harmful strain of E. coli is present. Even though diarrhoea is one of the main symptoms, the person should not take anti-diarrhoea medicines because they can slow down recovery time. Some people recover at home, while others need to be in hospital. In some cases, E. coli poisoning can cause life-threatening kidney problems.

**GROUP ACTIVITY:**

In groups, discuss and record the following:

1. Does someone in the group know what Dusi guts is and how you get it? If not, ask your teacher.
2. Has any one in the group had a similar and unpleasant experience like the canoeists in the newspaper article? How did it happen? What did you do?
3. Who is responsible for the polluted state of the Dusi River water? Explain your answers.
4. What are the sources of water in or near your area or community?
5. Are the rivers in your community polluted? Explain your answer. What are the effects of the pollution?
6. What can one do, as an individual, to improve the quality of river water?
7. What can one do, as a community, to improve the quality of the river water?
8. What organisations are there in your community that are involved with water issues?

**CLASS ACTIVITY:**

Using the reports from the previous group activity, let learners share with each other what their groups discussed.

### A Community Service Assignment

1. Your group needs to identify an existing organisation / community project that is already working within the field of water and water-related issues and one that you would like to work with to find out more about what they do.
2. You will need to make arrangements with the organisation concerned by writing, phoning or visiting them.
3. Spend some time working there (possibly during the weekend or a day in the school holidays, find out when it is convenient).
4. Write a report which will be assessed by your teacher (each learner in the group needs to write a separate report) and shared with the rest of the class. See details that follow of what to cover in your report.

You will need to report on:

**1. Your involvement with your chosen organisation / project / programme**

* How much time you spent with the organisation / project / programme?
* What you did while you were there?
* Who did you work with?
* What did they do?

**2. Your evaluation of your chosen organisation / project / programme**

* What are the aims of the organisation / project / programme?
* Who does it serve?
* What is it achieving?
* Is it sustainable?
* Is it relevant?
* What problems / challenges does it face?

**3. Your findings and recommendations for your chosen organisation / project / programme**

* What would improve the project with its services?
* What could assist with some of the problems (if any)?

**4. Implementation of your findings and recommendations**

* How could I implement one of my findings and recommendations? (You need to draw up a plan with time frame, specific objectives or outcomes and how you will implement this plan. Include any financial costs or other expenses).

**5. Evaluating my involvement with the organisation / project / programme**

* How did I feel before I started – was I nervous, enthusiastic – why?
* What was the most useful thing I learnt?
* What was the most useful thing I contributed?
* What could I have done differently?
* Will I continue to be involved in this organisation / project / programme? Why?

**Criteria to assess learners during this life orientation lesson**

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| --- | --- | --- | --- | --- | --- | --- |
| Criteria | **Rating Code 6 (Outstanding)** | **Rating** **Code 5 (Meritorious)** | **Rating** **Code 4 (Satisfactory)** | **Rating Code 3 (Adequate)** | **Rating Code 2 (Partial)** | **Rating** **Code 1 (Inadequate)** |
| The learner was able to present a report to the class in which they communicated their group discussions(*Dusi Guts group activity*) |  |  |  |  |  |  |
| The learner was able to identify an existing organisation working within the water field |  |  |  |  |  |  |
| The learner was able to evaluate the services offered by this organisation |  |  |  |  |  |  |
| The learner was able to evaluate their own involvement in the organisation |  |  |  |  |  |  |
| The learner was able to record and report, following the given format, on their work experience with the organisation |  |  |  |  |  |  |

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| **ACTIVITY TWO: TESTING OUR WATER QUALITY** |

**The following LIFE SCIENCES lesson looks at the effects of biodegradable waste on dissolved oxygen. Learners conduct an experiment and then graph and write a report on their investigation which they present to the rest of the class.**

**ACTIVITY:**

**Read the following paragraph to your learners and then let them continue with the experiment that follows. Depending on the level of your learners, they can either do the experiment individually or in small groups.**

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 temperature also affects 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.

#### ****Experiment****

**What are the effects of biodegradable waste on dissolved oxygen?**

**Purpose:** To understand the relationship between biodegradable waste and dissolved oxygen found in polluted waters in your area.

**Background:** When micro-organisms (bacteria and fungi) eat biodegradable wastes, they use large amounts of oxygen. Thus, a lot of biodegradable waste means very little dissolved oxygen for fish and aquatic life. In this experiment, we will investigate that relationship. Yeast will represent the micro-organisms, milk is the biodegradable waste, and methylene blue (a dye) will indicate when oxygen is used up. Methylene blue shows the presence of oxygen in water and if there are bacteria in water, they use up the oxygen and cause the methylene blue to change to a colourless liquid. The more bacteria a water sample contains, the faster the methylene blue loses its colour. The methylene blue will change from blue to white when no more oxygen is present in the test tubes. (The colour change is actually from blue to colourless. The white colour you will observe in the test tubes is due to the milk’s colour).

