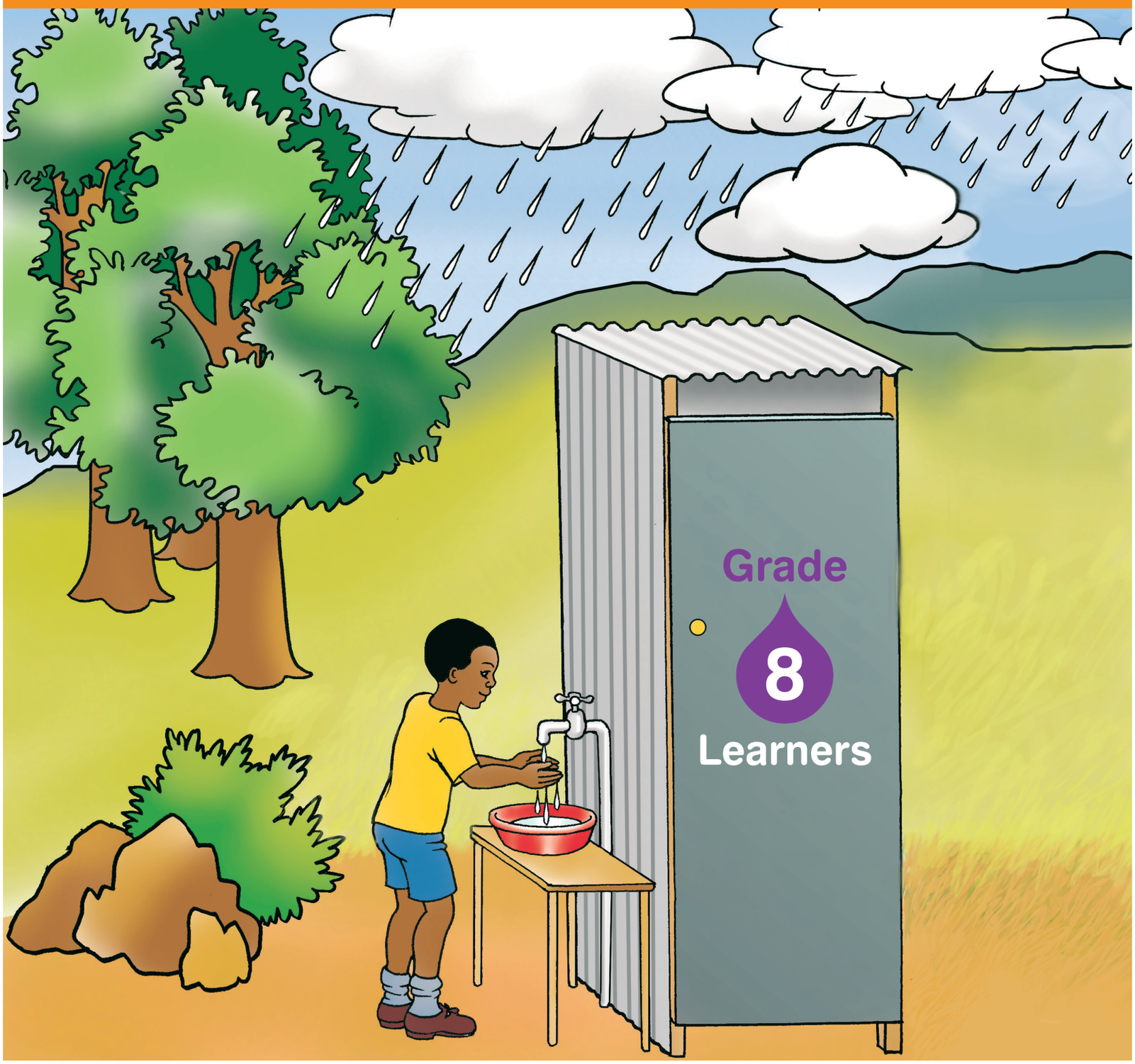
Water is Life

2020 Vision for Water and Sanitation Education Programme



water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

Acknowledgements

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It would probably have been a challenge to manage this process without the concrete support of the sponsors. Appreciation thus goes to ABSA, MTN, Play Pumps International and Cape Peninsula University of Technology for the resources provided in making this initiative a success.

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The Wildlife and Environment Society of South Africa (WESSA) played a big role in linking this resource to the CAPS curriculum as well as making the final edits and layout.

Water is Life

Name.....

Surname.....

Grade.....

Grade 8

Grade

8

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1 Precipitation

• Social Science Geography Term 2 (Topic: Climate regions)
• Maths Topics 2.1 (Numeric & geometric patterns) 2.5 (Graphs) and 5.3 (Interpret, analyze & report data)

Water is Life

Activity

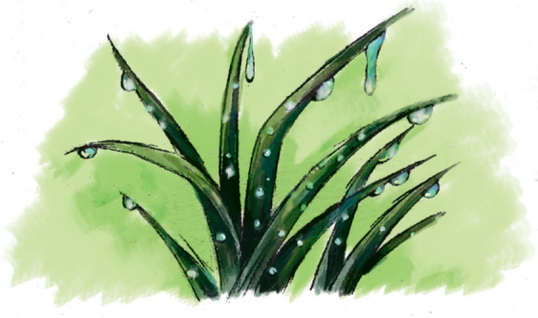
In this activity you will be able to:

- Explain different types of precipitation
- Describe the different phase changes of water vapour

Precipitation occurs when so much water has condensed that the air cannot hold it anymore. The clouds get heavy and water falls back to the earth in the form of rain, hail, sleet or snow.

What to do

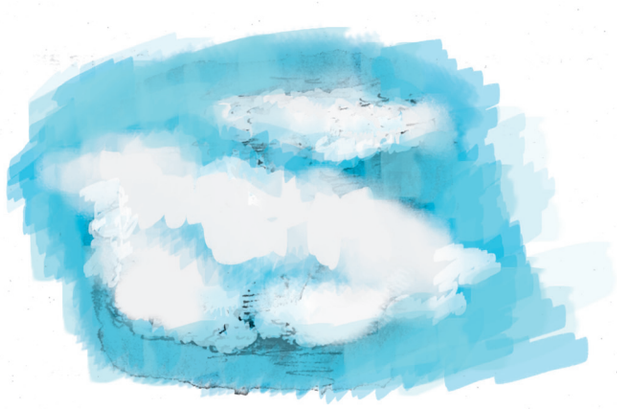
Look at the pictures below which identify different types of precipitation.



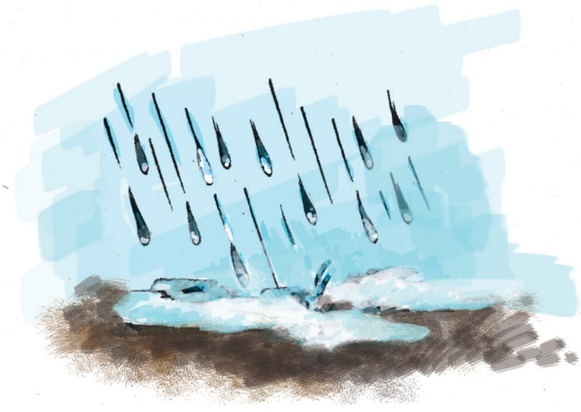
These tiny droplets of water are called ***dew***. ***Dew*** forms on grass, leaves and other surfaces early in the morning.

Those of you who live on the highveld in Gauteng or the Free State will know about ***frost*** - crystals of ice outside in the early morning.

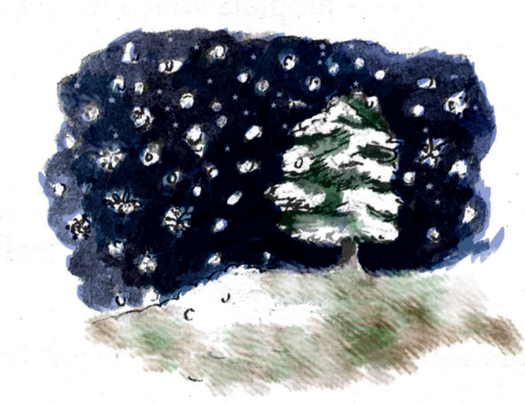
1 Precipitation



A ***cloud*** consists of water droplets and ice crystals held in the air. ***Mist*** and ***fog*** also consist of droplets of water hanging in the air. ***Mist*** and ***fog*** are really very low clouds.



Rain consists of water droplets which fall from clouds down to earth.



Snow consists of flakes of ice crystals which fall from clouds down to earth.

1 Precipitation

Activity 1a: Recognise precipitation

Answer these questions individually in your exercise books.

1. List the types of precipitation.

.....

.....

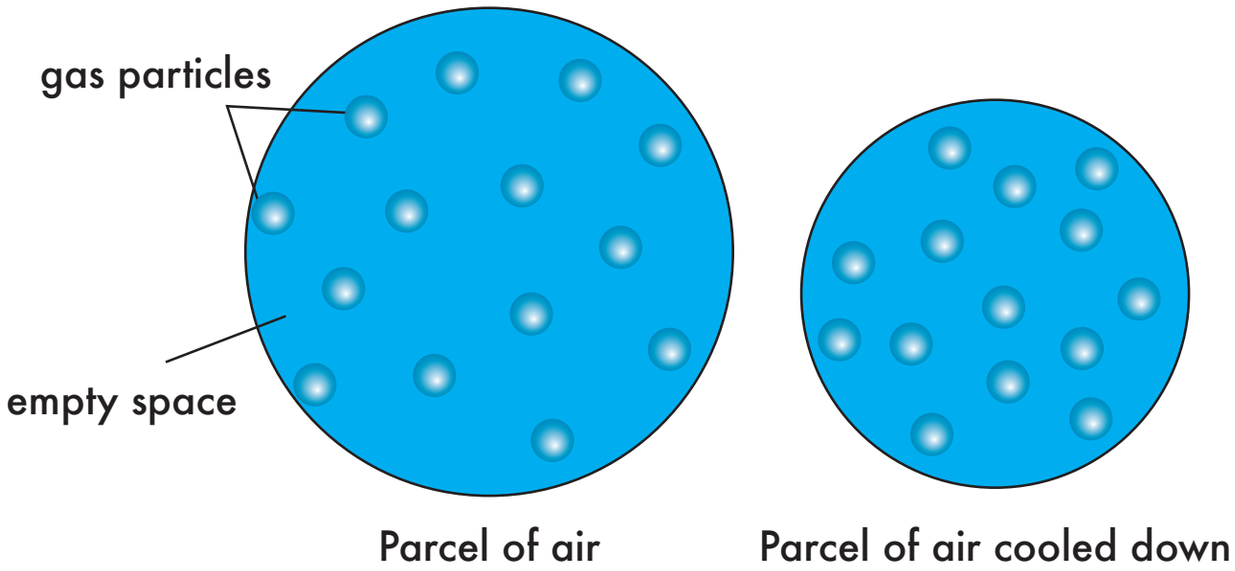
2. Does frost ever form in the area where you live? Explain why or why not.

.....

.....

How does precipitation happen?

Try to imagine a parcel of air magnified many times. It would look like this:



- Water vapour can occupy the empty space between the gas particles. Suppose we cool down our parcel of air. What will happen?

.....

.....

- The air will shrink into a smaller space. The gas particles will move closer together. There will not be as much space for the water vapour, so some of the water vapour changes or condenses into water. The water will appear as some kind of precipitation.

You can see that if we cool down air which contains water vapour, we will get precipitation. Every type of precipitation is the result of water going through a phase change. For example, dew represents the phase change from water vapour to liquid water and frost represents the phase change from water vapour to solid ice.

Activity 1b: Phase changes

1. Describe the phase change which water goes through when water vapour in the air changes to:

   a. Clouds .....

   b. Snow .....

   c. Rain .....

2. Why do you think clouds often form at the top of hills or mountains?

.....

.....

.....

.....

Assessment

You will be assessed whether you were able to:

- Explain the different types of precipitation
- Describe the different phase changes of water vapour

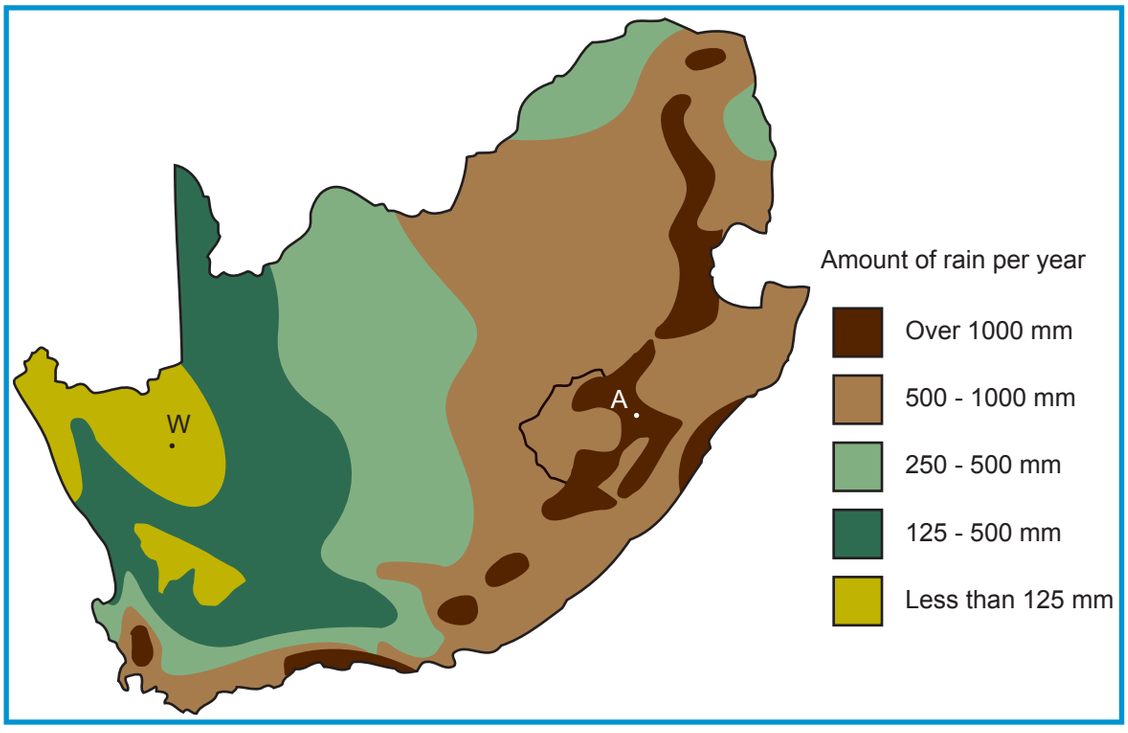
Global warming leads to climate change. Conserve water, and break this cycle of destruction.

Extended activity: Rainfall in different areas

Read the following cartoons:

What to do

Look at the map below and answer the questions in pairs. Look at the key to the map. See where Wilson and Suri live. Notice that Suri lives in an area with more than 1000mm rain per year. Wilson lives in area with less than 125mm rain per year.



Activity 1c: Reading the rainfall map

1. How much rain does the area where you live receive in one year?

.....

.....

.....

2. Which parts of South Africa receive the most rain – the mountainous parts or the flat parts?

.....

.....

.....

3. Which side of South Africa receives the most rain – the east side or the west side?

.....

.....

4. In which direction does the rainfall decrease in South Africa – eastward or westwards?

.....

.....

.....

5. On which side of South Africa do you think most people live? Why?

.....

.....

.....

1 Precipitation

What to do

Read the text below, study the diagram and answer the questions in pairs.

Look at the rainfall map again. Note that the areas which get the most rain are the mountainous regions. Suri said there was lots of rain where she lived and she lives close to the Drakensberg Mountains. Look at the diagram below to see why rain falls in mountainous regions.

1. Water vapour evaporates from the surface of the warm Indian Ocean.
2. Winds blow air containing water vapour to the KwaZulu-Natal coast.
3. The air rises to cross the mountains. As it rises it cools.
4. When the air cools some of the water vapour condenses to form water droplets.
5. The water droplets make a cloud.
6. Rain falls on the Drakensberg Mountains.
7. Air blows down the other side of the mountains and warms up.
8. The warm air can hold all the water vapour so no water vapour condenses. There are no clouds and no rain falls.

Activity 1d: Why does rain fall on the mountains?

1. Where does the air pick up water vapour?

.....

.....

2. How does the moist air reach the KwaZulu-Natal coast?

.....

.....

3. Why does the air cool down?

.....

.....

4. What happens to the water vapour in the air when the air cools down?

.....

.....

5. Why is there no rain on the other side of the mountains?

.....

.....

6. Write down two important things which must happen before rain can fall.

.....

.....

Activity 1e: Measuring rainfall

Research from the internet or a library and collect data regarding rainfall in your region for the last 5 years.

1. Plot the graphs according to the data collected:
   - Bar graph
   - Pie chart
   - Line graph
2. Which year did we have the most rainfall?
3. Difference between:
   - 2003 and 2006
   - 2004 and 2007
   - 2005 and 2008
   - 2006 and 2009

Assessment

You will be assessed whether you were able to:

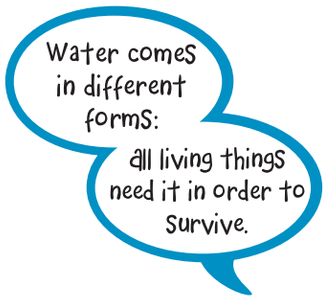
1. Read a rainfall map
2. Explain why rain falls in mountainous regions

Glossary of words

Clouds	A mass of water vapour or ice crystals in the atmosphere.
Dew	A collection of water droplets that form when water vapour in the air condenses on the ground or on plants.
Fog	Clouds that form at ground level.
Precipitation	Water that falls in any form from the atmosphere onto the earth; it includes rain, hail, snow, frost and dew.

Be sure to consider all the factors upstream that may influence the water quality.

(*From Understanding Models in the Earth and Space Science – Steven W. Gilbert and Shirley Watt Ireton - 2003 NSTA Press)



1 Precipitation

Assessment

Criteria	You were able to explain types of precipitation	You were able to describe the different phase changes of water vapour	You were able to read the rainfall map and explain why rain falls in mountainous regions	You were able to respond to questions appropriately
Not Achieved 0-29%				
Elementary Achievement 30-39 %				
Moderate Achievement 40-49 %				
Adequate Achievement 50-59 %				
Substantial Achievement 60-69 %				
Meritorious achievement 70-79%				
Outstanding Achievement 80- 100 %				

Water use Efficiency

- Social Science Geography Term 2 (Topic: Climate regions)
- Maths Topics 2.1 (Numeric & geometric patterns), 2.5 (Graphs) and 5.3 (Interpret, analyze & report data)
- Natural Science Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
- EMS Term 1 week 6 (Standard of living)
- English First Additional Language Term 3 weeks 3-4 (reading & viewing)
- English Home Language Term 1 weeks 7-8 (reading & viewing)

Activity

In this activity you will be able to:

- Read, interpret and draw maps and graphs
- Understand the relationship between physical features and rainfall distribution.
- Understand how rainfall distribution and other physical features influence human activities
- Recognize the importance of saving water as a precious natural resource and the importance of paying for it.

You will need:

- Class work book
- Lead Pencil

What to do

Refer to the following fact sheet and map to answer the exercise questions.

Fact Sheet

Of all the water we have in the world, 97% is salty seawater, 2% is frozen water in the poles and only 1% is fresh water suitable for use. South Africa is regarded as a semi-arid or water-scarce country. Our rainfall is unpredictable, 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). Our average rainfall is less than 500 mm a year, much below that of the world, which is 860 mm per year. The driest part of the country receives 200 mm per year and the wettest 2 500 mm per year. Rain doesn't always fall where it is most needed, and some areas of high demand like Pretoria-Witwatersrand-Vereeniging (PWV) receive less 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.

Common periods of drought limit our water resources even further whilst most rivers are dry or only flow during rainy seasons. To make things worse the limited water we have is polluted through a variety of human activities and thus cannot be used.

The water supply we have does not meet the needs of the growing population and the economy. Instead these factors increase the shortage of water.

2 Rainfall and human activity

Since we do not receive much rain, we need to protect our water and use it wisely. Large-scale engineering has been used to store water behind dam walls, and to distribute water from regions of plenty to regions of need. About half of South African rainfall is stored in dams in order to regulate the flow of a river, reducing flood damage and to keep the rivers flowing throughout the year rather than seasonally. However South Africa's geomorphology (the way the land is formed) is not well suited for dams and most dams are shallow. This, together with hot, dry conditions result in a high evaporation rate and again a shortage of water supply.