**Materials:**

* 2 small beakers or baby food jars
* stirring stick
* 2ml (about ½ teaspoon) dry yeast
* one 5ml pipette or an eye dropper
* one 10ml graduated cylinder
* methylene blue solution
* 3 test tubes in rack
* masking tape

**Procedure:**

* 1. Fill a baby food jar about half full of milk. Take it to your lab table.
	2. Place the three test tubes in the rack and put masking tape numbers (1,2,3) on them.
	3. Use the pipette or eye dropper to add the amount of materials to each test tube as shown below. (Approximately 15 drops equals 1ml.)

|  |  |  |
| --- | --- | --- |
| **Test tube** | **Milk ml or drops** | **Water ml or drops** |
| 1 | 2.5 or 37 | 0 or 0 |
| 2 | 1.0 or 15 | 1.5 or 22 |
| 3 | 0.2 or 3  | 2.3 or 35 |

Before you continue, check the liquid’s height. It should be the same in all three tubes. You should have exactly 2.5ml of solution in each tube.

4. Add three drops of methylene blue to each test tube. The methylene blue is an "indicator" solution. It will change from blue to white when the oxygen is used up.

5. Mix each tube by putting your thumb over the top and inverting it (turning it upside down) quickly four times.

6. Prepare a sample of yeast by adding 2ml (about ½ teaspoon) dry yeast to 20ml of water in a beaker or baby food jar. Mix the yeast and water thoroughly with your mixing stick.

7. You are now ready to mix the yeast and milk solutions. Follow these directions *very* carefully:

1. Watch the clock for exact timing. Proceed to the next step (b) when the second hand passes the "12". Record the *exact* time of mixing - on the minute - in the table below, next to test tube 1.

|  |  |  |  |
| --- | --- | --- | --- |
| **Test tube** | **Time of mixing** **(on the minute)****(A)** | **Time when****colour changes****(B)** | **Total time for the colour change to occur (B-A)** |
| **1** |   |   |   |
| **2** |   |   |   |
| **3** |   |   |   |

1. Mix the yeast solution vigorously with the tip of your pipette or eye dropper. Then carefully put exactly 2.0ml (30 drops) of yeast solution into test tube 1.
2. Mix by inverting four times.

d. Now repeat the procedure with test tubes 2 and 3. Be sure you record the *exact* time you added the yeast to each tube.

8. Wait until each tube’s colour changes from blue to white. (It usually takes about 15 minutes). Note: the surface of each test tube will always remain blue. Can you guess why?

1. When the colour change is complete, work out the total time by subtracting the time of mixing from the time the tube changed colour (column B-A). Record this time to the nearest minute. It may take several minutes for this change to occur.

**Questions:**

* 1. Name the gas "inhaled" (taken in) by micro-organisms.
	2. Name the gas "exhaled" by micro-organisms.
	3. Where do micro-organisms living in water get the oxygen they need to live?
	4. Where do green plants living in water get the carbon dioxide they need to live?
	5. Shake one of the test tubes that turned white. What happens to the colour? Why does the colour change?
	6. Oxygen is dissolved naturally in rivers when water goes through rapids and over falls. How does shaking the test tube prove that oxygen is dissolved in water when it tumbles over rocks?
	7. Why is the oxygen in the experiment "used up?"
	8. Name the part of the experiment that represents micro-organisms.
	9. Name the part of the experiment that represents waste.
	10. In which test tube did you have the most waste? The least waste?
	11. *Graph* your results on a separate sheet (time for colour change to occur, in minutes versus ml of milk) and answer the following questions:
		+ 1. What does the line you plotted tell you about the relationship between the amount of waste and oxygen in a body of water?
			2. If large amounts of waste were dumped in a river, what would be the effects of the dissolved oxygen in the water?
			3. What conclusion was reached?
	12. How could you improve your investigation?
	13. Some bacteria, given large amounts of food and water, can double every 20 minutes. *Calculate* the number of bacteria present after twelve hours at this rate (starting with one bacteria cell).
	14. Write a full report on your investigation which you can present to the rest of the class.

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| ***Teacher notes about this experiment:**** You may use fresh or powdered milk. Learners will get faster colour changes if you *dilute* the milk to 50% strength and warm slightly before the experiment.
* Many learners make mistakes in volume measurements - be careful!
* Since colour changes take up to 15 minutes, consider the length of your life sciences period.
* Learners must know graphing skills before this experiment.
* All glassware must be *clean* and free of soap residue. *Soap residue may kill the yeast.*
* All variables in this experiment are relative to one another. For example, shaking two times, instead of four will change the results.
* The yeast solution should be well-mixed before it is added to the test tubes. It is important to get approximately the same number of yeast cells in each test tube.
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**Criteria to assess learners during this life sciences lesson**