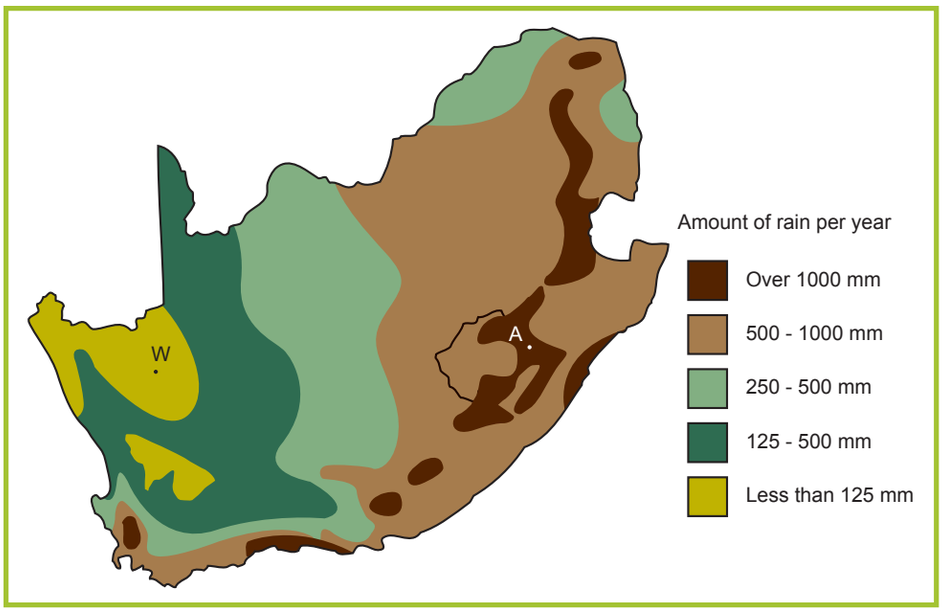
Another method of ensuring constant supply of water is through so-called inter-catchment transfers. This involves the movement of water from catchments/drainage basins with good water supplies and low demand to those where demand is high and supply is poor. These transfers are not enough and so the problem of a shortage of water supply persists.

Other options to overcome the problem of the shortage of water supply are recycling and desalination of seawater. Recycling of domestic wastewater and sewage is already done by some large industries and regional water suppliers. The option of desalination or turning seawater into fresh water is still under serious consideration as it is expensive.

The rapid population growth will result in a shortage of water as the rate at which we can build dams to store and supply water is not enough to meet the needs of a growing population. The population is not likely to decrease, nor is the annual rainfall likely to increase, which means that there is a growing problem of the lack of water in South African rivers. We depend on rivers, dams and underground water for our water supply.

Various methods to overcome the problem of the shortage of water have been tried but because of various problems, South Africa hasn't succeeded in overcoming this problem. The bottom line is that conservation of our limited water resources as well as improved management is a must for everyone! Let every drop count!

(Adapted from the Enviro-Facts Sheets series: Precious water, River Catchments, Water is Life! A handbook for teachers)



2 Rainfall and human activity

Activity 2a: Rainfall map

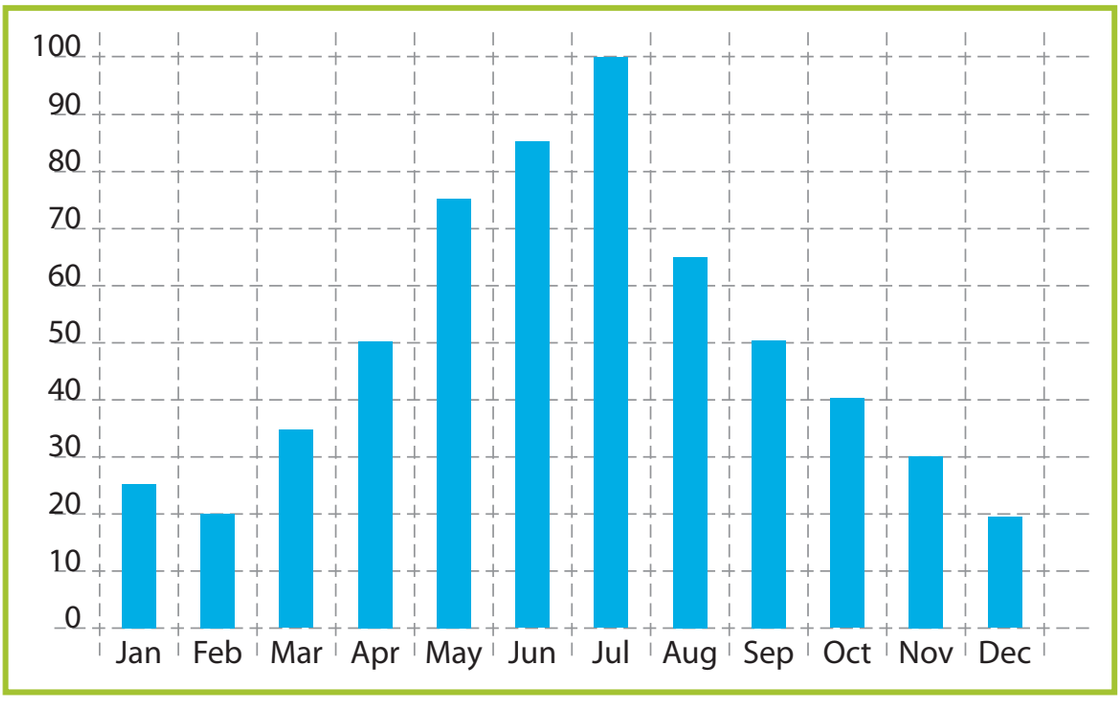
You can work in pairs for this activity.

Refer to the fact sheet and the map provided to do the following exercise:

1. Locate your province in the rainfall map by circling it with your pencil.
2. Study the rainfall map and answer the following questions:
   a. What is the average rainfall of your province per year?
   b. Comparing that with the average rainfall of 500 mm would you classify your province as a high, medium or low rainfall area? Why?
   c. Which part of South Africa receives more rain? (Western / Eastern)
3. Of the three forms of water supply mentioned in the fact sheet which one does your family use?
4. Name four methods of trying to ensure constant supply of water mentioned in the passage.
5. Which one is used in your area?

Activity 2b: Data-handling exercise

A. This graph shows the rainfall distribution for Cape Town each month of the year. Use the graph to answer the following questions.



2 Rainfall and human activity

1. During which month did the least rain fall?

.....

2. During which month did the most rain fall?

.....

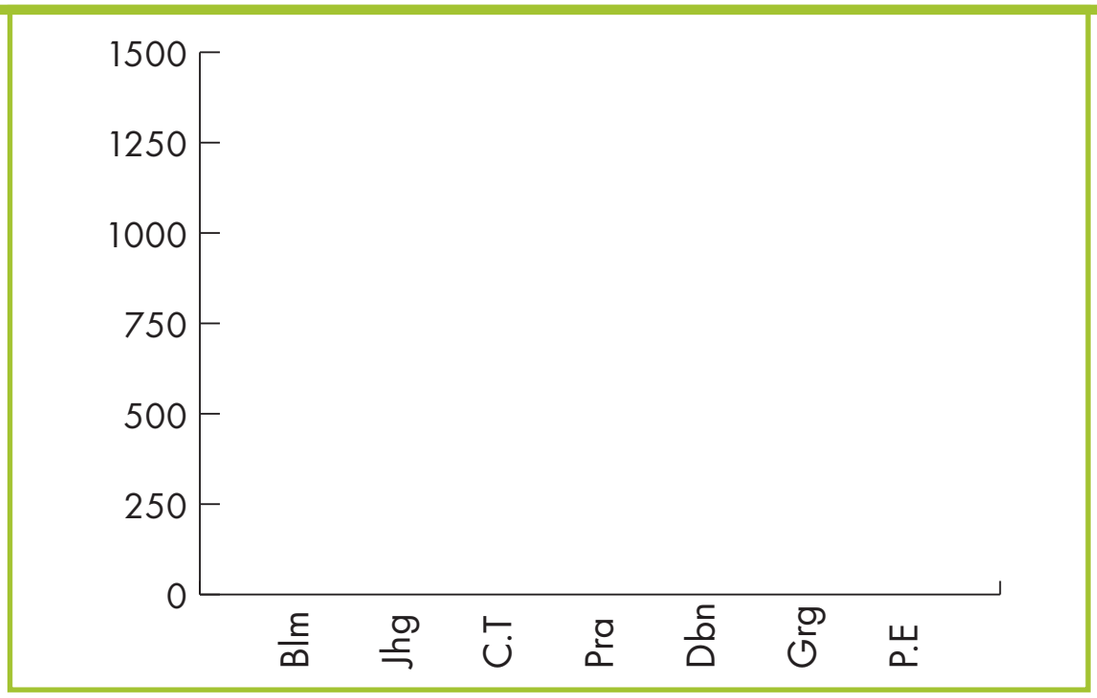
3. Which months received the same amount of rain?

.....

4. During which season does Cape Town receive the most rain? Choose one.
   a. Summer
   b. Autumn
   c. Winter
   d. Spring

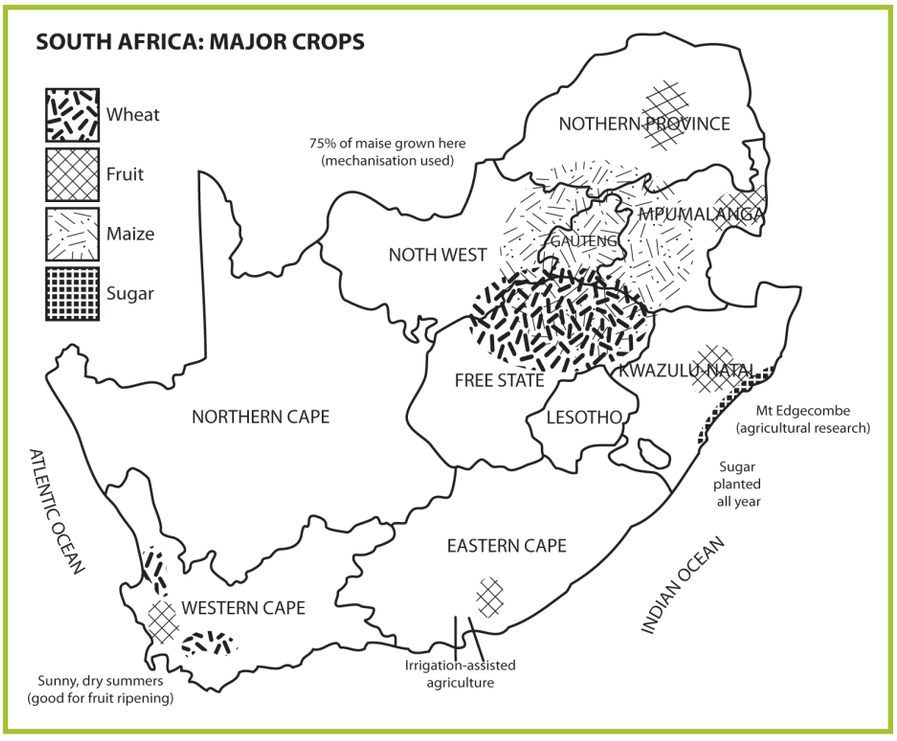
B Study the table carefully. It shows the annual amount of rainfall received by these cities. Draw a bar graph similar to the previous one, showing the amount of rainfall received by these cities on the following page. Replace the months in the y-axis with names of cities.

City	Rainfall in mm
Bloemfontein	680
Johannesburg	700
Cape Town	550
Pretoria	720
Durban	1200
George	850
Port Elizabeth	750



Activity 2c: Human activities

Using the map below and the map in the previous activity, answer the following questions.



2 Rainfall and human activity

a. Which province produces a wide variety of crops?

.....

b. Is that province high, medium or low rainfall area?

.....

c. Which province does not produce any crops?

.....

d. Can this be associated with the amount of rainfall they have. Support your answer?

.....

e. What type of farming do you think is practiced here if there is no crop farming?

.....

Assessment

You will be assessed whether you were able to:

- Identify and name the physical features of South Africa, including those of your provinces
- Associate the type of economic activity with the rainfall distribution pattern
- Interpret and represent data in various forms

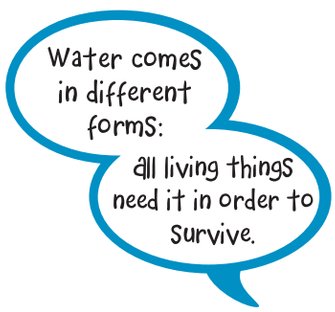
Glossary of terms

Pole: The two opposite ends of the Earth's axis. Its northern and southern points.

Semi-arid: A land that is almost dry where few plants can grow.

Engineering: It is the work that is involved in designing and constructing engines and machinery, or structures such as roads and bridges.

Catchment: The total land area from the mountain top to the sea shore which is drained by a single river and its tributaries.



Assessment

Criteria	You were able to identify and name physical features of South Africa	You were able to locate your province in the rainfall map	You were able to associate the type of economic activity with the rainfall distribution pattern	You could interpret and represent data in various forms
Not Achieved 0-29%				
Elementary Achievement 30-39 %				
Moderate Achievement 40-49 %				
Adequate Achievement 50-59 %				
Substantial Achievement 60-69 %				
Meritorious achievement 70-79%				
Outstanding Achievement 80- 100 %				

Teachers use in:
- Creative Arts: Drama
  Term 2 Topic 3
  Term 4 Topic 3
- English First Additional Language: Term 1, weeks 1-2; Term 2, weeks 1-2 (Listening and speaking)
- English Home Language: Term 1 weeks 1-2; Term 2 weeks 1-2 (Listening and speaking)

Water use Efficiency

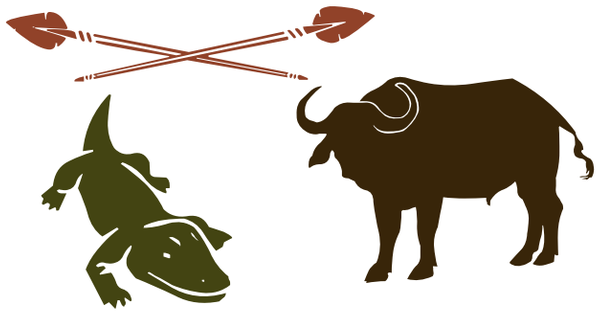
Activity 3a: Sweet water and early Nguni people

The story of 'Sweet Water and Nguni People' will be either read to the class by the teacher or photo copies of the story will be handed out.

As a class, discuss the following questions:

1. How many of you have collected water from a nearby river? What was the water used for? (If drinking, how were you certain that it was safe to drink?)
2. How many of you have heard the story that has just been read? Who told you this story?
3. Do any of you have stories of other ways of collecting water long ago?
4. Many stories from long ago are passed down orally from one generation to another. One does not find them written down in books and one has to ask the older people in a community who may remember how things were done long ago. How reliable is this information? What is the danger of not writing down stories from different cultures?
5. Why do you think it's important to look after our rivers and streams?
6. Does the class think that rivers and streams throughout South Africa have changed over the last 100 years? In what way? Why? Have any of you seen changes taking place in a river in your life-time? (Keen young fishermen in the class may have noticed a decrease or increase in fish species and a change in the water quality or path of the stream/river).
7. How can we find out what the rivers, streams and other water sources were like in our own community 50 years ago so that we can compare them with what we see today?





Assessment

Criteria	The learner was able to discuss how reliable and useful stories told by older members in the community were (question 4)	The learner was able to give reasons why we should conserve and look after our rivers and streams (question 5)	The learner was able to discuss possible or real changes that have taken place in rivers or streams
Not Achieved 0-29%			
Elementary Achievement 30-39 %			
Moderate Achievement 40-49 %			
Adequate Achievement 50-59 %			
Substantial Achievement 60-69 %			
Meritorious achievement 70-79%			
Outstanding Achievement 80- 100 %			

4 Interviews, stories and history

Teachers use in:
• Creative Arts: Drama
Term 2 (Topic 3) Term 4 (Topic 3)
• Social Science: Geography Term 3 (Topic: Settlement)
• English First Additional Language:
Term 2 weeks 5-6
(writing & presenting; listening & speaking)
• English Home Language: Term 2 weeks 5-6
(writing & presenting; listening & speaking)

Water use Efficiency

In this **ARTS AND CULTURE** activity, learners conduct interviews in their local community and then share their findings to the rest of the class in small group role-plays.

A watershed and its catchment is the land from which rainwater flows into wetlands, streams or rivers. Many of the river catchments of southern Africa have been changed by historical land use practices, settlements and industrial growth to cater for rapidly expanding population. In many cases, wetlands have been destroyed and riverine vegetation removed, decreasing natural flood control so that the amount and quality of water released by our river catchments is decreasing.

Interviewing local people and collecting stories can develop a sense of how things have changed. Local information and stories are essential for our understanding of local water quality issues.

Activity 4a: Finding out about our past

In small groups of 4 or 5, you must work out a set of questions to ask local people, particularly older folk, who have lived in the area for many years.

You also need to work out another set of questions about the present conditions of their catchments and possible problems. These questions can be asked to your friends, parents and other members of the community.

And now it's time for some drama in our lives.

What is role-play?

We use role-play to explore different situations and ideas. This is done by acting out a usually authentic situation, without a script.

Now that the water quality catchment interviews have been completed, each group will role-play their experiences of:

- Deciding what questions the group was going to ask the interviewees;
- Deciding who they are going to interview;
- The interviews themselves;
- Their interactions with one another during this activity: any conflicts that arose, any differing of opinions (how they were sorted out, or not!) any laughs and good times.

4 Interviews, stories and history

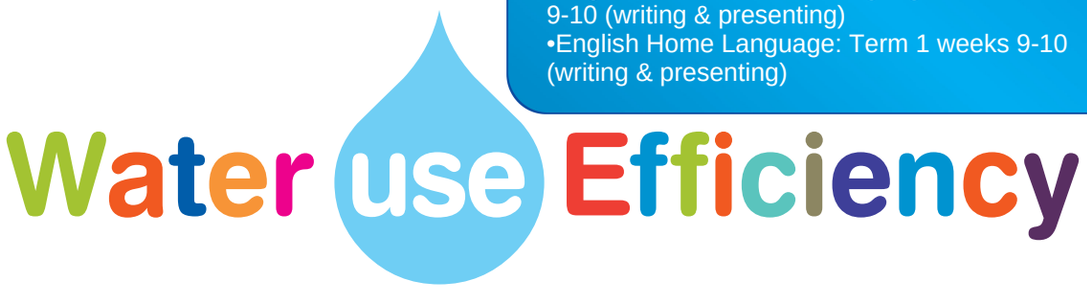
One of the first tasks of the role-play is a fun way of exploring environmental issues and concerns. At the end of the role plays, a list of all the main points that emerged from the interviews can be drawn up and shared with the whole class, thus giving a broader and fuller overview of the water and water quality situation in your local catchment.

Assessment

Criteria	The learner was able to research the issue of water quality by conducting interviews within their local community	The learner was able to work in a group and play a part in the role-play of water quality.
Not Achieved 0-29%		
Elementary Achievement 30-39 %		
Moderate Achievement 40-49 %		
Adequate Achievement 50-59 %		
Substantial Achievement 60-69 %		
Meritorious achievement 70-79%		
Outstanding Achievement 80- 100 %		

5 Water audit at school

Teachers use in:
•Natural Science Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
•English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
•English Home Language: Term 1 weeks 9-10 (writing & presenting)



Activity

At the end of this activity you will be able to:

- Explain the importance of saving water in the school-yard
- Carry out a water audit at your own school
- Record findings accurately in the audit record sheet
- Develop an action plan to save water at your school
- Calculate the results of the audit
- Communicate your findings to the school management

You will need:

- A Water audit sheet
- Activity guide for educators
- Pencil

Activity 5a: Water audit

- In groups you are going to do an audit of all uses of water around the school premises
- Follow the steps in the activity guide, which will be provided by your educator
- Use the table provided to record information.
- Place a tick next to the use(s) every time you observe water being used for that purpose
- Count the number of ticks and record the total
- Use the information and plot a bar graph to represent the information.
  (Do you remember how to draw a graph?)

5 Water audit at school

Water audit

Group name: .....