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| Criteria | **Rating Code 6 (Outstanding)** | **Rating Code 5 (Meritorious)** | **Rating Code 4 (Satisfactory)** | **Rating Code 3 (Adequate)** | **Rating Code 2 (Partial)** | **Rating Code 1 (Inadequate)** |
| Ability to follow instructions |  |  |  |  |  |  |
| Ability to observe safety precautions |  |  |  |  |  |  |
| Ability to work neatly and tidily |  |  |  |  |  |  |
| Ability to use allocated time properly |  |  |  |  |  |  |
| Ability to use equipment |  |  |  |  |  |  |
| The learner was able to draw a graph from the experiment |  |  |  |  |  |  |
| The learner was able to suggest specific changes that would improve the experiment |  |  |  |  |  |  |
| The learner was able to write up a report on the findings |  |  |  |  |  |  |
| The learner was able to present a report to the class in which they communicated their findings |  |  |  |  |  |  |

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| **ACTIVITY THREE: SPEAK TO US!** |

**This LANGUAGES lesson focuses on the art of speech making. Learners choose three water and water-related topics from a given list and then write and deliver introductions for each chosen topic.**

An introduction is very important to use in a speech or piece of writing to warm the audience to what is to come. It should grab the audience's attention. It should always arouses interest about the subject, and provide important background information. A speech without an introduction is like a train without an engine, you are not leading your audience anywhere. Your introduction also needs to provide a smooth transition into the body of the speech. The introduction is what the audience hears or listens to first, so make it interesting!

**INDIVIDUAL AND GROUP ACTIVITY:**

Ways to make an introduction to your speech more interesting could include the following:

* Make a surprising or thought-provoking statement at the start of your speech.
* Use visual, graphic or audio aids to illustrate part of your speech.
* Use gestures and body language that are consistent with the speech.
* Involve the audience in a practical activity (where appropriate).
* Step into the audience during your speech.
* Tell an appropriate anecdote, a humorous story or even a joke.
* Quote a famous person or expert – remember, however, that quotes must be relevant to your speech and not over-used.

Look at the list below and choose three water or water-related issues. Write and deliver introductions for each. Remember to use the school library and as many other sources of information as possible.

1. Water pollution
2. Water and our health
3. Water quality in South Africa
4. Planet Earth in 2050
5. The joy of water
6. Water water everywhere and not a drop to drink
7. Every South African has the right to a clean and healthy environment
8. Wetlands
9. Water is life
10. Cholera
11. Diarrhoea

Now, in groups of five, assess each other’s introductions. When assessing each other and one’s self, consider:

* + the volume of the speaker’s voice (varied, clear, too loud, too soft, not varied enough);
	+ the speaking rate (was it well-paced, too fast, too slow);
	+ the pitch (was the voice varied, too high, too low, monotone);
	+ the tone of the speaker’s voice (natural and pleasant, artificial);
	+ the vitality with which the speaker spoke (powerful, dynamic, unenergetic);
	+ was there eye contact of the speaker with his/her audience?
	+ how did the speaker stand? Relaxed, nervous, pacing etc;
	+ was the attention of the group held by what was being said?
	+ did the introduction introduce the rest of the speech clearly so that the listeners knew what they were going to hear?
	+ how many sources (e.g. the library, Internet, newspapers) did the speaker use to prepare their introduction?

**Criteria to assess learners during this languages lesson**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Criteria | **Rating Code 6 (Outstanding)** | **Rating Code 5 (Meritorious)** | **Rating Code 4 (Satisfactory)** | **Rating Code 3 (Adequate)** | **Rating Code 2 (Partial)** | **Rating Code 1 (Inadequate)** |
| A number of sources (at least 3) were used during the preparation of the learner’s introduction |  |  |  |  |  |  |
| The introduction was succinct  |  |  |  |  |  |  |
| During the introduction, a rapport was established with the audience |  |  |  |  |  |  |
| Presentation of the introduction was confident and motivated the audience to listen |  |  |  |  |  |  |
| The speaker gave the audience a clear idea of what the body of the speech would be about |  |  |  |  |  |  |
| Tone, voice projection, pace, eye contact, posture and gestures were correctly used |  |  |  |  |  |  |

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| **ACTIVITY FOUR: INTERCATCHMENT TRANSFERS – THE ONLY WAY TO SOLVE SOUTH AFRICA’S****WATER SHORTAGE** |

**Conservationists say that water is a limited resource. Water scientists say that by the year 2025, there will be insufficient water for all our country’s domestic, agricultural and industrial needs. During this LANGUAGES lesson, learners debate whether or not intercatchment transfers will solve South Africa’s water problems.**

**CLASS ACTIVITY:**

Ask the learners:

1. Have you seen or taken part in a debate?
2. What was it about?
3. Where did it take place?
4. Who was taking part in the debate? *Prompt: Politicians, general public, members of a group or organisation.*

Ask the learners:

1. What is a debate?
2. If you were going to define it in a dictionary, what would you write? *Suggestion: A formal argument where groups or individuals present opposing views about a particular issue according to a set of rules.*

## CLASS ACTIVITY:

* Explain that a debate is based around a suggestion or motion.

An example of a motion is: The voting age should be lowered to 16.

Explain that the people who are arguing to support the motion are called the proposers. The people arguing against the motion are the opposers.

The correct order for a debate is as follows:

1. The debate is chaired by the Speaker, who reads out the motion.
2. The first proposer presents the arguments for the motion.
3. The first opposer presents the arguments against the motion.
4. One of the proposers presents their arguments for the motion.
5. An opposer presents their arguments against the motion.
6. This side to side motion continues until everyone has had their say.
7. You can only speak ONCE during the debate.
8. An opposer sums up their group's main argument.
9. A proposer sums up their group's main argument.
10. The speaker re-reads the motion.
11. Everyone votes (apart from the Speaker) by leaving the debating chamber and coming back through a door marked 'yes' or 'no.'
12. Two people, called tellers, count up the votes (bodies), as they come through each door.
13. The Speaker announces the result of the vote.

**Ask the learners:**

1. Why do you think there is a rule about people only speaking once during the debate?
2. What other rules do you think you will need to make the debate run smoothly?

Here are some rules of debate that we will follow:

1. The debate is chaired by the Speaker, whose decision on all matters is final.
2. You can only speak ONCE during the debate. Your speech should be about five minutes long. If you can, develop an argument rather than making a single point.
3. But you CAN 'intervene' as many times as you like. To intervene is to ask a question about a point being made, such as … are those statistics up-to-date?
4. You can use notes to help you with your speeches and make notes during the debate.
5. If you want to speak during the debate, you should catch the Speaker's eye by standing up as soon as someone has finished speaking. The Speaker will pick someone from those standing up.
6. If you spot someone breaking these rules you should tell the Speaker. This is called a point of order.

The motion that the class will be debating is …

* **Intercatchment transfers – the only way to solve South Africa’s future water shortage.**

**Read the following extract to the class:**



**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.



# 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 Fish-Sundays River Canal Scheme which comprises a canal and tunnel system which supplies Orange River water from the Great Fish River valley to the Sundays River valley to supplement existing water supply in the Eastern Cape. The massive Lesotho Highlands Water Project is a multi-billion water transfer and hydropower project implemented by the governments of Lesotho and South Africa. It transports water from the upper reaches of the Orange system in Lesotho to the Vaal River for use in Gauteng.

## CLASS ACTIVITY:

1. Divide the class into two groups.
2. Give them the following debate topic.

***Intercatchment transfers – the only way to solve South Africa’s future water shortage*.**

1. One group needs to prepare their debate agreeing with the topic (the proposers), the other needs to argue against it (the opposers).
2. Using the information (*Enviro Fact 1: River Catchments, Enviro Fact 2: Water, Internet Article 1 and Internet Article 2*) as an introduction, learners need to find out as much as they can about this topic. If you have a well-resourced library (school or community), make use of it; use the Internet; search for newspaper articles or magazines; see if there are any environmental films or videos on river catchments and intercatchment transfers; as well as any other sources of information that will be useful. *(Learners need to keep a record of where they found their sources and what these sources were – this will help you, the teacher, when it comes to the assessment of this lesson).* Encourage the learners to make use of as many varied sources and methods of locating information as possible. Remind the learners to also remember what was learnt about effective introductions in the previous lesson (Activity Three: Speak to us!)
3. When the groups are ready and well prepared, you need to select seven learners to be:
* Speaker. This person chairs the debate but cannot take part or vote.
* First proposer to speak
* First opposer to speak
* Opposer to sum up
* Proposer to sum up
* Two tellers to count the votes

Hold the debate according to the formal order and rules.

**Ask the learners:**

1. What are the advantages of debating?
2. What are the disadvantages of debating?
3. Describe the strengths of a good debater. *Prompt: persuasive, confident, calm.*
4. Can you think of a better way to settle a difference of opinion?

Source: [*http://news.bbc.co.uk/cbbcnews/hi/newsid\_4530000/newsid\_4537100/4537177.stm*](http://news.bbc.co.uk/cbbcnews/hi/newsid_4530000/newsid_4537100/4537177.stm)

**Criteria to assess learners during this languages lesson**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Criteria | **Rating Code 6 (Outstanding)** | **Rating Code 5 (Meritorious)** | **Rating Code 4 (Satisfactory)** | **Rating Code 3 (Adequate)** | **Rating Code 2 (Partial)** | **Rating Code 1 (Inadequate)** |
| The learner participated in the debate and followed the correct procedures |  |  |  |  |  |  |
| The learner used a number of sources whilst researching his/her topic |  |  |  |  |  |  |
| The introduction, speech and conclusion presented by the learner during the debate was well organised and effective. |  |  |  |  |  |  |
| The learner participated in the class questions asked after the debate |  |  |  |  |  |  |

**Enviro Fact 1: River Catchments**

# River 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.

# 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 riverbank 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.

# Catchment conservation

A catchment conservation programme should include:

* protection of wetlands such as vleis and marshes;
* sound conservation practices on agricultural and forestry lands, e.g. all ploughing and planting should be on the contour; riverbank vegetation should not be disturbed; lands should be strip cropped;
* prevention of water pollution from informal settlements, industry or agriculture;
* protection of riverbank vegetation.