Place a tick in the block of each water use per time interval.

Water use activity	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	14:00-15:00	Total
Drinking								
Washing hands								
Toilets								
Cleaning								
Kitchen								
Garden								
Washing cars								
Others (specify)								
Total								

Questions

1. For what activity is water used at the school over a period of one day?

.....

2. Do you consider such uses of water in various points at the school efficient or not? Support your answer.

.....

.....

.....

5 Water audit at school

3. Does your school have a rainwater tank?

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4. Make a list of good water practices at school.

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5. Make a list of all the bad water practices at the school.

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Activity 5b: Make a difference by saving water at school

Using the findings recorded:

1. Determine which activity uses more water.
2. Which water use activity is not practiced at school at all?
3. Design an action plan to save water at your school. Your water saving action plan should be represented in a poster.

Assessment

You will be assessed on your ability to:

- Explain the importance of saving water at your school
- Carry out the water audit at your own school
- Record the finding accurately in the audit record
- Develop an action plan to save water at your school
- Calculate the results of the audit
- Communicate your findings to the school management

Glossary of terms

Water Quantity Audit: Process of determining the amount of water used and wasted.

5 Water audit at school

Assessment

Criteria	The learner was able to explain the importance of saving water	The learner was able to make a list of all good and bad water practices	The learner was able to conduct a water audit at school	The learner drew a bar graph showing water wastage in the school	The learner participated in designing an action plan to save water at school
Not Achieved 0-29%					
Elementary Achievement 30-39 %					
Moderate Achievement 40-49 %					
Adequate Achievement 50-59 %					
Substantial Achievement 60-69 %					
Meritorious achievement 70-79%					
Outstanding Achievement 80- 100 %					

Teachers use in:
- Creative Arts: Drama Term 2 Topic 3 (Praise poetry); Music Term 1 Topic 3, Term 2 Topic 3, Term 3 Topic 3 and Term 4 Topic 3 (performing & creating music)
- Natural Science: Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
- EMS: Term 1 week 6 (Standard of living)
- English First Additional Language: Term 1 weeks 9-10 (reading & viewing)
- English Home Language: Term 1 weeks 9-10 (reading & viewing)

Water use Efficiency

Activity 6a: Increasing awareness about water resource management

In this activity you will engage in a project that will:

- Increase awareness about integrated water resource management.
- Participate in a competition that will send a message to the community about the wise use of water.

You will need:

- To do research about water and its importance
- To compete with fellow learners through: drama, poem, traditional music and a poster

What to do

1. Work with your partner for this project.
2. You will need to read and understand the facts about water.
3. Read the facts and decide which ways you are going to use to bring about water awareness.
4. The theme for your project is "Water Wise". You may choose to engage in:
   - Drama
   - Poem
   - Traditional music
   - Poster
5. You will need to present your choice to the class.

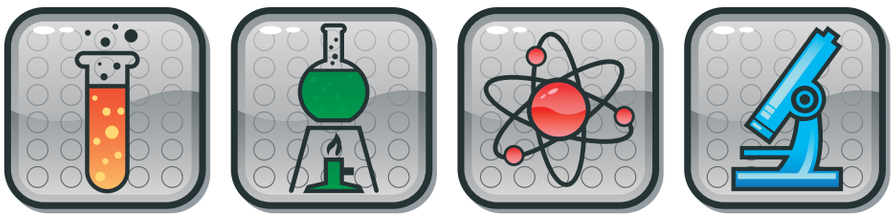
6 Use water wisely

Did you know?

- Water is re-usable
- The human body is made up of 80% water
- 70% of your skin is water
- The average rainfall in South Africa is 500mm, well below the world average of 860mm
- Only 1% of the Earth's water is available for drinking
- You can survive about a month without food, but only 5 to 7 days without water
- We have 550 government dams in South Africa with a total of 37000 million square metres

Hints to do your project

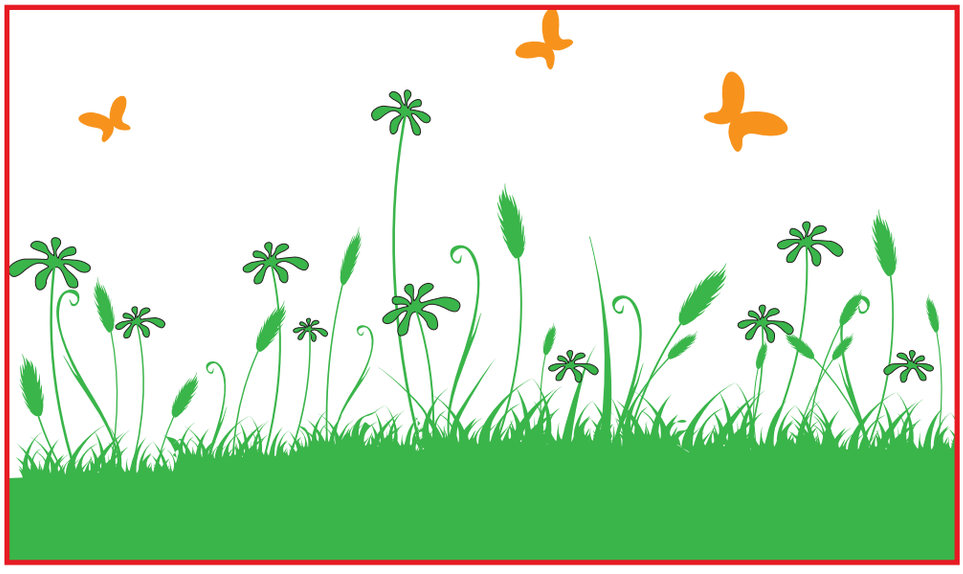
1. Observe carefully how water is used at home, school and in the community.
2. Identify the problems in the way water is being used in each of the places mentioned.
3. Write all the problems down.
4. Share them with your partner.
5. Agree on the solutions to the problem of water.
6. Then send a message. Decide on how the message will be sent, either through a poem, drama, traditional music or a poster.



Assessment

You will be assessed on the following:

	Level Descriptors			
	1	2	3	4
Understanding	The learner demonstrated little understanding of the subject	The learner demonstrated some understanding of the subject	The learner demonstrated good understanding of the subject	The understanding of the subject was beyond conceptual level
Relevance	The message is irrelevant to the topic	The message shows some relevance to the topic	The message is relevant to the topic	The message was conceptualised very well
Creativity	No creativity shown	The plan appears to be theoretical	Creative ideas shown in the plan	The learner was excellent in creativity
Presentation	Presentation is not good at all	Presentation is not good enough	Able to do presentation	Good presentation



7 Auditing our water consumption

- Maths: Topic 1.5 (decimal fractions)
- Natural Science: Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
- Life Orientation: Term 3 Weeks 4-6 (Topic: Health, social & environmental responsibility)

Water Quality

Auditing our individual family's water consumption is a good start to investigating how we can all reduce water waste and together, as a community, develop a water-wise management plan. This **NATURAL SCIENCES** activity allows learners to prepare for a water audit, collect data in and around their home, school and community and then develop a school water-wise management plan.

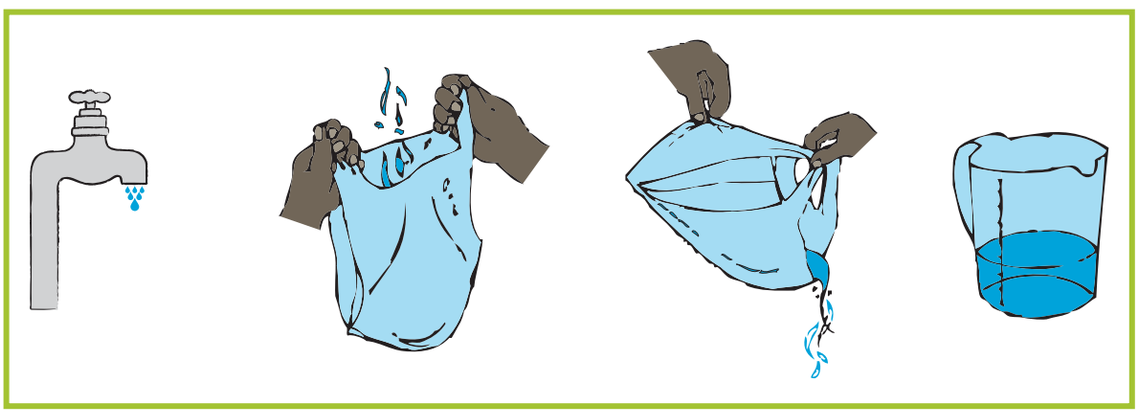
To prepare for an audit of the school, home or community water supplies, current patterns of use must be calculated and averaged. This makes an audit a simple matter of recording the number of times each activity happens. Preparation activities also point to wasteful practices that can be changed.

For example: People with piped water often clean their teeth or take a drink with the tap running. In this way, fresh water is wasted when it would have been more sensible to use a cup.

Activity 7a: Calculate how much water is wasted

Calculate the amount of wasted water when you're brushing your teeth or taking a drink from a running tap.

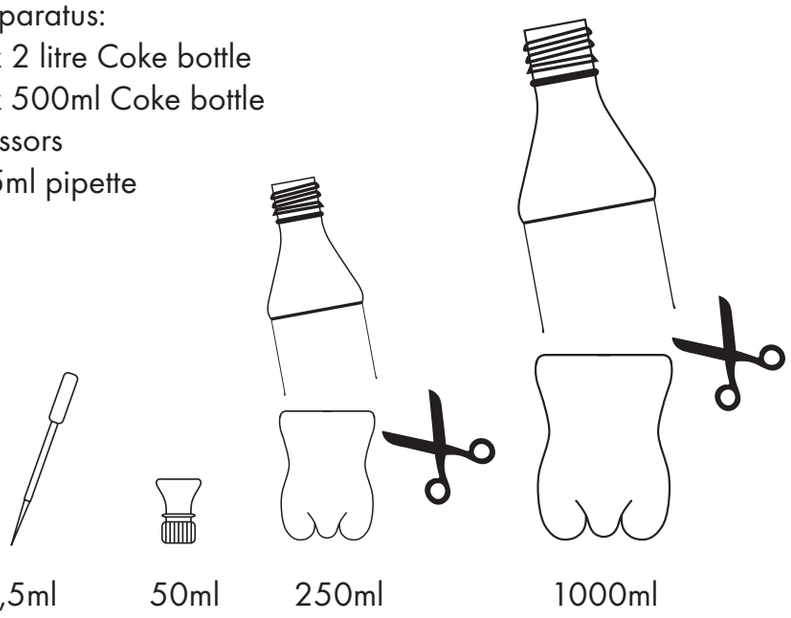
- For fast running water, use a supermarket plastic bag
- Pour the water collected into a container and use a measuring jug to measure



7 Auditing our water consumption

A cheaper alternative is to make your own measuring equipment

Apparatus:
1 x 2 litre Coke bottle
1 x 500ml Coke bottle
Scissors
2,5ml pipette



Cut the bottles as shown in the picture. This will give you 50 ml, 250 ml, 1000 ml (1 litre) measuring apparatus.

- Accurate apparatus is important so check by filling the larger from the smaller:
  - The 2,5ml is pre-calibrated
  - 50ml is 20 x 2,5ml
  - 250ml is 5 x 50ml
  - 1000ml is 4 x 250ml

Although not as accurate as a measuring jug, this equipment is more than adequate for auditing water use.

To measure a bag of water, simply fill the 1000ml, counting each time until a part-filled container remains. Pour this into the 250ml until a part-filled container remains and do the same right down to a part-filled 50ml measure which is determined by the pipette. Written like this, it seems a little complex but in practice, the bailing and counting method is both quick and accurate.

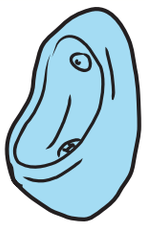
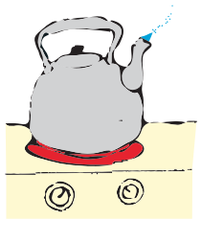
Calculate the difference

- Water used with tap left running .....ml
- Water used with a cup .....ml

Difference .....ml

7 Auditing our water consumption

Make a list of common water use activities in preparation for doing an audit of water use

	Flushing toilet ..... litres		Urinal ..... litres
	Washing hands ..... litres		Brushing teeth ..... litres
	Drinking water ..... litres		Bathing ..... litres
	Taking a shower ..... litres		Kettle ..... litres
	Hand washing clothes ..... litres		Washing machine ..... litres
	Washing dishes ..... litres		Dishwasher ..... litres
	Garden hose (litres per hour) ..... litres		Cooking pot ..... litres

7 Auditing our water consumption

Remember that...

Despite sound preparation and knowing how much water is used for each activity, a water audit is never an easy matter. You will only be successful if, from the beginning, you keep it simple and have ways of checking your work for accuracy.

For example:

If a check of results against the meter reading shows that more water is used than the audit records then there may be a leak in the pipes. (Check this by switching all the taps off and seeing if the meter keeps ticking). You may have missed measuring an important water activity, or

Your calculations may be wrong!

In this way, an audit of water use will always present challenges and problems to be solved. Here are some ideas to help the learners plan an audit of the school, home and community water use.

School

Start with each person in the class doing an audit of the water they use in a day. This can be combined into an audit of the water used by the whole class. During National Water Week, try an audit of water use in the school and check the accuracy of your records using the water meter if there is one.

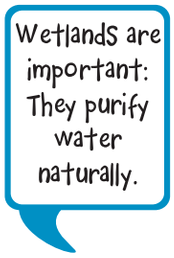
Home

Get the learners to plan an audit with their family, using simple record sheets at each site of water use. Totals for the day should be matched with the meter reading or monthly water bill.

Community

Patterns of use at home and at school can give the learners an idea of domestic water use in the community. Offices, industries and agriculture often use vast amounts of water when compared with domestic consumption. There are also many people in our communities who do not use piped water.

Remember that we need clean water for our health. Water conservation is not about people drinking or using less water but a challenge of working out ways to reduce unnecessary waste so there is more water to go around.



Adapt the following table, or develop your own, to calculate school, home and community water use. Results should be compared with metered use. This is a good check of how accurate the audit has been.

7 Auditing our water consumption

Name of person	Drinking	Kitchen use	Washing machine	Toilet	Urinals	Hand basin	Shower	Garden Hose	Washing carpets	Leaks detected	Other	Total meter reading KL L	Totals

7 Auditing our water consumption

Once the audits have been conducted at school and home discuss the results with the class.

Water audit actions can help us reduce water wastage and thus save money. Many schools are now developing water wise management plans to make changes in their water consumption.

Has your school got a water wise management plan?

If not, develop a plan for the entire school! Divide into small working groups and come up with five to ten ways of reducing water consumption in the school. As a class, go through the list and write on the most useful ones. Submit this plan to the head and management team of the school.

Assessment

Criteria	You adapted the water audit record sheet, where necessary, and added in more headings.	You were able to carry out a water audit around the school.	You contributed ideas in your group and during class to developing a school water wise management plan.
Not Achieved 0-29%			
Elementary Achievement 30-39 %			
Moderate Achievement 40-49 %			
Adequate Achievement 50-59 %			
Substantial Achievement 60-69 %			
Meritorious achievement 70-79%			
Outstanding Achievement 80- 100 %			

8 Do not pollute water

- Life Orientation: Term 3 Weeks 4-6 Topic: Health, social & environmental responsibility
- Natural Science: Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
- Social Science: Geography Term 3 (Topic: Settlement)

Water Quality

Activity

In this unit you will be able to:

- Complete the E. coli test step by step
- Interpret the findings.
- Make recommendations for
  a. Immediate and
  b. Long-term monitoring solutions
- Communicate the findings using appropriate communication strategies and media

You will need:

- E. coli kit (10ml tubes with powder for growing bacteria)
- Recording table

Background information

Escherichia coli (E. Coli) and Faecal Coliforms (FC) are bacteria which indicate faecal contaminationin fresh waters. They are important for digesting food and therefore are present in high numbers in the gastrointestinal tracts of vertebrates. That is why they provide a sensitive measure of **faecal** pollution. These bacteria can enter the water directly from mammals (including humans) and birds, from farm lands, from storm run-off and from sewage discharge into rivers.

If the presence of these bacteria is high owing to sewage contamination, it is likely that **pathogenic** micro organisms are also there in numbers to cause water borne diseases in people who drink or swim in the water. Diseases such as **typhoid, hepatitis, gastroenteritis, dysentery** and **throat** and ear **infections** can be contracted from that rivers water.

It is important to do faecal contamination testing in our fresh water sources because contaminated water poses a serious health hazard to the people who use that water. A test to determine the quality of drinking water and river water used in a community will assist in identifying the pollutants in the water, raise awareness among people about water quality and health issues, and assist people in taking action to improve the quality of their water resources.

8 Do not pollute water

Activity 8a: Identifying water pollution

In this activity you will be able to:

- List the water sources you know
- Describe water pollution problems that may affect those sources
- Suggest long and short-term solutions to address the problem of water pollution

What to do

1. Discuss and answer the following questions:

   a. List the sources of water that you know and use.

.....

.....

.....

   b. What are water pollution problems that may affect those water sources mentioned above?

.....

.....

   c. Name the health risks involved in consuming polluted water.

.....

.....

   d. Describe short- and long- term solutions that you can suggest to ensure that your water source is not polluted.

.....

.....

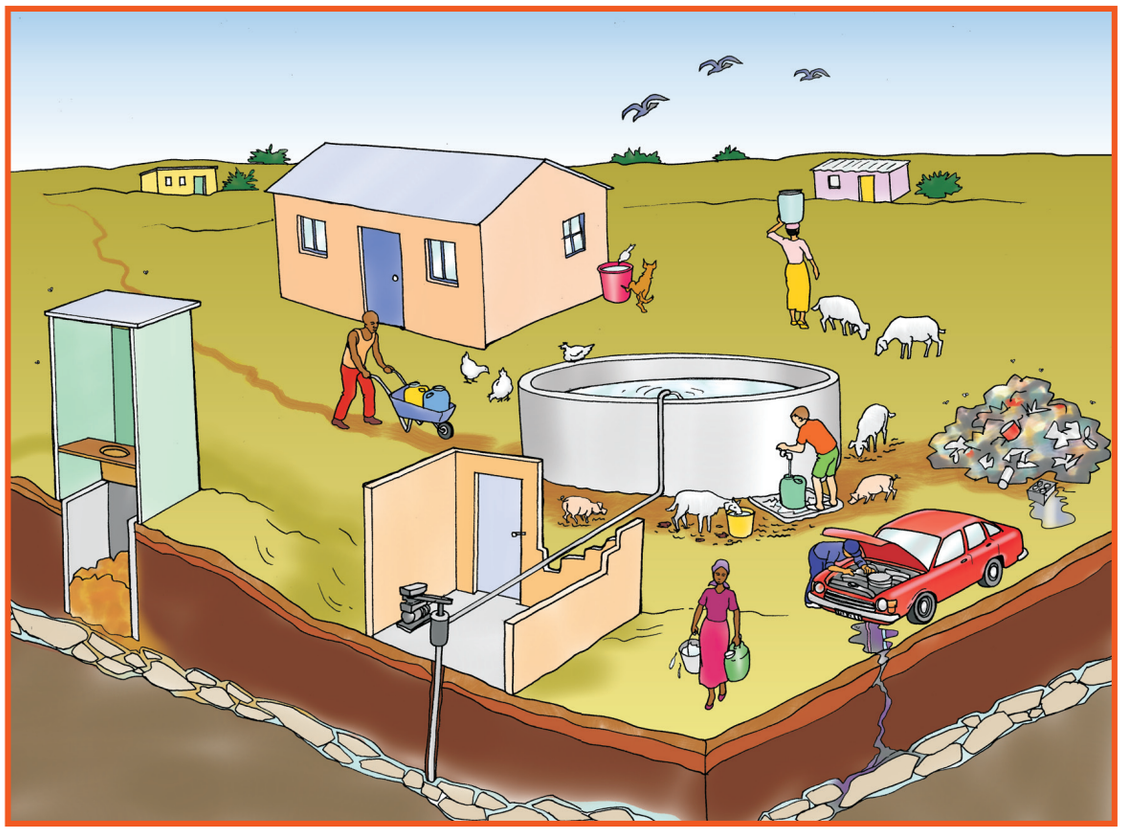
.....

8 Do not pollute water

2. Read and make sure that you understand the background information.
3. Do you think it is true to say that only river water can be exposed to faecal contamination?