# What you can do

* Alert your local land use authority regarding misuse of a catchment.
* Start a catchment conservation project for a river in your area.
* Read "Vanishing Waters"\* which has a very useful chapter entitled "You and Water".
* Participate in the South African Youth Water Prize. Contact the Project Manager: South African Youth Water Prize, Department of Water Affairs and Forestry, Private Bag X313, Pretoria, 0001. (012) 336 7127 or 0800 200 200.

**Further reading:**

* \*Davies, B.R. and J. Day. 1988. *Vanishing Waters*. 1998. University of Cape Town Press.
* Camp, S. *A Guide to Water Saving in South Africa.* Umgeni Water, Pietermaritzburg.
* *How your school can be water wise*. 1997. Jacana Education, Johannesburg.

**Enviro Fact 2: 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 there will be insufficient water for domestic use, agriculture, and industry.

**Rainfall**

Our average rainfall is less than 500mm a year, with the driest part of the country receiving less than 200mm/year and the wettest receiving more than

2 500mm/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 (see "Intercatchment transfer of water").

**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 over 550 government dams in South Africa, with a total capacity of more than 37 000 million m3.

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. The massive Lesotho Highlands Water Project is a multi-billion water transfer and hydropower project implemented by the governments of Lesotho and South Africa. It transports water from the upper reaches of the Orange system in Lesotho to the Vaal River for use in Gauteng.

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.

**Did you know?**

* South Africa has a National Water Bill that attempts to ensure an equitable and sustainable water supply.
* Some 12 - 14 million South Africans do not have access to safe drinking water and some 21 million have inadequate sanitation. As a result, about 50 000 children die each year from diarrhoeal infections.

**Further reading:**

Davies, B. R. and J. Day. 1998. *Vanishing Waters.* University of Cape Town Press.

Camp, S. *A Guide to Water Saving in South Africa.* Umgeni Water, Pietermaritzburg.

**Internet Article 1**

**The Lesotho Highlands Water Project**

**Katse and Mohale Dams**

This is a major long term project, the aimbeing to pump water from the rivers draining the Lesotho Highlands, north into South Africa, and eventually into the Vaal Dam, the main water supply for the Johannesburg region. This region is growing so large and so fast that it is fast outstripping its watersupply. There isalready a smaller scheme pumping water from the Tugela river in Kwazulu Natal, but the needs are great.

The project will eventually include four large dams, several smaller ones and many kilometres of tunnel. The entire project is scheduled for completion by the year 2020. At present Phase IA is nearing completion and Phase lB is in the infrastructure development stage. Phase IA involved the building of the first major dam, the Katse Dam, located on the Malibamatso River north of Thaba Tseka. It also involved the building of transfer tunnels for the water and a hydro-electric power station. The dam is currently filling up and is nearly full.

The Katse Dam wall has a height of 180m and dams the course of the river for many kilometres. The river valleys in Lesotho are deep and narrow, so the dam does not form a huge shallow lake but rather a deep, narrow one. Since most of the population live in villages at the mid-level, very few people have been displaced, though much arable land and grazing land has been lost. The company has promised to compensate those dispossessed.

The transfer tunnel from the dam to Muela (near Butha Buthe) is 45km long and over 4m in diameter. Since Muela is lower in altitude than the dam, the water flows by gravity and at Muela a hydro-electric power station is being built. It is projected that this will supply all of Lesotho's needs as well as a small surplus. From Muela, another tunnel 37km long takes the water across the border to near the town of Clarens, where it flows into the Axle River, a tributary of the Vaal River.

Phase lB of the project is the building of Mohale Dam on the Senqunyane River, and the tunnels linking it to Katse Dam. The access roads, staff villages and other infrastructure are currently under construction.

The next three major dams of the project are further down the course of the Senqu River. Most of the project is being paid for by South Africa through a complex loan servicing agreement and the South Africans will also pay for each unit of water received. Thus Lesotho is assured of a large boost to its infrastructure and a long term source of income.

There are, however, several unanswered questions surrounding the project.

* What will its impact be on the environment?
* Will the dams silt up? (A look at Lesotho's rivers after a good rain shows how much silt they carry).
* What will the effect be on the Orange River downstream in South Africa since half its flow will now be diverted?
* And, what will its impact be on the people living around it? Will the company make good their promise of compensation?

The dam construction has brought roads, people and technology into previously remote, subsistence farming areas. A look at the villages around Katse, with shanties springing up and litter everywhere raises serious questions. It is the question of "progress". Is it always positive? Only time will tell.

The project has certainly improved Lesotho's infrastructure greatly. This is especially evident in terms of roads. There is now a beautiful tar road all the way from Hlotse, over the mountains to the Malibamatso river valley and all the way south to the Katse. From there the dirt road to Thaba Tseka has been upgraded.