.....

4. In response to question 3, look at the following picture and:



a. Try to identify other types of water systems that could be exposed to faecal contamination; and

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b. Add a paragraph that describes other environmental problems that are water based on the background information supplied

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Activity 8b: E. coli testing

In this activity you will:

- Carry out an experiment to determine the possibility of faecal contamination in a river or a borehole / well and its surroundings. This is an experiment in which you will observe a river or borehole / well and its surrounding areas to determine if there is a possibility of faecal contamination or not.

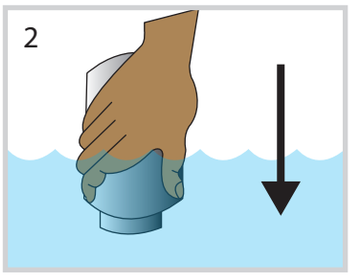
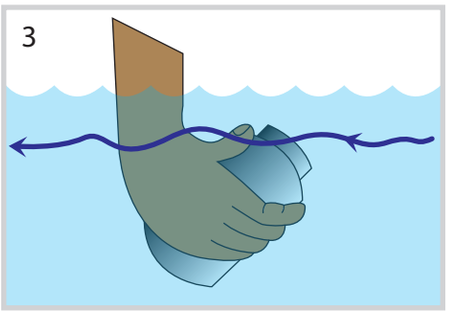
You will need:

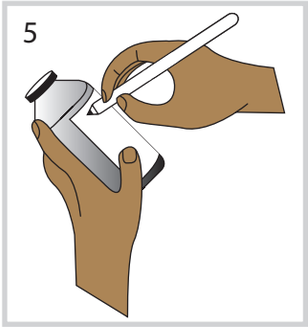
- E. coli test kit
- Test tubes
- Incubator

8 Do not pollute water

What to do

- Divide yourselves into 3 groups so that each can collect samples of water from one site. (If there is a borehole near your area you can form a 4th group to work on the borehole)
- You will sample water from the source for the purposes of testing it in order to take appropriate action to improve the quality of your water as well as of your lives.
- Follow the steps listed below to conduct an E. coli test using the kit provided.

Step 1 At the sampling point remove cap of sample bottle but do not contaminate inner surface of cap and neck of sample bottle with hands.	
Step 2 Take samples by holding bottle with hand near base and plunge the sample bottle, neck downwards, below the water surface (wear gloves to protect your hands from contact with the water).	
Step 3 Turn bottle until neck points slightly upwards and mouth is directed towards the current (can also be created artificially by pushing bottle forward horizontally in a direction away from the hand).	

Step 4 Fill sample bottle without rinsing and replace cap immediately Before closing the sample bottle leave air space in the bottle (at least 2,5 cm to facilitate mixing by shaking before examination.	4 
Step 5 Complete label and sample sheet.	5 

The procedure of the experiment is outlined below.

Your educator will instruct you on what you should do

1. Identify closest water source (river) in your community
2. Choose a 50m river section
3. Mark off the start (10m); middle (25m); and end (50m).
   NB: Make sure that you wear gumboots before getting into the water
4. Take your samples into tubes at these three points i.e. 3 samples each at point: 10m, 25m, and 50m. You will have 9 samples
5. Fill the tubes with the water sample to the first water line
6. Screw lids tightly on tubes and label the tubes.
7. Shake tubes to dissolve powder. Record the colour of water after shaking it.
8. Put it in an incubator or warm place and leave for 24 hours (specimens must be kept warm for bacteria to multiply)

Interpretation of results

In interpreting the results of your observations, you must:

- Carefully follow the steps a and b to interpret the results
- After 24 hours, take out the tubes and observe what has happened
- Use the table below as a guide to interpret the results

- Record the colour changes (if any) in each sample
  a. Circle the result of each sample at the different sites in the table below.
  b. Read the key below the table for colour change results, compare the colour of each sample with the E. coli test record sheet.
  c. Would you say your drinking water is generally safe?

.....

.....

Discussion

Discuss with your partner what the implications of the results are in relation to:

- The effects this water would have on their community's health
- Report their group results orally

Share your group's findings with the whole class orally

E. coli test record sheet

	Site 1	Site 2	Site 3
Sample 1	Yellow • Not yellow	Yellow • Not yellow	Yellow • Not yellow
Sample 2	Yellow • Not yellow	Yellow • Not yellow	Yellow • Not yellow
Sample 3	Yellow • Not yellow	Yellow • Not yellow	Yellow • Not yellow

Activity 8c: Take action. Address the problem.

Depending on the results of the test, your educator may instruct you to proceed to the following tasks:

- If your water quality is contaminated can you come up with suggestions on how to address the problem?
- Group your suggestions into Do-It-Yourself Action Projects for your class or Enviro-Club or Raise the Red Flag Actions for the relevant government department official, local community or the media
- Discuss and formulate your plan of action as a group
- Finally, present your implementation plan to the whole class

NB: Remember your plan can contribute toward the implementation of the resource management or health and safety focus area of your school environmental policy, so it can also be presented to the environmental club.

8 Do not pollute water

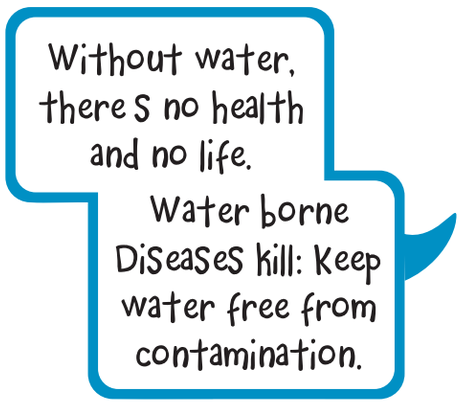
Assessment

Educator will assess the accuracy with which you have:

- Completed the E. coli test step by step
- Collected and recorded the data
- Interpreted and evaluated their findings
- Reported and evaluated their findings
- Made recommendations for
  - Immediate solutions
  - Long-term monitoring solutions
- Communicated their findings using appropriate communication strategies and media

Glossary of terms

Dysentery:	Infection of the intestine which causes severe diarrhoea.
E. coli:	Escherichia coli.
Faecal:	Body waste.
FC:	Faecal Coliform.
Gastroenteritis:	Inflammation of the lining of the stomach and intestine causing vomiting and diarrhoea.
Hepatitis:	Inflammation of the liver, causing fever, jaundice and weakness.
Pathogen:	Any agent, such as a bacterium that can cause disease.
Red Flag:	For issues that the learners cannot provide any solutions, they can take up the matter with the relevant authorities, e.g. government departments, local authorities, communities' media structures etc.
Typhoid fever:	An acute infectious disease characterized by high fever, spots, abdominal pain etc. It is spread by contaminated food or water.



8 Do not pollute water

Assessment

Criteria	You participated in an E. coli testing and completed the all the steps	You were able to collect and record the data	You were able to participate when his / her group was reporting back to the rest of the class
Not Achieved 0-29%			
Elementary Achievement 30-39 %			
Moderate Achievement 40-49 %			
Adequate Achievement 50-59 %			
Substantial Achievement 60-69 %			
Meritorious achievement 70-79%			
Outstanding Achievement 80- 100 %			

- Natural Science Term 1 Interaction & interdependence within the environment (ecosystems) 5 weeks
- English First Additional Language: Term 3 weeks 3-4 (reading & viewing)
- English Home Language: Term 3 weeks 3-4 (reading & viewing)

Water Quality

Activity

In this activity you will able to:

- Discuss how people benefit from wetlands
- Identify uses of wetlands as shown in the pictures

Read the following information and answer the questions that follow.

Why are wetlands important?

A wetland is a place covered with shallow water. Marshy areas, vleis, lakes and estuaries are also called wetlands. Areas where rivers start are wetlands. Some wetlands are always under water, but others are only wet during the wet season.

About 6% of the Earth's surface is covered by wetlands. Wetlands have great biodiversity. Many species of plants and animals only live in wetlands, so it is important that we conserve these areas. But they are disappearing because of farming, tree planting and the development of housing.

What do wetlands provide?

- Grazing for wild and domestic animals.
- Raw materials for making crafts. There are many species of reeds, rushes and grasses that people use to weave mats and baskets, and thatch their houses.
- A place for fishing. Floodplain wetlands such as the Pongola flood plain in KwaZulu – Natal and estuaries such as Kosi Bay estuary in KwaZulu – Natal are good sources of fish.
- A place for crops. Most crops will not grow under water. But rice is a very important crop in many parts of the world and this crop only grows underwater.
- A source of water. Water is stored in wetlands so wetlands can be sources of water for people, livestock and for irrigation.
- A water purification system. Wetlands are natural filters that trap things that pollute water. Water flowing out of a wetland is cleaner than when it went in.
- A place for recreation and tourism. Wetlands are very attractive areas with a wide variety of plants and animals to look at. Bird watchers especially like wetlands.

9 Wetlands

Activity 9a: Save our wetlands

You may work in pairs for this activity.

a. Discuss how people benefit from wetlands

b. Identify the uses of wetlands shown in pictures A-D

Picture A

Picture B

Picture C

Picture D

c. Find out if there is a wetland near where you live. If there is, describe what the wetland is being used for. Has your local council educated the community about wetlands? How does the local council make sure that people do not harm the wetland?

Activity 9b: Newspaper article

Read the following newspaper article, and answer the questions that follow.

Resources will be used up in 150 years

At the meeting of the World Wildlife Fund (WWF), it was announced that humans are using too much of the Earth's natural resources too quickly. There is so much pressure on water suppliers, forests, usable land and energy suppliers that these resources could be exhausted in the next 150 years.

At the rate at which these resources are being used now, over 20% more natural resources are being used up to every year than can be replaced. The people who are using the most resources are in the rich countries, such as the USA and Canada, the countries of Western Europe and Japan. Human economic activity has reduced the number of animal, bird and fish species by 35% over the past 30 years.

The WWF said that if the Earth's productive land and sea is divided equally between the population, everybody would have natural resources from about 1,9 hectares of land. At the moment, on average Asian or Africans have the resources from 1,4 hectares, the average west European has resources from 5 hectares, and the average person from the USA and Canada has resources from 9,6 hectares.

The report said that one way to help solve the situation was to promote education and health care to control population growth.

Adapted from article Cape Times, 7 July 2002

Questions

1. a. What is the issue being discussed in this article?

.....

.....

b. What is considered to be an 'equal share' of the Earth's natural resources?

.....

.....

c. Which countries of the world get more than their fair share of the world's resources? Why do you think this is so?

.....

.....

.....

d. Which countries get less than their equal share of the world's resources? Why do you think this is so?

.....

.....

.....

2. Which sentences in the article tells us that people are not using resources in a sustainable way?

.....

.....

3. What suggestion is made by WWF to help to share resources and reduce poverty? Do you agree with this suggestion? Explain why or not. Can you suggest another possible solution to the problem?

.....

.....

.....

.....

.....

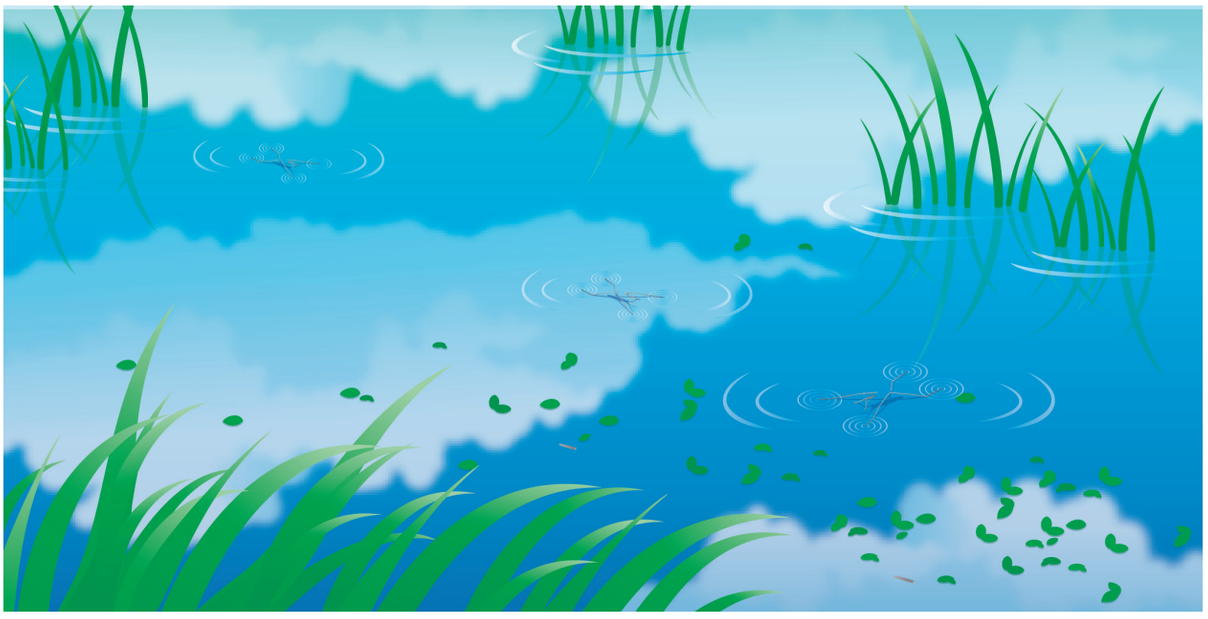
4. What does WWF mean?

.....

Assessment

You will be assessed whether you were able to:

- Discuss how people benefit from wetlands
- Identify uses of wetlands as shown in the pictures
- Answer all the questions from the newspaper article



Assessment

Criteria	The learner was able to discuss how people benefit from the wetlands	The learner was able to identify the uses of wetlands as shown in the pictures	The learner was able to respond appropriately to questions
Not Achieved 0-29%			
Elementary Achievement 30-39 %			
Moderate Achievement 40-49 %			
Adequate Achievement 50-59 %			
Substantial Achievement 60-69 %			
Meritorious achievement 70-79%			
Outstanding Achievement 80- 100 %			

10 The water conflict game

- Life Orientation Term 3 Weeks 4-6 Topic: Health, social & environmental responsibility
- Natural Science Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
- Social Science Geography Term 3 (Topic: Settlement)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)

Water Quality

Activity 10a: Facts about our environment

Development in a sensitive wetland area! Is it a yes, is it a no? Can the environment, the culture, the people who live there and the economic future be considered, in a sustainable way, without one aspect compromising the other? This **LANGUAGES** lesson encourages you to investigate an environmental situation and debate, discuss and communicate your ideas.

The following story will be read by your educator

The Strong River system rises in the majestic 7 000m peaks of the Molombi mountain range. After cascading down the mountain slopes it winds down into the Strong River valley where the river channel widens to form a large wetland area. From here, the river continues to flow into the river estuary and the ocean.

There are five groups of people involved in the area. They are: The nomadic indigenous Bongo tribe which has migrated between the floodplain and the mountains for over two thousand years. They are dependant on water and the land for their existence. Nomadic pastoralism, fishing and crop cultivation are some of their livelihood activities.

The Wildlife and Environment Society of South Africa (WESSA) are dedicated to maintaining the socialand ecological biodiversity of the wetland system. They want to install research facilities in the area to obtain better understanding of the dynamics of the wetland system.

The Goodgrip Tyre Company wants to build a tyre factory in the area. Vast quantities of water will be consumed and the waste from the factory will need to be disposed. No environmental impact assessment (EIA) has been conducted in the area where they want to build the factory. Three hundred job opportunities will be created.

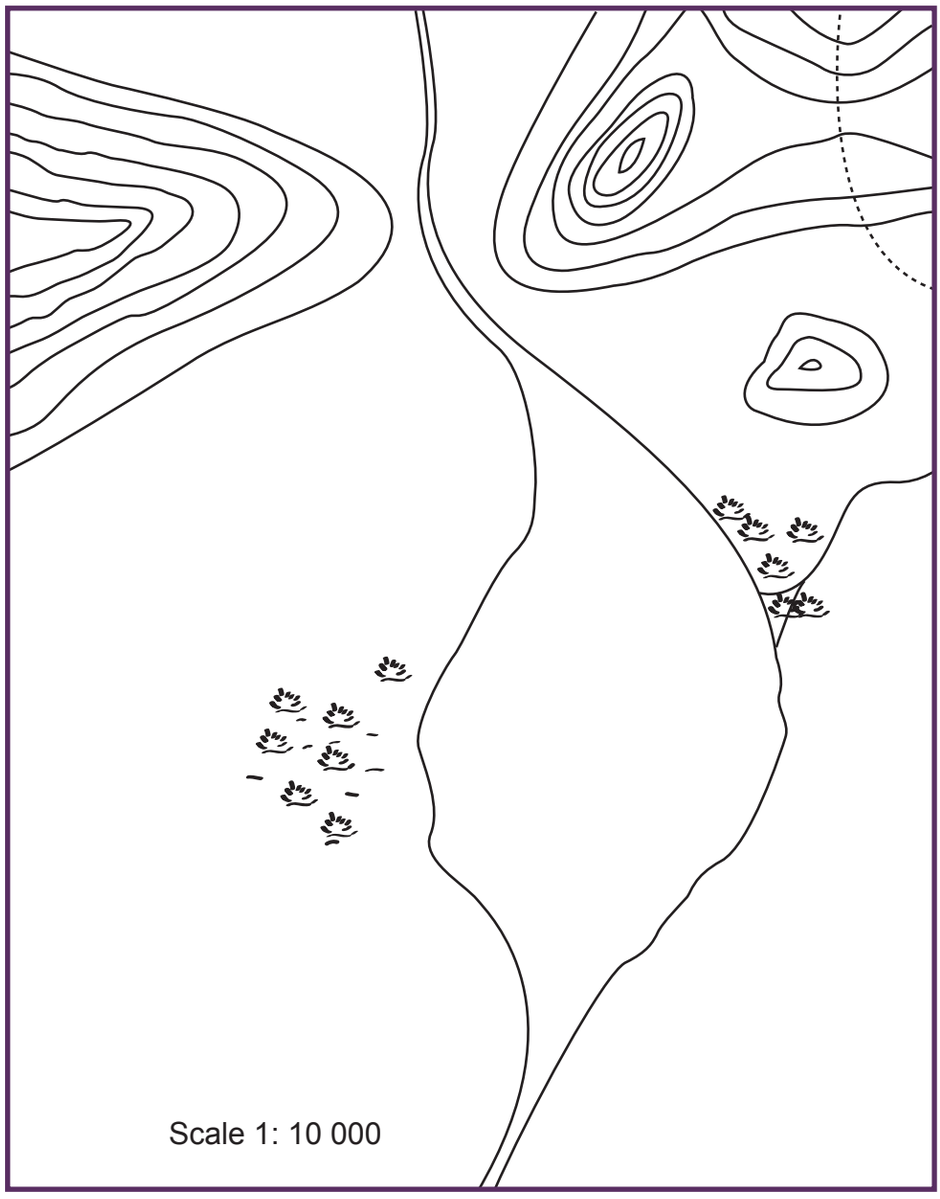
The fitness Fanatics Group is planning to develop a huge sports centre which will provide accommodation, canoeing, golfing, yachting, hiking and fishing.

The Provident Engineering Firm wants to build a dam to provide water and electricity to the tyre factory and the sports centre. Five groups involved in the area.

10 The water conflict game

Activity

- Divide into groups to represent each of the five groups involved in the area.
- Each group will need:
  - A map
  - Enviro Fact section on the following page
  - A marker (stones, leaves, bark, a small piece of rubber etc)



Each group should spend time planning where they would like to complete their development – this is then marked on their worksheet. You must consider the advantages and disadvantages of your choices. Consider all the other groups - they are more likely to make a better decision if you focus on a sustainable and long-term view rather than a quick, unthoughtful decision which is based only on the money that will be made over a short period of time.