*Extract from The Lesotho Highlands Water Project: Katse and Mohale Dams* [*www.seelesotho.com/travel/info/waterproject.htm*](http://www.seelesotho.com/travel/info/waterproject.htm)

**Internet Article 2**

**Fish-Sundays Transfer Scheme**

**Water Transfer Schemes in the Middle Orange**

The Fish-Sundays River Canal Scheme comprises a canal and tunnel system which supplies Orange River water from the Great Fish River valley to the Sundays River valley to supplement existing water supply in the Eastern Cape. Since 1992 water from the Sundays River valley has been supplied to Port Elizabeth. It is estimated that up to 200 million m3 of Orange River water could eventually be transferred to the Port Elizabeth metropolitan area annually.

Orange River water is diverted from the Great Fish River by a weir at [Elandsdrift](http://www.dwaf.gov.za/orange/images/web128l.jpg) into an aqueduct which winds approximately 65 km along steep slopes and cuts through the Bosberg chain between Cookhouse and Somerset East. The main feature of this aqueduct is the 13,1 km Cookhouse Tunnel through the Bosberg, which was completed in 1978. The canal discharges into the Little Fish River near Somerset East via a multi-stepped chute, from where the water flows down the Little Fish River for some 40 km to the [De Mistkraal Weir](http://www.dwaf.gov.za/orange/images/web177l.jpg).

The droughts of the past have created a critical situation in the [Darlington Dam](http://www.dwaf.gov.za/orange/images/web118l.jpg) (formerly Lake Mentz) region which, despite being a fertile area, requires an assured water supply. The serious drought of 1966 and 1967 emphasized the necessity to commence work on the Skoenmakers Canal with a capacity of 22 m3/s to link the Great Fish River to Darlington Dam as soon as possible. In view of an expected increase in irrigation below Darlington Dam and the demand for water in the Port Elizabeth metropolitan area, it was decided to replace the Wellington Grove pumping station with [De Mistkraal Weir](http://www.dwaf.gov.za/orange/images/web127l.jpg) upstream of Wellington Grove and a short section of connecting canal to the beginning of the Skoenmakers Canal.

With the completion of the De Mistkraal Weir in 1987 the possibility of transferring water to Darlington Dam at the full design capacity of the Skoenmakers Canal was created. This water dilutes the salinated water of Darlington Dam and therefore presents an immediate benefit by improving the water quality for citrus farming in the lower Sundays River valley. A long-term economic benefit of the weir is the development of irrigation potential in the lower Sundays River valley. As a result of the developments, a further 16 500 ha can now be utilized for citrus farming.

A further extension of the scheme was launched in 1989 in order to provide water to Port Elizabeth where supplies were limited due to a severe drought. Water from Darlington Dam and the Sundays River irrigation canals flows to the Scheepersvlakte Dam, the main balancing dam for the irrigation scheme. From there water is conveyed by means of a gravity pipeline to a point on the right bank of the Sundays River where a purification works has been constructed. From the purification works, the water is pumped to a balancing dam on the plateau which separates the Port Elizabeth metropolitan area from the Sundays River, from where it flows to the municipality's existing reservoir at Motherwell. Apart from the increase in available water to the Port Elizabeth-Uitenhage metropolitan area, the municipality is less dependent on the Kouga Dam (formerly Paul Sauer Dam). This is to the advantage of the irrigators in the Gamtoos Government Water Scheme as it will increase the assurance of supply for irrigation.

The lower Fish River Scheme was initiated in 1985 and completed in 1992. The purpose of this scheme is to provide sufficient water of a suitable quality to irrigation developments along the Great Fish River in the vicinity of Committees Drift. The scheme consists of the Hermanuskraal Weir in the Great Fish River with a tunnel to discharge flood water and water released from the Orange River into an off-channel storage dam, the Glen Melville Dam in the Ecca River. The distribution system consists of a canal and pipelines to the irrigation areas on both sides of the river. The scheme will enable further irrigation expansion and will ensure that water of an acceptable quality is supplied.

The scheme also makes provision for Grahamstown's increasing requirements. When the scheme was started, Grahamstown was already experiencing problems in meeting its growing demand for water and the Fish River was the obvious source to serve as a supplement. The scheme ensures that a stable supply of good quality water is available, which can be linked to the municipal water supply network. The scheme also benefits rural communities in the Great Fish River catchment (including portions of the former Ciskei) by improving the quality and availability of water.

*Source: www.dwaf.gov.za/orange/Mid\_Orange/fish-sun.htm*

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|  **ACTIVITY FIVE: JUST FOR FUN!** |

**Learners can quickly assess the quality of a nearby stream or river and its catchment by looking at visible animal life. This LIFE SCIENCES lesson encourages learners to explore a nearby water source.**

**ACTIVITY:**

You can assess the quality of a river or stream and its catchment by looking at:

1. Stream bank vegetation;
2. The colour, smell and taste of the water;
3. The types of water life; and,
4. Chemical tests.