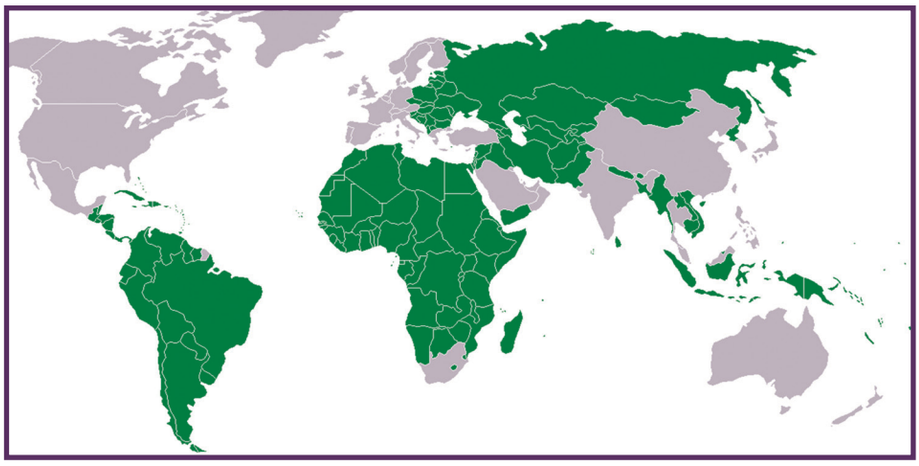
1. Gather around a larger copy of the map (you can enlarge the A4 sheet to A3 size) and place your markers where you plan to develop.
2. Two or more groups can use the same space (if they have both decided on that during their earlier discussions).
3. Each group is then given the opportunity to state the reasons for their choice. Through the guidance of the teacher, the groups should argue their cases. It is important that despite conflicts that may arise, the groups find a solution.

Enviro Fact 1: Sustainable development

Historically, development and conservation have been in conflict, because conservation has been understood as the protection of resources. Recognising the need for both, the United Nations appointed, In 1987, a commission on environment and development to advise on development and conservation. In the commission's report called "The Bruntland Report" or "Our Common Future", the concept of sustainable development was emphasised. The report's definition of sustainable development as "... development which meets the needs of the present without compromising the ability of future generations to meet their definitions, principles and criteria for sustainable development, however, the concept is seldom explained or deeply understood and is thus difficult to put into practice.

Historical perspective

During the Industrial Revolution, development was associated with economic growth through industries such as mining, manufacturing and large-scale farming. Industrialisation began in Britain and spread to mainland Europe, north America and Japan, all of which became known as the First world. Characteristics of First World countries are high economic growth; many and varied job opportunities, and high incomes. The Soviet Union and its satellite states, governed under the economic communism, became known as the Second World. Third World Countries, such as those in Africa, South America and parts of Asia, have slow, if any economic growth, with a high level of unemployment and very low incomes, but often substantial natural resources. In fact, the wealth of many First World countries is founded in part of the exploitation of resources (natural and human) from Third World countries.



Environmental Problems

The environmental problems of the First World are associated with economic wealth, high resource consumption and industrialization. These have contributed to, for example, ozone depletion and global warming. Environmental problems of the third world, however, can be associated with poverty, high population rates, lack of food, shelter and water, and a lack of technical capacity.

Developmental as a solution?

The solution to the devastating poverty, environmental problems of the Third World countries is often seen as 'development'. For example, the development of Third world countries towards the First World ideas of economic growth through industrialization and high consumption patterns. However, many people have begun to seriously question the wisdom of this approach? Thabo Mbeki, South Africa's former president, believed Africa must use African resources, especially human; in order to achieve a strong, well-developed and competitive continent he has called this process the "African Renaissance".

Limited resources

It is argued that the Earth's finite resources would not be able to support the entire world's people if everyone had high consumption patterns of those living in First World countries. Mahatma Ghandi, when asked if, after independence, India would attain British standards of living, commented that "... it took Britain half the resources of the planet to achieve its prosperity, how many planets will a country like India require?"

A different type of development?

Development is conventionally seen as economic growth, dependent upon 'throughput growth', i.e. growth which depends on ever increasing consumption of energy and natural resources. This type of development is unsustainable. One alternative being suggested is qualitative development, with minimum inputs and outputs, maximum standards of service, but use fewer material resources such as fossil fuels, minerals and water. Development programmes in Third World countries probably need both quantitative growth (to address poverty), and qualitative development. The First World also needs to minimise its throughput growth, and replace it with qualitative growth. For example, an industry-orientated economy (high throughput) might be characterised by coal mining and steel manufacture, whereas a service orientated economy might focus on information technology including the use of fibre optics and electronics (low throughput).

Who benefits?

Third World development programmes that focus on economic growth as a solution to widespread poverty, assume a trickledown effect, i.e. the benefits of economic growth will trickle down to all members of society. However, economic growth does not always benefit the poor in a country. Many developmental programmes now give special attention to human needs, improved participation in programmes, and the distribution of development benefits, rather than focusing all efforts on economic development. A more people-orientated development should empower people to take greater control over all aspects of their lives: social, political, economic and ecological.

Indicators of economic performance

If we are to move towards sustainable development, we will need tools with which to measure our performance. At present the performance of an economy is measured in terms of its gross domestic product (GDP). The GDP is the total value of all the money transactions that take place, and is a poor measure of the effect of economic policies and practices on people and the environment. The GDP does not differentiate between different kinds of economic activity. For example, if a new prison is built, this amount is added to the GDP- the more prisons built the better the GDP! However, there are no simple answers to how sustainable

development can be assessed. Many attempts endeavour to value, or put a price to, the depletion and degradation of natural resources as a way of ensuring that this is taken into account when assessing economic performance.

Other approaches argue that valuing the environment is often impossible or undesirable, and maintain the environmental quality should be measured in purely physical terms, which should then be published alongside the GDP as an environmental account. As situations and conditions change, so will our understanding of sustainable development change? Sustainable development is not a model to be imposed, but can be seen as a process of learning how to live on the Earth. Ultimately the focus of sustainable living and sustainable development is to find a balance between the social, economic and ecological aspects of our existence.

Agenda 21

Agenda 21 is a global action plan for socially, economically and environmentally sustainable development. It was adopted at the United Nations Conference on the Environment and Development held in Rio de Janeiro in June 1992 (Earth summit). The conference proposed that Agenda 21 be implemented at the local authority level, and this came to be known as local Agenda 21. The principles guiding Local Agenda 21 in South Africa are: people-centred development, meeting basic needs, integrated planning and development. Several South African cities and provinces have developed Local Agenda 21 programmes.

Enviro Fact 2: Pollution

Pollution is an unwelcome concentration of substances that are beyond the environment's capacity to handle. These substances are detrimental to the 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 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, PCB's and organochlorines.
- Substances that, in any amount, are non 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 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
Carbon monoxide – vehicle emissions	Restricts oxygen uptake, causes drowsiness, headaches, death
Carbon dioxide – vehicle emissions	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
Fresh water	
Sewage- inadequate sanitation	Pathogens cause typhoid, cholera, gastroenteritis; nutrients cause eutrophication
Fertilizers – agriculture	Eutrophication
Silt – agriculture, construction, mining	Smothers 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	Reduce crop yields; scale and corrosion in domestic and industrial water systems
Marine	

Sewage – inadequate sanitation	Pathogens cause typhoid, cholera, gastroenteritis; nutrients cause eutrophication
Fertilisers – 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 stationary location, e.g. Industrial plants, mines, 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 manufacturers 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 industrial 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 you can 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 and Sanitation.
- Report marine pollution to the Department of Environment Affairs and Tourism, Marine Pollution Division.

Enviro Fact 3: Energy and Environment

Some of South Africa's most serious environmental problems are associated with our use of energy. Coal fired and nuclear power stations for electricity generation, coal combustion in the township, SASOL coal-to-oil processes, petrol and diesel use in vehicles for bulk transport, and over exploitation of fuel wood resources, all result in serious, long-term environmental damage.

Pollution from burning coal

More than three quarters of South Africa's energy comes from coal, approximately half of which is used to generate electricity, a quarter to produce synthetic liquid fuels and another quarter directly by industry and in homes. Air pollution problems from coal combustion are serious. Medical studies are revealing increased rates of respiratory disease in residents in polluted areas.

Acid rain

Most of South Africa's power stations are concentrated within a 100 km radius Mpumalanga and this leads to pollution problems. While all of Eskom's coal fired power stations are designed to remove dust and other particles from waste gases produced during coal combustion, none are fitted with flue-gas scrubbers (cleaning equipment) to remove oxides of sulphur and nitrogen. Tall chimney stacks in power stations assist in releasing oxides of sulphur and nitrogen into the upper atmosphere where atmospheric conditions are more favourable for their dispersal and dilution. Although this reduces ground level concentrations of these pollutants, they may combine with moist air and rain at higher levels and cause acid rain in areas far from the source of pollution.

Whilst South Africa's coal has relatively low sulphur content there is considerable concern about the potential environmental and economic impact of acid rain. Half of South Africa's agriculturally productive land, half of its commercial forests and a quarter of its surface water run-off are in Mpumalanga.

Pollution from vehicles

Motor vehicle fumes make air pollution problems worse and are the main cause of photochemical smog in cities. Unleaded fuel has recently been introduced to South Africa and this may reduce the amount of lead in exhaust fumes. Catalytic converters fitted to exhausts would result in a significant reduction in the release of carbon dioxide, hydrocarbons, and nitrogen oxides. However, South Africa lags far behind other countries (e.g. Japan, Germany) in legislation to control vehicle emissions. Solutions to transport pollution and vehicle congestion require long-term planning to introduce efficient public transport systems in our cities.

Deforestation

Another environmental concern associated with energy use is the reliance by a significant number of South Africans on fuel wood, once a renewable resource, but now being used at a rate much greater than that at which it is naturally regenerated. Fuel wood is an inefficient source of energy for cooking and heating and its use can cause increased respiratory illnesses. It has been estimated that if current consumption trends continue, all natural woodland in the former "homelands" will be denuded by 2020. In addition to the environmental consequences of deforestation, diminishing supplies of wood require rural people (particularly women) to travel further and further from home to gather wood, placing a great burden on them.

Global warming

South Africa uses a great deal of energy, very much more per unit of gross domestic product (GDP) than most other countries. The combustion of coal, oil and wood results in increased carbon dioxide production. This gas acts likes a greenhouse - it lets short-wave, natural light through but traps out going long-wave (infra-red or heat) radiation. The potentially devastating consequence is that the earth is slowly getting warmer, causing the climate to change and sea levels to rise. Although South Africa produces only a small percentage (1, 6%) of the total, global carbon dioxide emissions, it plays a disproportionately large role per person in contributing towards the greenhouse effect and global warming. As a country needing rapid economic growth in the medium term to satisfy the country's developmental needs, South Africa's potential contribution to global warming is an area of concern.

Nuclear energy

South Africa currently has one commercial nuclear power station at Koeberg near Cape Town. It provides 1 800 MW of Eskom's installed electricity generation capacity of 37600 MW, less than 5% of the total. There is intensive debate among energy planners as to whether nuclear energy should play a role in South Africa. In addition to being a costly option, nuclear fission produces dangerous radioactive by-products. There is considerable concern about their safe containment in the case of accidents at nuclear power stations, the closing down (decommissioning) of old power stations, and the storage of highly toxic wastes. At present, low-level radioactive wastes are stored in sealed containers which are buried underground at disposal sites. No long-term solution has been agreed on for the safe storage of high-level radioactive wastes, some of which remain harmful for thousands of years. At present there is no national policy to deal with radioactive waste.

Enviro Fact 4: Energy Options

Coal supplies most of South Africa's electrical energy. It is a finite, non-renewable resource. Burning coal to produce electricity causes serious environmental problems. Pollution from power stations contributes to global warming and acid rain. In addition to the environmental challenges associated with energy supply, South Africa faces significant social challenges. Although we produce half of the electricity on the African continent, 40% of South Africans do not have access to electricity and rely instead on fuel wood and other inconvenient fuels such as coal, paraffin, gas, or candles. It is important that South Africa addresses both the environmental problems associated with energy supply, and the inequalities in access to adequate and affordable energy.

How can we provide adequate and affordable energy for all, while promoting environmental sustainability?

Many of South Africa's medium- and long-term energy needs could be addressed through regional cooperation. This could include the establishment of a regional electricity transmission grid and a SABC power pool, and regional energy planning. Such coordination would create opportunities for SABC countries to provide their people with clean and sustainable energy into the next century. Regional cooperation does however require political and economic stability. There are also several technologies that could improve the sustainability of the regional electricity industry.

In addition to reducing pollution from coal fired power stations, hydroelectric and solar power, natural gas, wind, tide and wave power may all help the region address its energy needs with minimum impact on the environment.

Reducing pollution from coal fired power stations

This pollution can be reduced by using equipment which removes oxides of sulphur and nitrogen from the gases released when coal is burnt. This could result in electricity being more expensive, but this should be weighed against the benefits to the environment.

Hydro-power

Coal stocks are finite and sooner or later we shall have to rely on another source of energy. A possible medium term alternative is to harness the huge hydroelectric potential of the sub-Saharan Africa region, estimated to be more than twice Eskom's current generating capacity. For example, the Zaire River alone is capable of providing in excess of 7000MV (megawatts) of hydroelectricity. There are many other rivers in Zambia, Zimbabwe, Angola and Mozambique suitable for hydroelectricity.

Hydroelectricity is renewable and does not pollute. However, it is expensive, and requires the construction of large dams which have significant social and environmental costs. In addition, this option requires regional co-operation and political stability.

Solar energy

Solar energy can be used to produce heat. In Israel more than two thirds of houses are fitted with solar water heaters. South Africa experiences more sunshine than most places and there is much potential for widespread

use of solar water heaters, particularly in mass, low-income housing projects. However, the initial outlay for solar panels is expensive as large areas of panels are needed to collect useful amounts of energy. Solar energy could be particularly useful in remote areas far from the electricity grid, such as farms, rural clinics, and water pumping stations.

Nuclear energy

There is much debate among energy planners in South Africa as to whether nuclear energy should play a role in this country's future. Using current technology it is a costly option, with unresolved environmental problems such as the disposal and storage of waste products.

Natural gas

Although natural gas is a non-renewable energy resource, it has great potential as a future energy source for South Africa. South Africa has a limited amount of natural gas reserves, but strong regional ties would allow us to import gas from Namibia and Mozambique. Natural gas produces less pollution that other fossil fuels. In fact, latest natural-gas-burning turbines can produce electricity 50% more efficiently than those burning coal. Natural gas can also be burned cleanly in co-generation (see below). Because of its advantages over coal and oil, some analysts see natural gas as the best fuel for the transition to energy efficiency and renewable energy.

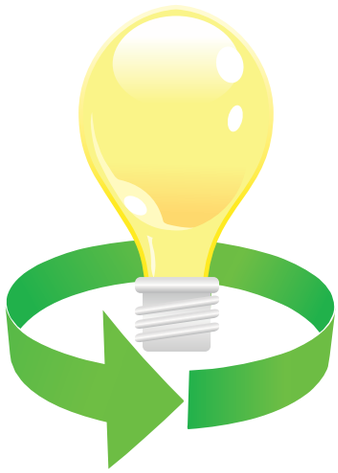
Wind power

As global energy resources become more and more scarce, wind power is becoming increasingly attractive. Wind energy is freely available and poses less of a threat to the environment than fossil and nuclear energy sources. Wind energy can provide electricity for communities not linked to the electricity grid. Telecommunications companies currently use small wind turbines to support cellular networks in the region. In addition, wind energy can be exploited on a large grid tied scale through the development of wind farms. However, wind is not a reliable source of energy, and its use is limited to areas with steady winds. These areas are often found near coastal regions and in some arid and semi-arid areas.

Energy efficiency

South Africa uses more energy per unit of economic output (GDP or gross domestic product) than many other countries. There is much potential for energy saving. European countries and Japan have shown in recent years that industrial production can be increased while using less energy through energy efficient manufacturing processes. Passive solar design principles and more efficient lighting and insulation contribute to energy savings in buildings. Industry is able to save energy through cogeneration, advanced heat recovery systems and better control of energy usage. (Cogeneration is a process which produces both electricity and heat at the same time, while advanced heat recovery systems economize on, and use the heat generated in industrial and chemical processes). Recycling waste materials can also save energy, for example aluminum produced from scrap uses 95% less energy than when it is manufactured from ore. New motor vehicles are also becoming more fuel- efficient.

Planning in towns and cities should encourage the use of efficient public transport systems rather than private motor vehicles. In the long term we shall also have to find alternative fuels for transport. Hydrogen offers a clean alternative and as one of the elements in water it is plentiful. But it still requires energy to separate hydrogen from oxygen in water. Nuclear fusion (the combination of hydrogen atoms to form helium, i.e. the reaction which powers the sun) may also be a future option, but scientists do not foresee major progress in this area for many years to come.



Enviro Fact 6: 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 500mm a year, with the driest part of the country receiving less than 200mm/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 resultthat most dams are shallow with a large surface area. Together with the hot, dry, climate, this results in muchwater evaporating from dams. In addition, the high silt load (a result of 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.

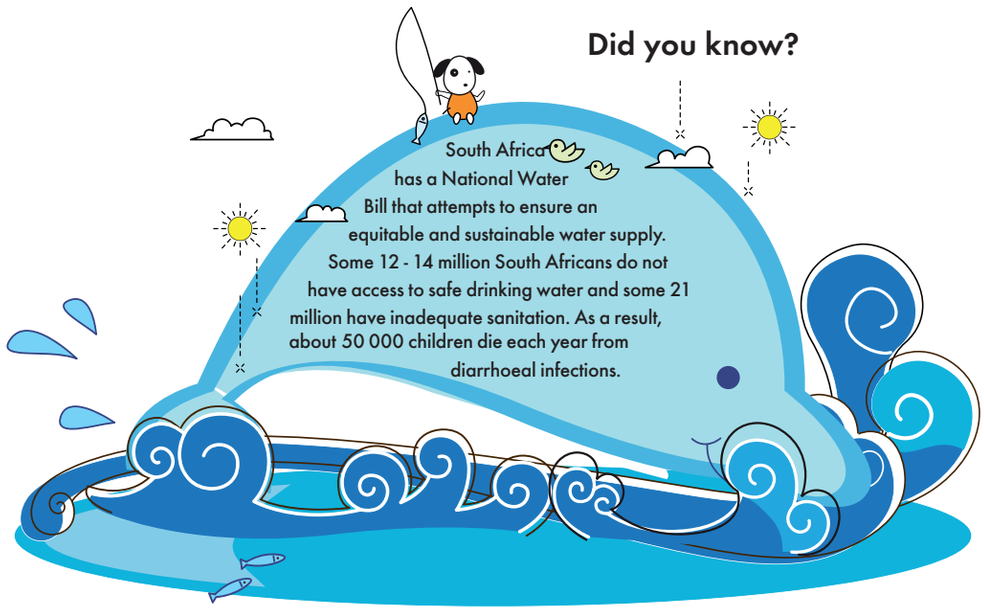
Intercatchment transfer of water

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 socioeconomic 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.



Enviro Fact 7: 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, water lilies, 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 dependent on wetlands for breeding. The rich diversity of waterbirds in southern Africa (totaling 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, and 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 wetlands 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 Department of Environmental Affairs and Tourism. Always make your report in writing to ensure that the officer concerned has to investigate.

Enviro Fact 8: Protected Areas

South Africa has a remarkable diversity of animals, plants, vegetation communities, landscapes, geological features, and numerous sites of archaeological, historical and cultural significance. Arguably one of the most effective ways to preserve and conserve this diversity is through the establishment of protected areas.

Classification of protected areas

At present there are over 700 state owned protected areas, including more than 100 marine protected areas covering about 75 000km^2 (6.1% of S.A.). In addition there are over 200 privately owned protected areas, covering about 9 000km^2 (0.8% of S.A.), thus bringing the total to about 7%. This proportion is small by international standards, being below the ideal of not less than 10% set by the Convention on Biodiversity.

An enormous variety of protected areas occur in South Africa ranging from large national parks to comparatively tiny, little known reserves. A range of authorities is involved in the management of these protected areas, including state departments, parastatal organisations, local authorities, non-governmental organisations, communities and private individuals. The situation is further complicated by legislation, as more than ten Acts of Parliament, numerous Provincial ordinances, and various local by-laws govern the administration of protected areas, and it is commonplace for two or more pieces of legislation to be relevant for one protected area.

To simplify the situation a classification system has been adopted for protected areas in South Africa. It follows the international guidelines devised by the IUCN (International Union for the Conservation of Nature). Six broad categories of protected areas are recognised and these are defined by the primary management aims of the protected area under consideration.

- Scientific reserves and wilderness areas are the most pristine of all protected areas where human intervention is non-existent or minimal. Scientific reserves are for the purpose of preserving areas of outstanding scientific importance for research. The only scientific reserve belonging to South Africa is the Prince Edward Island group (Marion Island and Prince Edward Island). Wilderness areas, e.g. Cedarburg Wilderness Area in the Western Cape, and Ntendeka Wilderness Area in Kwazulu-Natal, are large undeveloped and uninhabited areas where access is strictly controlled and only non-mechanised tourism is permitted.
- National parks and equivalent reserves are relatively large outstanding natural areas of land or sea, or both, which are not materially altered by human occupation or exploitation. They are managed mainly for ecosystem conservation and recreation. National Parks, e.g. Tsitsikamma National Park, are scattered throughout South Africa and are managed by the South African National Parks. Equivalent reserves refers to the large provincial reserves, e.g. De Hoop Nature Reserve, that have many similarities to national parks, the major difference being that they are managed by the relevant provincial authorities according to different legislation. A process is underway to ensure that all protected areas which qualify should be designated as national parks, and that an appropriate management authority operating within national policy and guidelines is appointed.
- National monuments and areas of cultural significance are areas containing at leastone unique or outstanding natural feature recognised for its rarity, beauty or cultural significance. Natural monuments are established for the primary purposes of protecting and conserving the feature/s at the site, and making them available for education and tourism. Examples include botanical gardens, e.g. Kirstenbosch, and Paarl Mountain.
- Habitat and wildlife management areas are areas of land or sea where the protection and conservation of habitat is essential for the survival of important fauna and flora. Conservation of the habitats or species in these areas may require active intervention and even habitat manipulation. Most of the provincial reserves, e.g. Willem Pretorius Game Reserve, and many local reserves, belong in this category. Private nature reserves, e.g. Timbavati Game Reserve, proclaimed in terms of provincial

ordinances, are distinct from conservancies, e.g. Bitterputs Conservancy, where landowners agree to combine resources to improve the conservation of a larger area, but which lack legal conservation status

- Protected landscapes or seascapes are scenic areas where traditional customs, lifestyles, and practices such as traditional fishing methods, exist in harmony with nature. They are managed to ensure that the integrity of the site is maintained, whilst allowing tourism, e.g. Kosi Bay
- Sustainable use areas are areas of land or sea, or both, which are predominantly natural and where harvesting of natural resources is permitted. These areas are established for the primary purpose of maintaining biological diversity whilst benefiting local communities by allowing them to harvest natural resources in a sustainable way.

Citizens' role

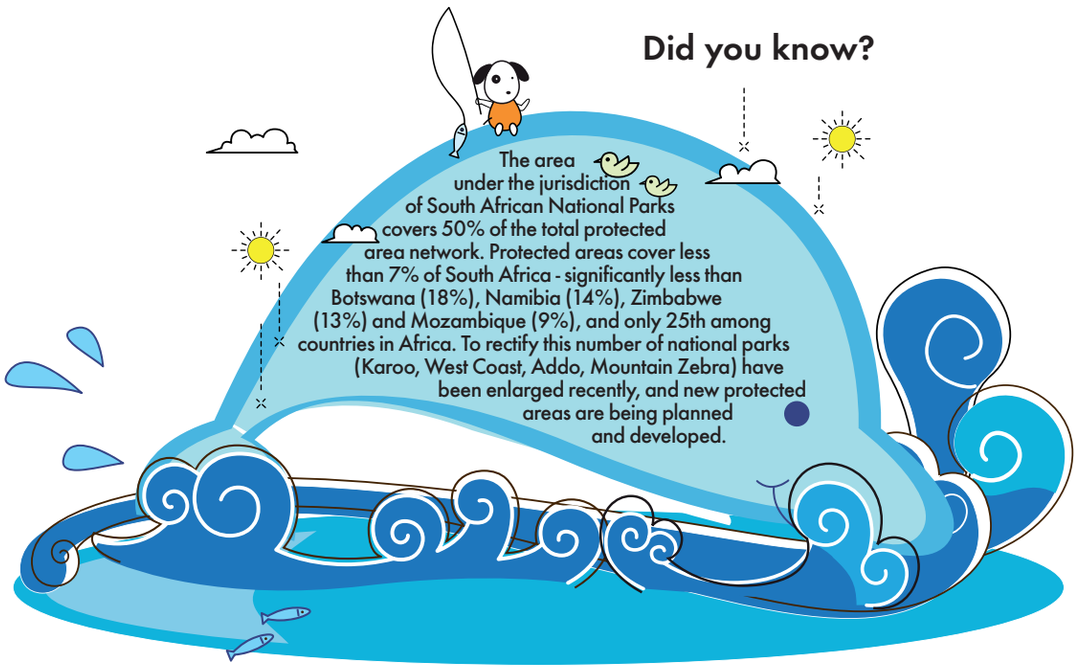
Protected areas are not only the responsibility of the state, and many have been established and managed by communities and private landowners. These can be designated formally in terms of the relevant legislation to provide greater protection. A developing trend is for partnerships to be forged among the state, communities and private sector interests to develop and manage protected areas and ensure that communities, especially in disadvantaged rural areas, benefit from the many opportunities which protected areas can generate. In some cases, e.g. in Kwazulu-Natal, statutory Local Boards for protected areas have been established, giving communities a direct say in the planning and management of these areas, e.g. the Hluhluwe-Umfolozi Park.

International recognition

Inter-governmental treaties or conventions to which South Africa is a signatory afford opportunities to register outstanding natural sites of international significance. The sites identified could belong to any of the categories of protected area described above. The special recognition accorded these sites through registration raises their conservation status and improves international support. Examples include Ramsar sites, e.g. Ndumo Game Reserve; Biosphere reserves, e.g. Kogelberg Biosphere Reserve; and World Heritage Sites, e.g. Robben Island, the Greater St Lucia Wetland Park, and the uKhahlamba-Drakensberg Park. The latter park is one of only 23 areas worldwide which has been listed as a World Heritage Site on both natural and cultural grounds.

Peace parks

Transfrontier parks (transboundary protected areas or peace parks) involve the collaboration of protected areas across an international border to form a single large protected area. The first transfrontier park in South Africa was created by linking the Kalahari Gemsbok National Park in South Africa with the Gemsbok National Park in Botswana to form one area now called Kgalagadi Transfrontier Park. There are initiatives to develop more transfrontier parks to enhance regional cooperation and biodiversity conservation, e.g. the Gaza-Kruger-Gonarezhou Transfrontier Park.



Enviro Facts 9: Hazardous Waste

The widely used term hazardous waste is difficult to define. In this fact sheet it includes substances harmful to life and the environment, i.e. wastes with any of the following characteristics: infectious, poisonous (toxic), radioactive, flammable, explosive, corrosive, carcinogenic (cancer causing), mutagenic (damages chromosomes), teratogenic (causes defects in the unborn), or bio-accumulative (accumulating in the bodies of plants and animals and thus in food chains).

Hazardous wastes are produced during industrial, medical, chemical and biological processes. Even household, office and commercial wastes contain small quantities of hazardous wastes (e.g. batteries, pesticides, bleach, paint thinners and their containers).

Examples of hazardous waste

- PCBs (polychlorinated biphenyls): Non-flammable, insulating materials used by big electrical networks such as Eskom. South Africa lacks the technology to safely treat and dispose of waste PCBs.
- Dioxins: A by-product of industrial processes, e.g. incineration and refining of oil. Used to bleach paper in the paper and pulp industry.
- Heavy metals: Widespread industrial use, such as in cadmium and nickel plating. Found in batteries (e.g. mercury, cadmium, lead), fluorescent tubes, mercury thermometers, and leaded petrol.
- Radioactive waste: By-product of nuclear power generation; and used in medicine (e.g. cancer therapy).
- Medical waste: Waste generated by health-care institutions may contain infectious material, which can transmit diseases such as tuberculosis, hepatitis, and HIV / AIDS.

Options for treatment and disposal

There is no completely safe way of disposing of hazardous waste and the best option is the prevention and reduction of hazardous waste production, and the re-use of waste. Recently introduced minimum standards forthe disposal of hazardous waste have decreased the risk of pollution, however no guarantees can be given.Some of the safer methods of dealing with hazardous waste are:

- Land disposal: Waste is co-disposed (buried with domestic waste) and/or pre-treated in landfills that are designed with various layers of clay and plastic liners.
- Encapsulation: Waste, which cannot be pre-treated or does not biodegrade, is encapsulated in concrete. Incineration (burning): Incineration of hazardous waste is dangerous and should not be considered as an option for treating or 'disposing' of hazardous waste. Such incineration produces dioxins and furans, and releases heavy metals into the atmosphere. Most medical waste produced in South Africa is incinerated by private contractors or hospitals.
- Chemical or biological treatment: This treatment includes adding chemicals to waste to make it less hazardous or adding bacteria to break it down into a less toxic residue. A good example of this is the use of algae to break down liquid hazardous waste from landfills and tanneries.
- Plasma arc conversion: This treatment subjects waste to temperatures of approximately 4 000 ^{o}C, thereby reducing it to its molecular form. This new and expensive technology produces virtually no hazardous by-products. Possible drawbacks of this process are yet to be investigated in South Africa.

International trade in hazardous waste

In the late 1980s, a tightening of environmental regulations in industrialised countries led to a dramatic rise in the cost of hazardous waste disposal. Searching for cheaper ways to get rid of the wastes, 'toxic traders' began shipping hazardous waste to developing countries and to eastern Europe. When this activity was revealed, international outrage led to the drafting and adoption of the Basel Convention. During its first decade (1989-1999), the Convention was principally devoted to setting up a framework for controlling the transboundary movements of hazardous wastes, that is, the movement of hazardous wastes across international frontiers. It also developed the criteria for environmentally sound management. A control system, based on prior written notification, was also put into place.

The Bamako Convention is an OAU (Organisation of African Unity) convention - this means that it applies only within Africa. It bans the importation of hazardous waste into Africa.

South Africa is a signatory to the Basel Convention, but not the Bamako Convention.

Shipping waste to other countries is no solution; it merely moves the problem. Each country should take responsibility for its own hazardous waste.

Hazardous waste and the law

Realising that pollution legislation (as well as other environmental legislation) was inadequate, the South African government embarked on a major reform of all environmental laws in 1994. Aspects of this reform process that are relevant to hazardous wastes include first, the establishment of the Integrated Pollution and Waste Management Committee (IP&WMC). This committee has been set up to streamline and co-ordinate pollution control and waste management legislation, and to develop a new National Pollution Control Act to co-ordinate pollution control.

Second, NEMA (National Environmental Management Act) increases the ambit of people who can be held responsible for pollution damage from not only any person, company or government department causing pollution, to any person, company or department owning, using or controlling the land on which the problem exists - even if the pollution causing activity was authorised by law.

What can industry do about hazardous waste?

The ultimate solution is the reduction of hazardous waste production. This can be achieved in a number of ways:

- substitution of non-polluting alternatives, e.g. the use of chlorine to bleach wood and paper results in the formation of dioxins -chlorine could be replaced with oxygen;
- efficient production processes and good maintenance of machinery can reduce waste production. This can be achieved through adopting one of a number of Environmental Management Systems, such as IS014001, Life-Cycle analysis; cradle-tograve, and the reduction of illegal dumping-,
- recycling waste reduces pollution and can result in cost-savings, e.g. expensive, toxic heavy metals could be re-used.

Assessment

Criteria	Exceeded the requirements of the learning outcome	Satisfied the requirements of the learning outcome	Partly satisfied the requirements of the learning outcome	Not satisfied the requirements of the learning outcome
You participated and contributed to the group discussions, prior to the debate				
You participated in the debate, putting forward your views and opinions				
You spoke confidently and expressively during the group discussions and the class debate/discussions				
You were able to acknowledge other's opinions during the debate and agreed or disagreed politely				
You were able to receive criticism, during the debate of the "Water Conflict Game"				

11 Exploring the wetland

Teachers use in:
- Natural Science: Term 1 Interaction & interdependence within the environment (ecosystems) 5 weeks
- Life Orientation: Term 3 weeks 4-6 (Health, social and environmental responsibility)
- EMS: Term 1 week 6 (Standard of living)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)

Water Quality

Activity

In this activity we shall:

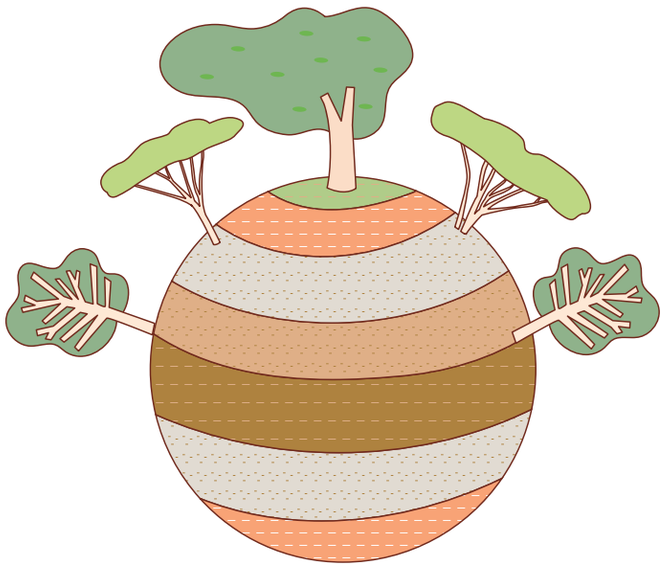
- Explore wetlands
- Design a poster that describes the benefits that would be derived from wetlands, and also threats to the wetlands

You will need:

- Gum boots / strong shoes
- Rain suit
- Exercise book and pencil / pen

Activity 11a: Wetlands clean up

A wetland means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and where the land, in normal circumstances, supports or would support vegetation typically adapted to life in saturated soil.



11 Exploring the wetland

What to do

1. Take a field trip to the school or the community nearby
2. Identify the wetland area
3. Study the wetland carefully and record what you observe in that wetland
4. Use the following worksheet as a guide. Place a tick (√) where applicable

Item	Yes	No	Is it a threat to the wetland?	Yes	No
Plants			Plants		
Animals			Animals		
Water			Water		
Plastics			Plastics		
Papers			Papers		
Wood			Wood		
Dead			Dead		
Organism			Organism		
Alien Plants			Alien Plants		
Other					

5. List all the items that are not supposed to be in that wetland

.....

.....

.....

.....

.....

.....

6. Now discuss with your partner what should be done to save the wetland
7. Design a poster that will show the importance of a wetland
8. Highlight the responsibility of not polluting a wetland

Activity 11b: Adopt the wetland

- You have identified problems in a school environment, now visit the wetland in a nearby community
- Identify the problem in that wetland
- Design a plan that you can use to care for the wetland
- Adopt a wetland and make it your own responsibility
- You may need to be involved in the following activities to secure your wetland

Educational activities

Educate the community about:

- What wetlands are?
- Their functions and importance
- Threats to wetlands
- Clearing of alien plants
- Planting of South African trees

Assessment

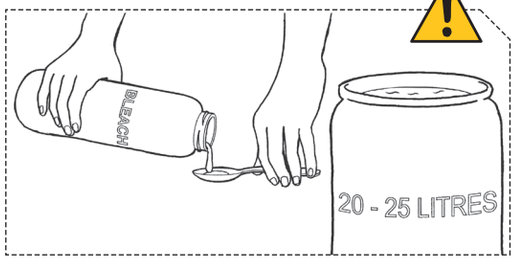
You will be assessed on the following:

- Plan to secure the wetland
- The cleanliness of the wetland
- Checking the quality of water
- The number of alien plants around
- The pollution level around your wetland

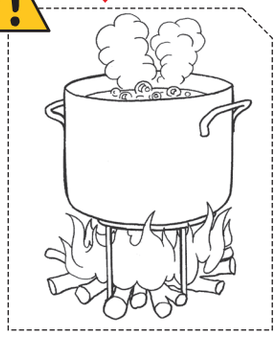
How to purify water

Collect fresh water every day.

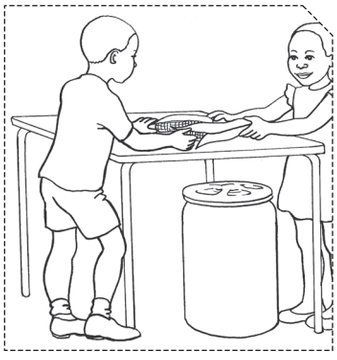
Pour (filter) the water through a clean cloth



Pour 1 teaspoon (5ml) of bleach into 20 -25 litres of water, mix well and wait for at least 30 minutes (half an hour), before drinking.



Boil the water. Let the water bubble for one minute, before it is clean and safe to drink.



Safe water can easily get dirty. Store safe water in a clean, closed container.

Use a clean cup each time to scoop water out of the container.

Pour water from the container when you need to use it.

11 Exploring the wetland

Assessment

Criteria	The learner was able to participate in a wetland cleanup project	The learner was able to list all items that are not supposed to be in the wetland	The learner was able to design a poster that shows the importance of wetlands	The learner was able to adopt a wetland and design a plan they can use to take care of the wetland with his / her group
Not Achieved 0-29%				
Elementary Achievement 30-39 %				
Moderate Achievement 40-49 %				
Adequate Achievement 50-59 %				
Substantial Achievement 60-69 %				
Meritorious achievement 70-79%				
Outstanding Achievement 80- 100 %				

12 Look after groundwater together

- Creative Arts: Drama Term 2 Topic 3 (Praise poetry); Term 3 Topic 2 (drama elements in playmaking) Music Term 1 Topic 3, Term 2 Topic 3, Term 3 Topic 3 and Term 4 Topic 3 (performing & creating music)
- Natural Science: Term 1 Interaction & interdependence within the environment (conservation of the ecosystem) 5 weeks
- EMS: Term 1 week 6 (Standard of living)
- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- Social Science: Term 3 (Topic: Settlement)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)

Sanitation, Health & Hygiene

Activity

You will be able to:

- Explain what groundwater is, how it is formed, how it can be polluted and how we can keep it clean
- Plan and undertake an action project

Background information

What is groundwater?

People often think that groundwater occurs in large underground dams or lakes or in streams under the ground. Groundwater is however, only water that fills the natural openings that are in rocks or sand under the ground. These openings can take many forms, for instance, the cracks or joints between rocks, the openings between small sand or mineral particles in the soil, or the openings between sand particles in dunes or sand-filled riverbeds.

Groundwater comes from rain. A small percentage of rain that falls as part of the water cycle soaks into the ground and fills the openings in the rocks and into the sand below the surface of the ground.

How do we access groundwater?

We can drill down to the water underground and pump it up so we can use it. Water can be pumped to the surface with a pump. There are many different kinds of pumps.

Why do we need to look after groundwater?