To quickly judge river water quality, pick up 10 medium sized rocks and see:

1. what organisations live in the water (species present) *(use the Water Organisms Picture Reference Sheet)*
2. the variety of different kinds of water life (diversity)
3. the total number of each type (populations)

Clean water with balanced proportions of different kinds of plants and animal life usually indicate a healthy system.

### Questions to guide your observation

Common questions to guide the observation of plants and animals that live in and near water are:

**What is it like?**  adaptation

**What is it doing?**  behaviour

**With what does it interact?**  interdependence

**Where is it found?** distribution

**How much or how many are there?** abundance

**How many different types are there?** diversity

A diversity of animal species in a stream usually indicate good water quality. Some species cannot tolerate even the slightest amount of pollution and if found alive in a stream, these indicate clean water that is probably drinkable.



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**Water Organisms: Picture Reference Sheet**

**Water Organisms: Picture Reference Sheet**

**Water Organisms: Picture Reference Sheet**

**More information on each of the Water Organisms on the**

**Water Organisms: Picture Reference Sheet**

**Water Organisms: Picture Reference Sheet**

**Picture Reference Sheet**

**Back swimmer:** *(Phylum: Arthropoda, Class: Insecta, Order: Hemiptera).* They swim and rest on their backs. The hind legs are used for movement. They breathe at the surface and an extra supply of air is trapped amongst the hairs on the upper side of the body.

**Caddisfly:** *(Phylum: Arthropoda, Class: Insecta, Order: Trichoptera).* The larvae have 6 long legs close to the head. Caddisflies like clean, unpolluted water.

**Crab:** *(Phylum: Arthropoda, Class: Crustacea, Order: Decapoda. Prawns and crayfish are also in the class Crustacea).* Crabs have a hard exoskeleton. They have flat bodies and 5 pairs of legs. Crabs eat mostly dead or dying animals but also catch some live prey, such as tadpoles.

**Cranefly:** *(Phylum: Arthropoda, Class: Insecta, Order: Diptera).* Cranefly larvae are found in water, in moist ground or in mud or under leaves. The larvae eat roots, dead plants and some small water animals like worms. The cranefly is often called a daddy-long-legs!

**Damselfly:** *(Phylum: Arthropoda, Class: Insecta, Order: Odonata).* Adult damselflies are smaller and thinner than dragonflies. Nymphs are usually brown or green and have three large, flat gills at the end of the abdomen. They swim and run among stones at the bottom of streams.

**Dragonfly:** *(Phylum: Arthropoda, Class: Insecta, Order: Odonata).* The adults fly very fast. Nymphs develop in the water and crawl amongst weeds and stones. Folded underneath their jaw they have a modified lower lip or “mask”. This is used to catch prey. Water is drawn in and out of the body through an opening at the rear end. This provides a supply of oxygen to the rectal gills, just inside the opening. The nymphs live in fairly polluted water. Nymphs eat water insects. Adults capture insects in flight. In emergencies, the nymph is able to expel water from its rear end – propelling itself forward like a jet!

**Freshwater fish:** *(Phylum: Chordata, Sub-Phylum: Vertebrata, Class: Pisces).*Fish have streamlined bodies that are covered with slimy scales. Fins are used to move. Breathing is through their gills.

**Freshwater shrimp:** *(Phylum: Arthropoda, Class: Crustacea, Order: Decapoda).* They feed on small animals and plants and are usually transparent, green or brown.

**Frogs and toads:** *(Phylum: Chordata, Sub-phylum: Vertebrata, Class: Amphibia).* Tadpoles have gills and live under water. Adult frogs and toads have lungs. Frogs spend their whole lives in very moist areas or near water. Toads are stout, have short limbs and live in open country. Platanna (clawed toads) are neither true frogs or toads. They spend their whole lives in water.

**Leech:**  *(Phylum: Annelida, Class: Hirudinea. The earthworm also belongs to this phylum).* Leeches are small worm-like creatures that have suckers to suck the blood or body fluids from other animals. They like nutrient-rich water that is low in oxygen. They are mostly parasitic, which means they prey on other living animals, including people. If leeches stay on your body for too long they can cause your blood pressure to drop and make you feel ill. The suckers of a leech release a chemical, which stops blood from clotting so that they can feed properly.

**Mayfly:** *(Phylum: Arthropoda, Class: Insecta, Order: Ephemeroptera. Adults emerge in MAY in the northern hemisphere, hence the name).*The nymphs (baby mayfly) have three long thin tails and have gills on the sides of their bodies. Mayflies need unpolluted water with plenty of oxygen to live in. They eat vegetable matter. The adult mayflies only live for one day once they hatch, and in this time they must find a mate and reproduce before they die. This is why mayflies often all hatch at the same time. This gives them the greatest chance of success.