There are two key issues that you need to understand:

- Groundwater is a precious resource so we need to use it carefully
- If groundwater is contaminated by pollution it can affect our health

Groundwater is replaced only when it rains so learners need to understand how to conserve water

Groundwater can be polluted by a number of different things:

- Dirty water around a pump site can soak into the groundwater
- Toilets that are built too close to a borehole or downhill from a borehole can pollute ground water
- Dumping of chemicals such as pesticides, chemicals and batteries allows pollution to soak into the groundwater

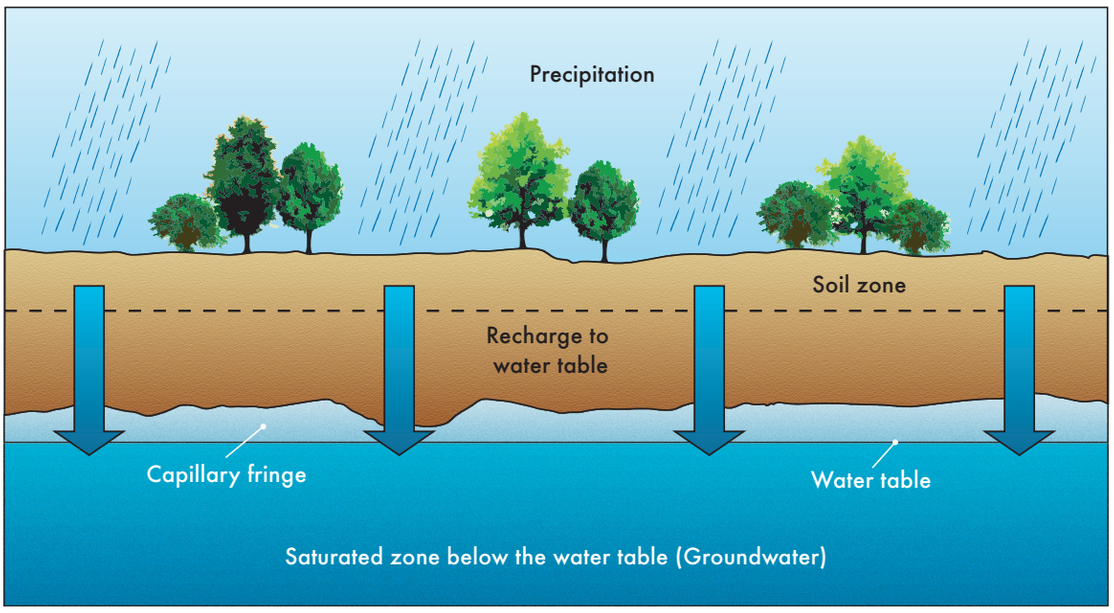
12 Look after groundwater together

Guidelines for this activity

- In some schools around South Africa young people have started action groups to make their area healthier and safer
- You can take action for health too!
- You can work together to educate your community about protecting groundwater
- You can also start a group to look at general water and health even if you do not use groundwater

Activity 12a: Plan and undertake an action project

1. Get a project group together
   a. Most effective action groups begin when someone feels very strongly about an issue. If you have found the work we have done on water interesting and you have noticed that your community could do something to make your groundwater resource safer then why not start a group to do something about it?
   b. As a group write a problem statement saying something like this: "Our problem is that the community is not taking care of our groundwater."
2. Research the problem
   a. Now you will need to find out more about the problem
   b. Speak to a clinic sister. Ask her about water-related diseases
   c. Speak to people in your community about water. Where do they get water? What problems do they have? Do they have health problems related to water? Ask them what they think could be done to solve the problem



3. Analyse your research and choose a project
    a. You may find that the water you use is clean, but that people are getting sick because they are not covering their water containers or they don't have proper toilets
    b. Some of the problems you may not be able to solve yourself. See if you can speak to an expert (clinic sister or someone at the local Department of Water Affairs office).
    c. A good kind of community project is an education project.
    d. Perhaps you can think of some ways to educate your community about groundwater and how to stay healthy?
4. Draw up an action plan
    a. Know what you would like to achieve.
    b. Be clear on what needs to be done and how
    c. Decide who will do the different tasks, and make sure that everyone is taking part
    d. By when? Have time-frames for all tasks
5. Take action
    a. Undertake your tasks
    b. Report back to the group regularly on the progress you are making
    c. Write up a group report when you are finished
    d. Present your report to your class
    e. Make your report available to your educator, principal, clinic (if it is about health), municipality and anyone else who may be interested

Extension activity

Read the Ideas for educating their community about groundwater. In groups choose and implement one of the ideas listed below, your educator will monitor you so that you do not choose the same idea.

Ideas for educating your community about groundwater

1. Posters
    a. Make posters and display them at local shops
2. Have a concert
    a. Collect songs about water and rain like the one in this Guide. Ask old people if they know any old songs
    b. Choose some facts that you want to teach people about groundwater. Make up a drama that includes these facts
    c. Use the songs and drama to make up a concert. You could ask the local clinic sister to talk about water and health after your concert
    d. Make small pamphlets that tell people about how to keep groundwater safe or about water and health. Distribute these at your concert

Look after groundwater together

3. Organise a 'kill the fly' campaign
    a. Invite people to come up with ideas for killing flies. Give small sponsored prizes to the more useful and most fun ideas
4. School projects
    a. Make sure there is water for washing hands at school. There could be a bucket outside each classroom
5. Make a set of school health rules and display them
    a. If you do not have good toilets at school talk to the educators and principal about contacting your municipality or the Department of Heath to help you get healthy toilets
    b. When you have these, set up a system for monitoring them and keeping them clean
6. Make a groundwater and health model
    a. Take all the information you can from the pictures in this Guide and make a model that shows how important it is to keep groundwater clean. Display the model at school or in the community
7. Have a competition
    a. Hold an essay or a drawing competition around groundwater and then give prizes. At the prize giving talk about how important it is to keep groundwater clean
8. Radio
    a. Do you have a community radio station? Ask if you can bring some friends and then prepare a discussion about groundwater for the radio

Assessment

You can use the following rubric in assessing the learners

	Excellent	Satisfactory	Need attention	Not done at all
Get a project group together				
Research the problem				
Analyse the research and choose a project				
Draw up an action plan				
Take action				

Sanitation, Health & Hygiene

Activity

At the end of this activity you will be able to:

- Identify different types of toilets
- Research on sanitation systems

Teachers use in:
- EMS: Term 1 week 6 (Standard of living)
- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- Social Science: Term 3 (Topic: Settlement)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)

Background information

What does 'sanitation' mean?

Sanitation means collecting and disposing – in a hygienic manner - of waste, including human excreta, household's waste water and rubbish. If this is not done, neighbourhoods become dirty and people get sick. In South Africa we already have 1,5 million cases of diarrhoea (runny stomach) each year in children under the age of 5, as well as outbreaks of cholera. This must be changed through good hygienic behavioural practices.

Sanitation is vital for good health. Health problems associated with poor sanitation include diarrhoea, dysentery, typhoid, cholera, malaria, bilharzia, worm infestations, eye infections, skin diseases and increased infections in HIV - positive people. Good sanitation leads to increased life expectancy.

Many schools use pit latrines that are inadequate, dirty and unsafe. This all adds up to a potential health time bomb. The government will therefore support communities and households in wiping out the sanitation backlog.

The Ventilated Improved Pit (VIP) latrine

Although many still consider the VIP toilet to be second rate or inferior, the advantages of well constructed VIP toilets have been proved in many other countries besides South Africa including Zimbabwe, Botswana, Ghana, Tanzania and Lesotho where national and regional sanitation programmes using this technology have been launched and implemented. The VIP is a pit latrine which has been improved by providing a dark sealed pit, a ventilation pipe with a fly screen and a seat cover.

1. The advantages of a properly built VIP are:
    a. Eliminates the smell of faeces in the superstructure
    b. Prevents the flies from entering and breeding in the pit

c. Prevents insects that have managed to enter the pit from escaping

d. Is adaptable to most situations including some urban areas

2. The disadvantages are:

a. It cannot be emptied easily when full

b. Needs relatively costly modification in areas with hard rock, high water table or collapsing sands

The bucket toilet

The bucket system is very basic. It is basically a superstructure provided with a seating platform under which a bucket is provided for collection of both faeces and urine. For the system to work properly, buckets have to be emptied once a day by ten o'clock in the morning. If this does not happen the bucket attracts many flies and become unhygienic and smelly. This system is being eradicated from the country and should not exist beyond 2008.

1. The advantages are:

a. Very low set-up cost

b. Can be set up quickly

2. The disadvantages are:

a. The system is unhygienic and can attract flies

b. It is smelly

c. Regular collection of waste needed

d. Off-site treatment necessary

e. Social stigma for the workers

f. High running costs

Waterborne flush toilet

The waterborne flush toilet uses water for flushing. Both urine and faeces are flushed down the toilet to a sewer which takes the waste to a treatment plant. For proper use the household should have a water connection to the site and should be able to afford the water that is required to flush the toilet every time it is used as well as toilet paper in order to avoid blockage. This is the most convenient system if used and maintained properly by both the householder and the local authority. Unmaintained sewers can be a public nuisance and can be more harmful than pit latrines.

1. The advantages are:

a. They can be put inside houses

2. The disadvantages are:

a. They need a constant supply of water to a yard or a home

b. They need well maintained infrastructure such as sewers

c. They are expensive to set up in low density areas

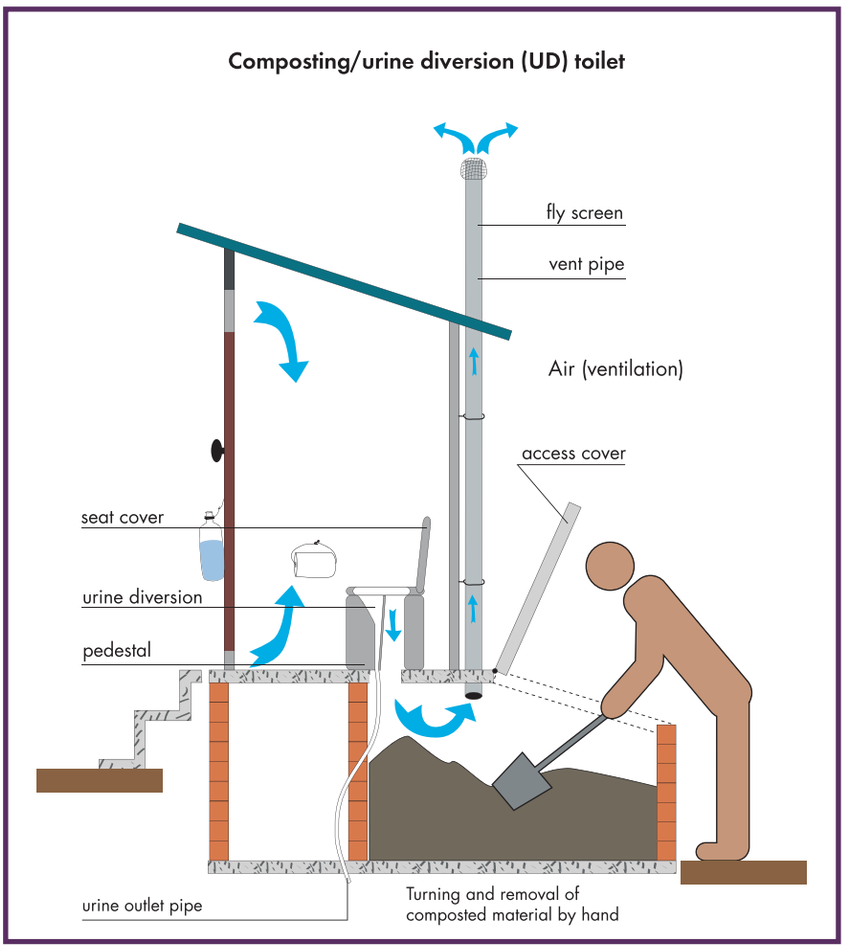
Septic tanks

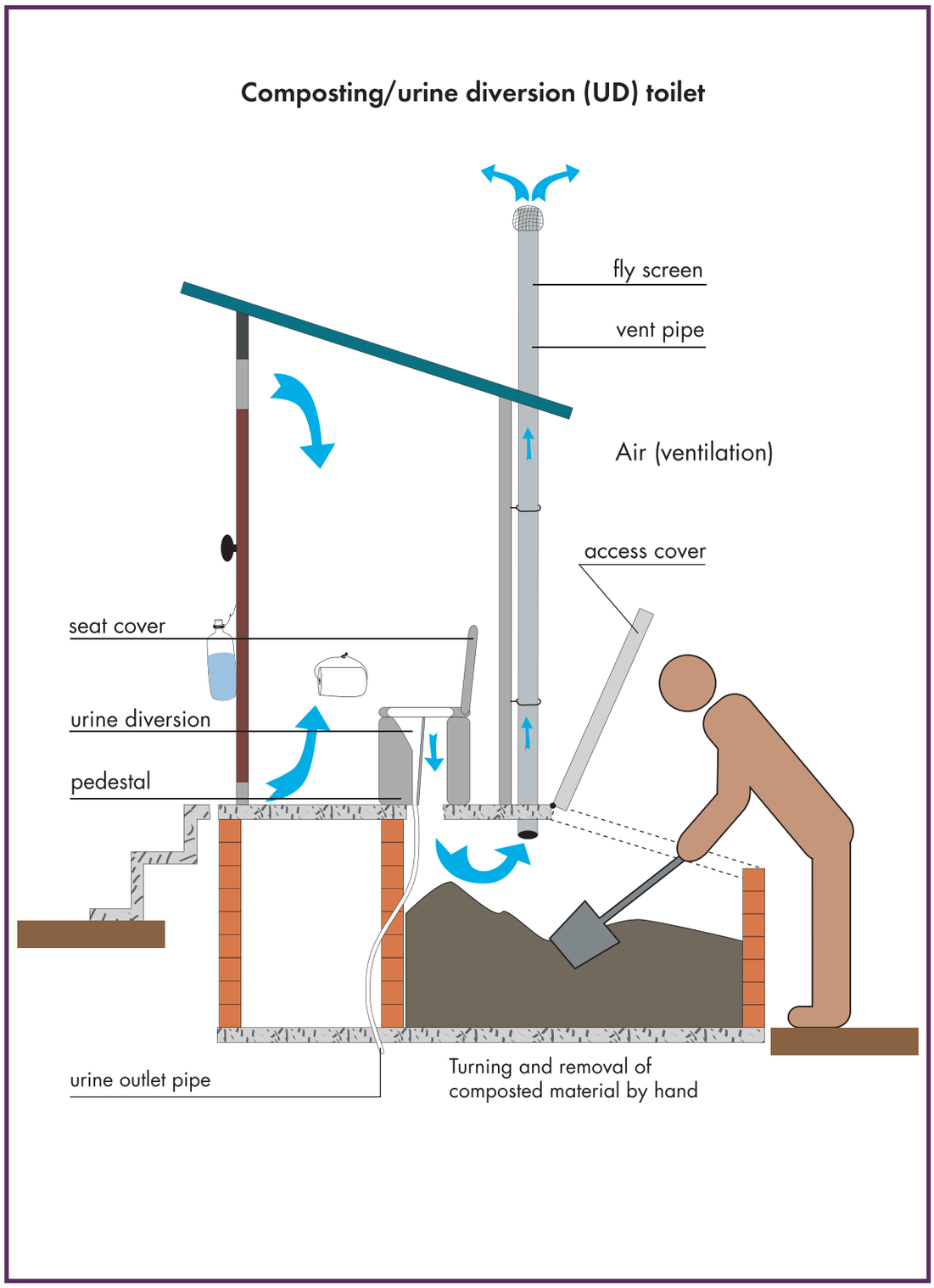
A septic tank is designed for bacteria to degrade (digest) sewage up to a point where the outflow is almost clean water. If this outflow is allowed to soak away in the ground sustainable sewage disposal can be obtained with a very little chance of pollution. Zero pollution can be achieved if rules are followed. Water-borne flush toilets can be used with septic tanks.

Water-borne flush toilets connected to a municipal water care works also cause pollution when the capacity of the works is exceeded and raw sewage is dumped or spilled into water resources. A broken pipeline also makes for heavy pollution because of volumes.

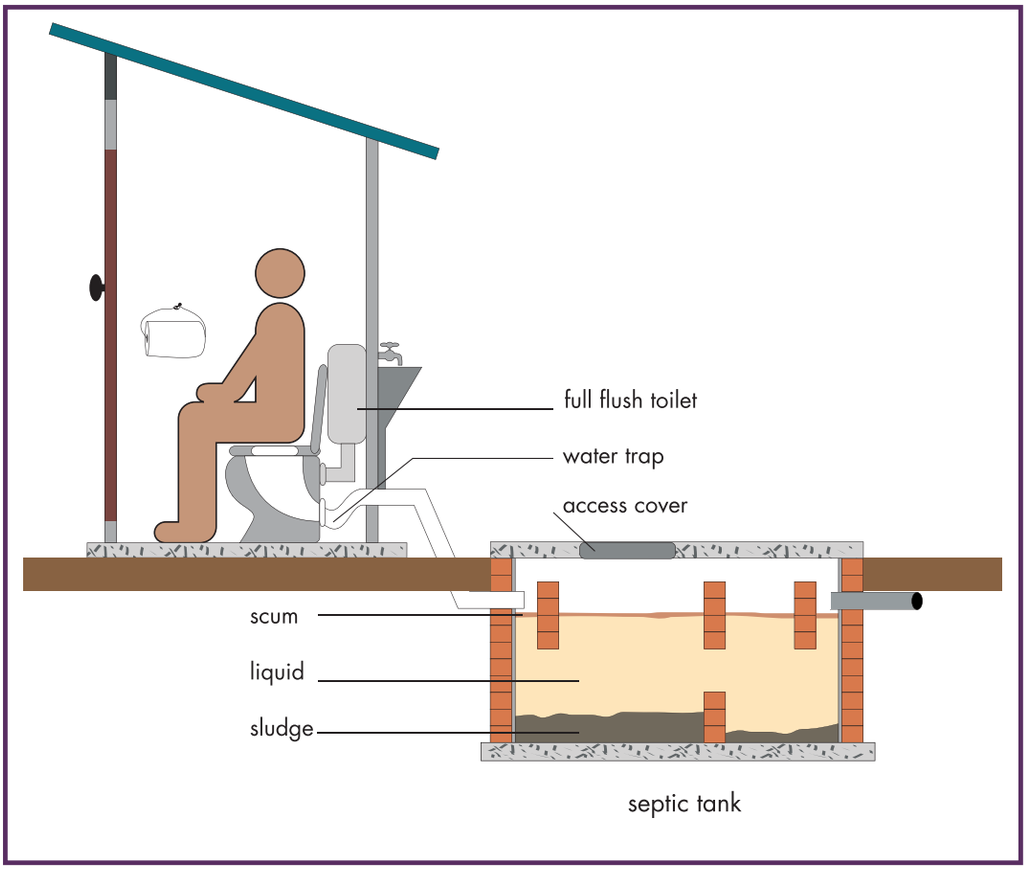
Activity 13a: Advantages and disadvantages of sanitation practices

Look at the pictures showing different types of toilets i.e. flush toilet, VIP toilet and a bucket system toilet.





Practice good sanitation



Working with partners, study the pictures, discuss the advantages and disadvantages of these toilet systems and tabulate your conclusions in the table below.

	Bucket Toilet	Flush Toilet	Ventilated Improved Pipe (VIP) Toilet
Advantages			
Disadvantages			

1. Now list the number of advantages in each system.

.....

2. List the number of disadvantages.

.....

3. Which one is better for your household / school?

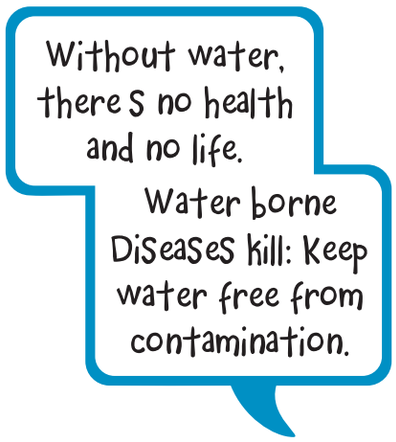
.....

Extension: Research on sanitation systems

- Conduct research on the following aspects of the sanitation systems. You may need to present the findings of your research in the class.
  a. The management of water-borne systems
  b. The management of flushing toilet system
  c. The management of Ventilated Improved Pit (VIP).
  d. The management of the urine diversion system

Activity 13b: Research on sanitation systems

This activity aims to broaden your understanding of the different types of toilet systems and their functioning. In this activity you are required to conduct research on these four types of toilet systems that are commonly used and present your research to class. This research should be conducted in the library. If there is no library nearby your educator will provide you with relevant information about sanitation facilities which can be obtained from a nearby municipality sanitation unit.



You will have to conduct research on the following aspects of the sanitation systems:

1. The management of waterborne systems
2. The management of flushing toilet system
3. The management of Ventilated Improved Pit (VIP)

13 Practice good sanitation

Management of waterborne systems

Management of flushing toilet system

The management of Ventilated Improved Pit (VIP)

Practice good sanitation

Assessment

Criteria	You were able to read the information about sanitation and was able to identify types of toilet systems	You were able to tabulate the advantages and disadvantages of the toilet systems	You were able to conduct a research on sanitation systems
Not Achieved 0-29%			
Elementary Achievement 30-39 %			
Moderate Achievement 40-49 %			
Adequate Achievement 50-59 %			
Substantial Achievement 60-69 %			
Meritorious achievement 70-79%			
Outstanding Achievement 80- 100 %			

Sanitation, Health & Hygiene

Teachers use in:
- EMS: Term 1 week 6 (Standard of living)
- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- Social Science: Term 3 (Topic: Settlement)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting); Term 3 weeks 5-6 (listening & speaking)
- English Home Language: Term 1 weeks 9-10 (writing & presenting); Term 3 weeks 5-6 (listening & speaking)
- Maths: Topics 2.5 (Graphs) and 5.3 (Interpret, analyze & report data)

Activities

At the end of this activity you will be able to:

- Research different water-related diseases
- Describe symptoms and causes of water-related diseases
- Learn how polluted water causes diseases
- Learn actions you can take to decrease the risk of disease

Background information

Waterborne diseases are any illnesses caused by drinking contaminated water. Diseases can include infection from bacteria (Salmonella), viruses, through small parasites (Cryptosporidium, Giardia, and Toxoplasma). These organisms or viruses cause diseases like cholera, typhoid fever, malaria, botulism, polio, dysentery, giardia, and hepatitis A. One of the symptoms of these diseases is diarrhoea, which causes about three million deaths throughout the world. The most well known waterborne diseases such as cholera, dysentery and typhoid are leading causes of morbidity and mortality. Sewage is sometimes discharged into rivers where children downstream might be taking a bath or using the water to drink. The simplest water treatment method is boiling. Just bring the water to a boil for at least 1 minute then allow it to cool. But this is not always effective in heavily chemically polluted water supplies.