**Midge:** *(Phylum: Arthropoda, Class Insecta, Order: Diptera. The order Diptera includes all flies).*Adult midges or gnats are tiny insects that are usually seen flying in swarms above the water. Midge larva are often called ‘bloodworms’ because many have red or brown body fluids. The larvae are often found in mud in slow-flowing or still water. The red midge larvae are usually found in polluted water. The adult midge never eats anything! Its stomach remains an empty air sac. Generally midges are found in water that is slightly polluted.

**Mosquito larvae:** *(Phylum: Arthropoda, Class: Insecta, Order: Diptera).* Mosquito larvae live in stagnant (still) pools of water just below the surface. They feed on tiny plants and animals. Male mosquitos suck plant juices when they are adults but adult female mosquitos suck blood from humans and other animals. If they are infected, the female mosquito will then pass on malaria to people, which can be deadly! Mosquito larvae are often found in poorly oxygenated ponds of water.

**Otter and water mongoose:** *(Phylum: Chordata, Sub-Phylum: Vertebrata, Class: Mammalia. Dogs, cats, lions etc all belong to the class Mammalia – this class includes all animals that suckle their young).* Otters and water mongoose are shy animals and are seldom seen. You may see their droppings, which contain large quantities of crab shells.

**Planaria:** *(Phylum: Platyhelminthes, Class: Turbellaria. This phylum also includes the tape-worm).*They are dark brown with flat bodies. Planarias live in clean, unpolluted water. They can regenerate themselves if cut in pieces, with each piece growing into a new individual.

**Rat-tailed maggot:** *(Phylum: Arthropoda, Class: Insecta, Order: Diptera).* Rat-tailed maggots are usually grey with a fat wrinkled body and a long breathing tube. They can live in mud and polluted water.

**Sludge Worm:** *(Phylum: Annelida, Class: Oligochaetae, Order: Lumbriculidia)*. Their tails are used as gills to absorb oxygen. They are dark red due to the high oxygen levels in their bodies. Sludge worms like to eat mud, and they are able to live in polluted waters.

**Stonefly:** *(Phylum: Arthropoda, Class: Insecta, Order: Plecoptera).* The nymphs have two thin ‘tails’. They live under stones in running streams. They can only live in clean, unpolluted water. Nymphs eat small water insects and algae. If one finds stoneflies in a stream, it usually indicates good water quality as they are affected by small amounts of pollution.

**Terrapin and leguaan:** *(Phylum: Chordata, Sub-Phylum: Vertebrata, Class: Reptilia).* Water terrapin are usually a muddy brown colour. They have a scaly skin and scales modified to form a leathery shell. Water leguaans are very large lizards with a patterned scaly skin.

**Water beetles and bugs:** *(Phylum: Arthropoda, Class: Insecta).* All the water beetles and bugs have flat, smooth bodies. They are usually found in clean streams and rivers.

**Water birds:** *(Phylum: Chordata, Sub-Phylum: Vertebrata, Class: Aves).* A wide variety of water birds are found in and around water systems. They have beak and feet adaptations for feeding in streams, rivers, ponds and wetlands.

**Water boatman:** *(Phylum: Arthropoda, Class: Insecta, Order: Hemiptera. The order Hemiptera includes all bugs).* They swim mostly on the surface of the water and dive down deeper to feed on algae. They catch bubbles of air in their body hairs that they use to breathe from when they dive down deeper – similar to a scuba diver! This air bubble is what gives the boatman a silvery colour in the water.

**Water snail and limpet:** *(Phylum: Mollusca. Oysters, octopus, mussels and garden snails also belong to this phylum).* Water snails have a soft body protected by a coiled shell. They have a muscular foot that sticks out of the shell and is used to move. Limpets have a flattish shell covering their body. This shell has a foot that sucks on to the smooth surface of rocks and plants. Snails eat water plants. Limpets eat algae on rocks and on water plants. Snails can live in slightly polluted water. Snails can carry very small (microscopic) animals, like bilharzia, inside their bodies, that can make people sick. Snails that carry bilharzia like slow moving waters and stay near reeds to keep from being washed away. People who have bilharzia often feel very tired and may have kidney damage.

**Water scorpion:** *(Phylum: Arthropoda, Class: Insecta, Order: Hemiptera).* This insect does not have a poisonous sting. It is usually brown and often looks like a dead leaf! It creeps around amongst water reeds or in the mud at the bottom of shallow pools. The water scorpion breathes through its tail – this is used like a snorkel.

**Water strider:** *(Phylum: Arthropoda, Class: Insecta, Order: Hemiptera).*The water strider has long middle and back legs for resting and skating on the surface of the water. Water striders eat insects which have fallen into the water. To find their prey, water striders have sensory areas in their feet. With these they can feel the vibrations of the insects that have fallen into the water.

**Whirlygig beetle:** *(Phylum: Arthropda, Class: Insecta, Order: Coleoptera. The order Coleoptera includes all the beetles).*The larvae look like small centipedes. Adult whirligig beetles are smooth and streamlined and are usually a shiny grey colour. Adults and larvae both feed on dead or dying insects that have fallen into the water.