Since our interest here is drinking water, the manner of exposure we will consider is ingestion. Illnesses in the digestive tract (sometimes caused the alimentary canal) are called gastrointestinal diseases. Common symptoms of gastrointestinal diseases are vomiting and diarrhoea. Prolonged and severe diarrhoea is a major cause of death in many parts of the world, and contaminated, untreated drinking water is the principal cause of these afflictions. Think about your symptoms: did you throw up, have a fever, go to the bathroom frequently? How long did your illness last? Did you go to the doctor? Did anyone suggest what made you sick? Chances are very high that there were germs involved.

Germs are everywhere and on us, in us, and around us. Some of them can make us sick, by causing infections, so doctors are scientists working hard to learn as much as they can about them. Water suppliers need to understand germs too, because it is their job to keep drinking water safe.

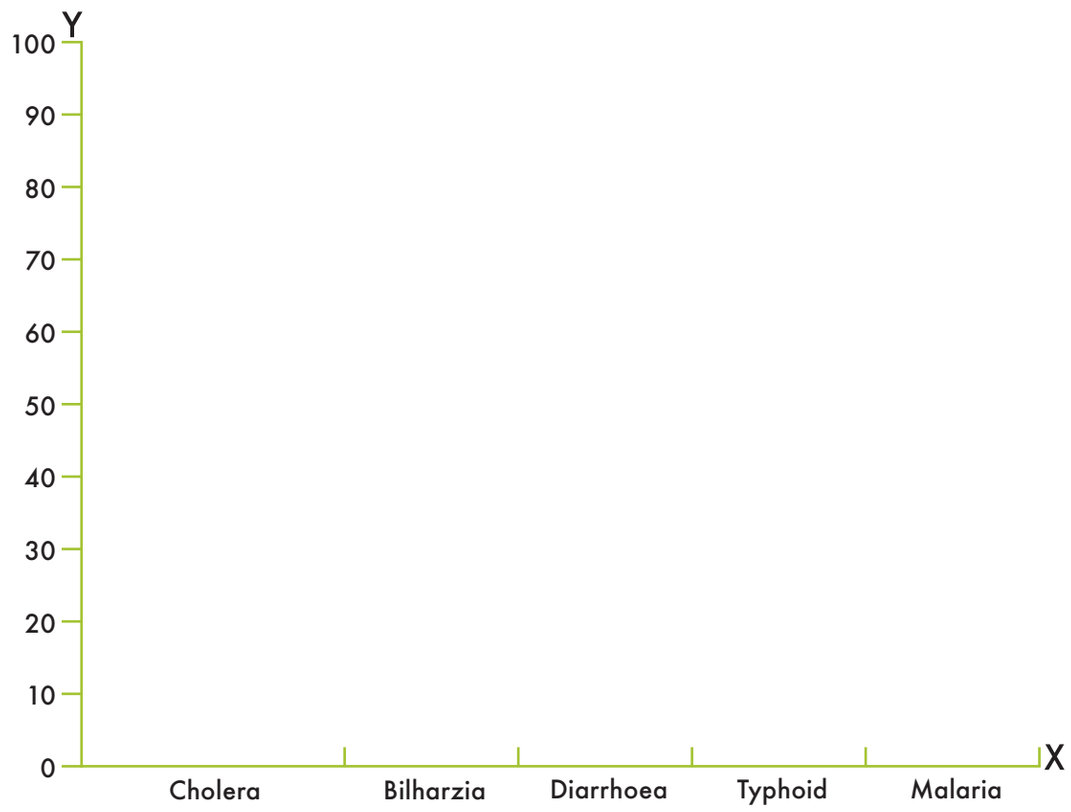
14 Water-related diseases

Activity 14a: The concept of waterborne diseases

What to do

- Name water-related diseases that you know
- You need to visit the local clinic and find out about the water-related diseases that young people visit the clinic to be treated for
- Use the following table to gather the information

		Gender		Is this disease familiar to you?	
Diseases	No. of cases per month	Boy	Girl	Yes	No
Cholera					
Bilharzia					
Diarrhoea					
Typhoid					
Malaria					
Total					



1. Use the X and Y axis to plot a graph showing the number of cases for each disease.
2. Find out what kind of environment the affected children live in.
3. Write the description of the environment in your answer sheet.
4. Share the information with other learners and form a group of at least 5 learners.
5. Compare your information by answering the following check list:
   a. Are there any learners that have chosen the same disease as yours?

.....

   b. Did any learner describe an environment similar to yours?

.....

   c. Which gender is mostly affected?

.....

Assessment

You will be assessed on your ability to:

- Gather enough and relevant information
- Complete all the information required in the worksheet
- Ability to plot the graph
- Share your information with the other members of the class

Activity 14b: Take action

In this activity you will:

- Choose a water-related disease
- Find out more about the disease you have chosen to study
- Present your findings orally to class

What to do

The educator will help you choose a disease that will be of interest to you as a group

1. Visit the library and source information about water-related diseases such as cholera, bilharzia, malaria or typhoid etc.
2. Your educator can also assist you with books, magazines or brochures
3. In groups, research the causes and symptoms of that particular disease

4. Record your findings in the provided space in your workbooks
5. Make sure that you consult other members in your group about the disease to avoid duplication
6. In groups make an oral presentation. You may also dramatise your presentation/conduct an interview or role play it etc.

Causes and symptoms

Part 1

Name of disease	Cause	Symptom
Cholera		
Bilharzia		
Diarrhoea		
Typhoid		
Malaria		

Part 2

Answer the following questions individually.

1. How can I change my behaviour towards streams and rivers to avoid and prevent the spread of these diseases?

.....

.....

.....

.....

2. Describe what a healthy lifestyle is in your own personal view

.....

.....

.....

.....

14 Water-related diseases

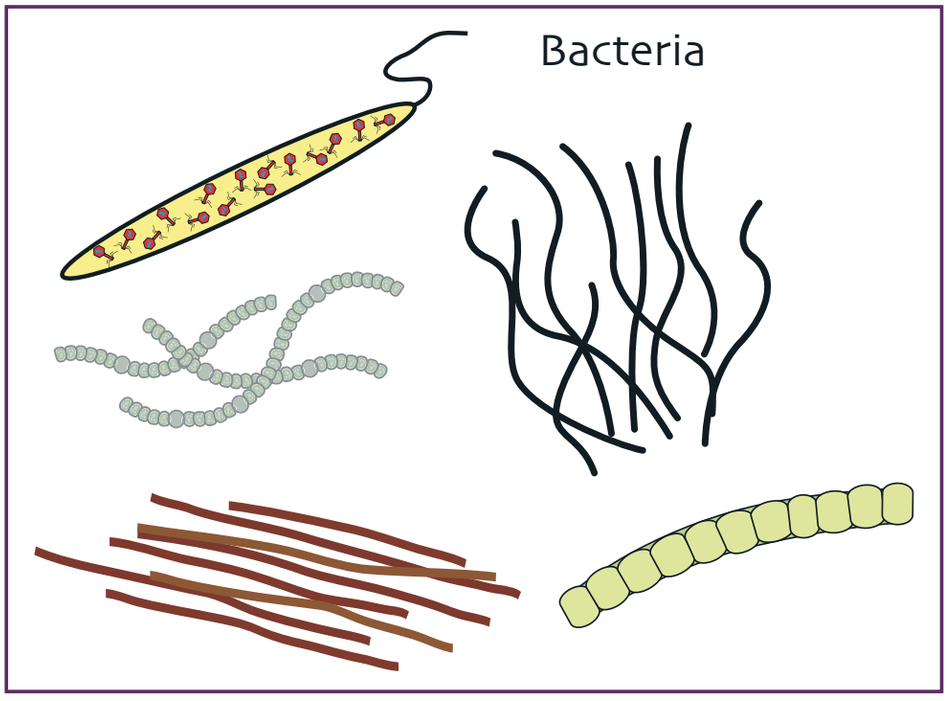
Assessment

You will be assessed on the following:

- Ability to conduct research on a water-related disease.
- Collect relevant data
- Your presentation will be assessed on:
  - The accuracy of information
  - Your audibility
  - Your confidence
  - The ability to communicate the information

Glossary of Terms

Communicable disease:	A disease that is capable of being passed on easily.
Defecate:	To discharge waste from the body through the anus.
VIP]:	Ventilated Improved Pit.
Bilharzia:	A disease caused by infestation of the body with blood flukes.
Groundwater:	This is water that occurs in the spaces and cracks of rocks and soils such as sand, gravel, clay and silt, below the surface of the land.



Assessment

Criteria	You were able to visit the local clinic and conducted a research on water related diseases	You were able to collect the relevant data	You were able to plot a graph showing the number of cases for each disease	You were able to share the information with other learners
Not Achieved 0-29%				
Elementary Achievement 30-39 %				
Moderate Achievement 40-49 %				
Adequate Achievement 50-59 %				
Substantial Achievement 60-69 %				
Meritorious achievement 70-79%				
Outstanding Achievement 80- 100 %				

Sanitation, Health & Hygiene

Activity

At the end of this activity you will be able to:

- Design and produce a poster / brochure / pamphlet that effectively communicates information
- Illustrate the text by means of diagrams

Teachers use in:
•EMS: Term 1 week 6 (Standard of living)
•Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
•Social Science: Term 3 (Topic: Settlement)
•English First Additional Language: Term 1 weeks 9-10 (writing & presenting);
•English Home Language: Term 1 weeks 9-10 (writing & presenting)

You will need:

- Drawing paper or board
- Crayons
- Pens / pencils
- Information booklet

Background information

Most rural communities rely on natural water supplies like groundwater, rivers, streams and springs. These are open to all kinds of pollution and are then a threat to the health of the communities using that water. Pollution mostly happens when human and animal waste seep into these water sources. If the water is polluted it can carry living organisms that cause diseases. It can taste bad. Water should be protected from faecal contamination as people and livestock need clean water as a way of combating disease and death.

As a means of raising awareness about the issue of protecting water sources from faecal contamination learners can be engaged in activities like designing information brochures that inform as well as demonstrates how ground-water sources can be protected.

Read the important things that you can do to decrease the risk of diseases

- Do not defecate or urinate near water sources
- Wash your hands with soap and water after going to the toilet
- Do not drink water that you think might be unclean – boil it if you are unsure
- Wash all fruit and vegetables well before eating them and do not cook with unclean water
- Do not leave empty containers or any litter lying around for disease transmitting insects to breed in?
- If you have access to VIP toilets, ensure that they are away from the water source that is used for drinking and bathing. The VIP toilet should not penetrate the ground-water level

15 Protect water from contamination

Activity 15a: Tell others about the risk of water related diseases

- Work in pairs for this activity
- Read some of the important points you may consider to decrease the risk of diseases
- Brainstorm with your partner on how you can communicate the information using either posters, brochures or pamphlets
- You may cut pictures from a magazine, other pamphlets or brochures to illustrate what is written
- If you can draw, you may illustrate the information in the form of a drawing

Design the action plan

- In your group design an action plan of how you can distribute the flyers to the community. This can be done via the environmental club's community outreach programmes, the school's open day etc.
- Present your brochure and action plan to the class.

NB: Remember these presentations can contribute toward the implementation of the health and safety focus area of your school environmental policy, so it can also be presented to the environmental club.

Activity 15b: Solving the problem of faecal contamination

In this activity we will:

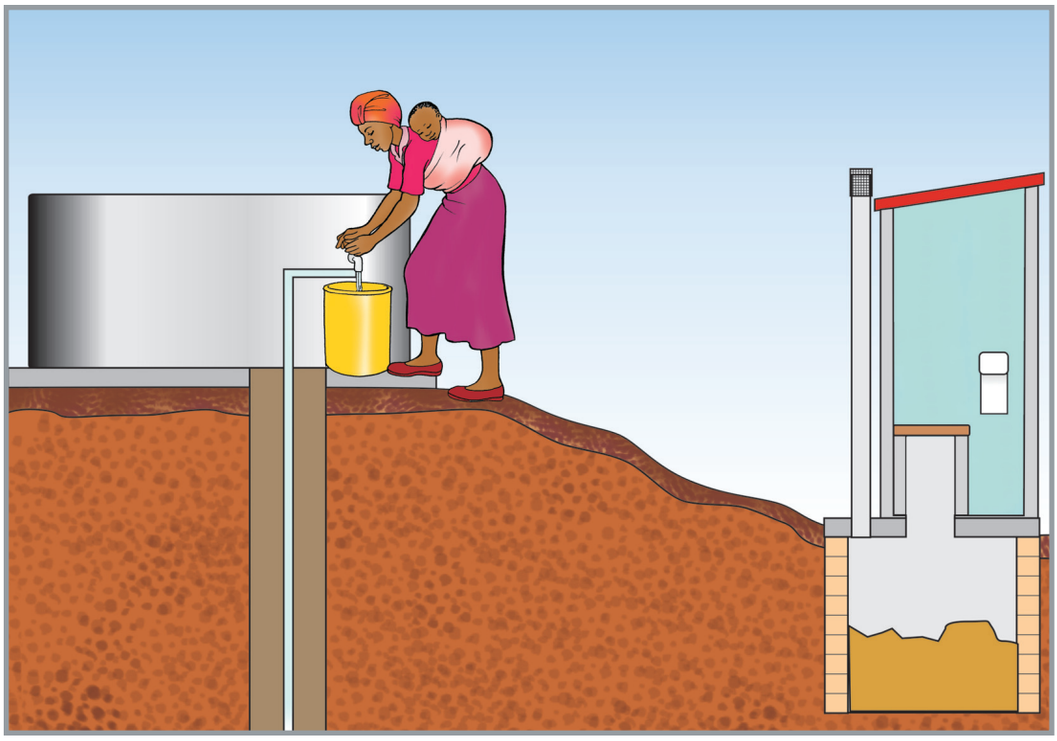
- Explore possible ways of solving the problem of faecal contamination
- Discuss how each way contributes to clean health
- Suggest other ways of solving the problem

What to do

- Look carefully at the following pictures
- Discuss with your partners how do the pictures contribute to solving the problem of faecal contamination
- Write your points in spaces provided
- You may suggest other ways to solve the problem

15 Protect water from contamination

Each of the following pictures demonstrates a possible way to solve the problem of faecal contamination.



1. Pit latrine on a slope at least 20 cm below the borehole.

   a. Possible Problem

.....

.....

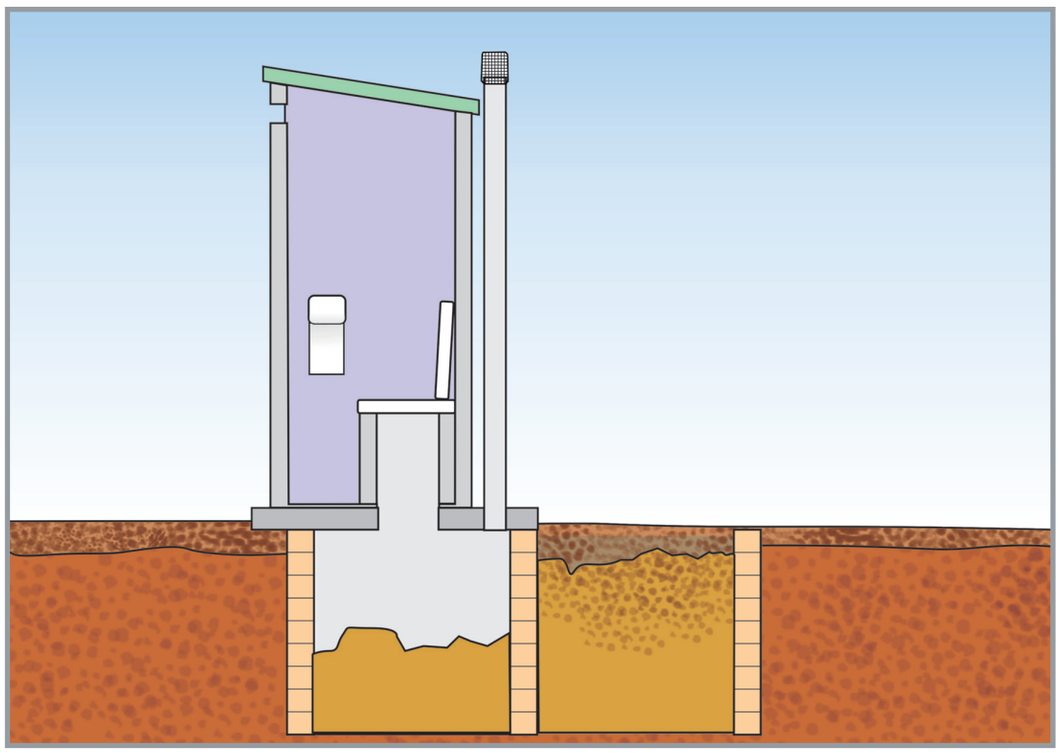
.....

   b. How does it solve the problem?

.....

.....

.....



2. Double pit latrine.

   a. Possible Problem

.....

.....

.....

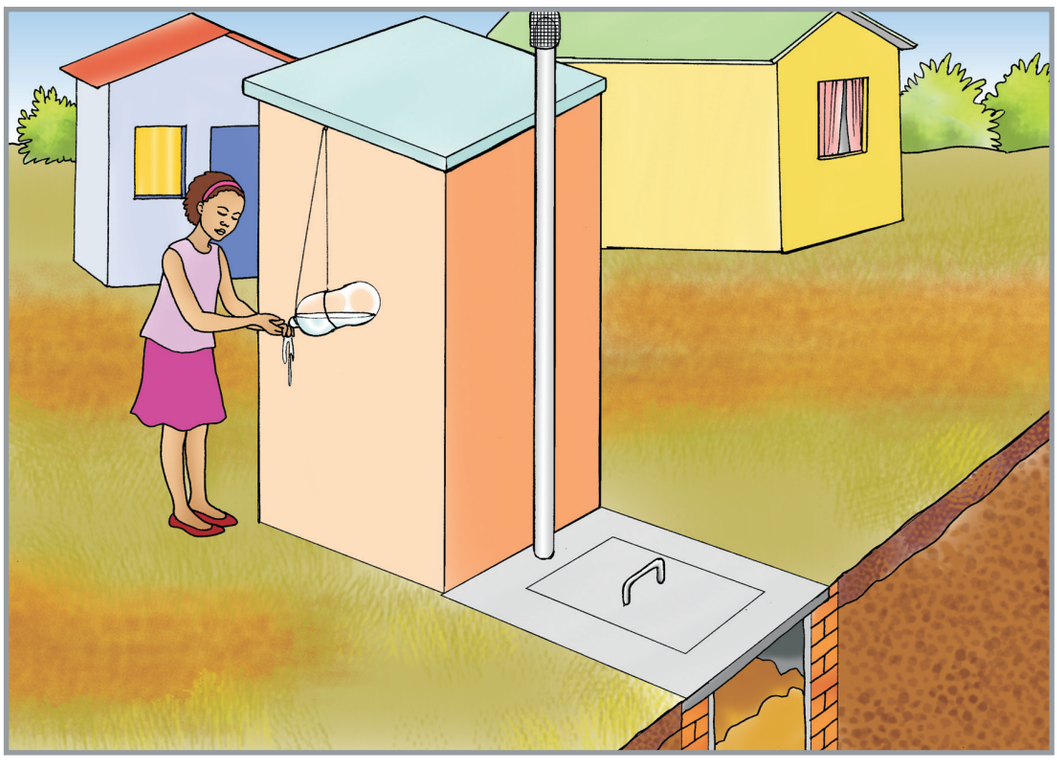
   b. How does it solve the problem?

.....

.....

.....

Protect water from contamination



3. Pit latrine lined with concrete.

   a. Possible Problem

.....

.....

.....

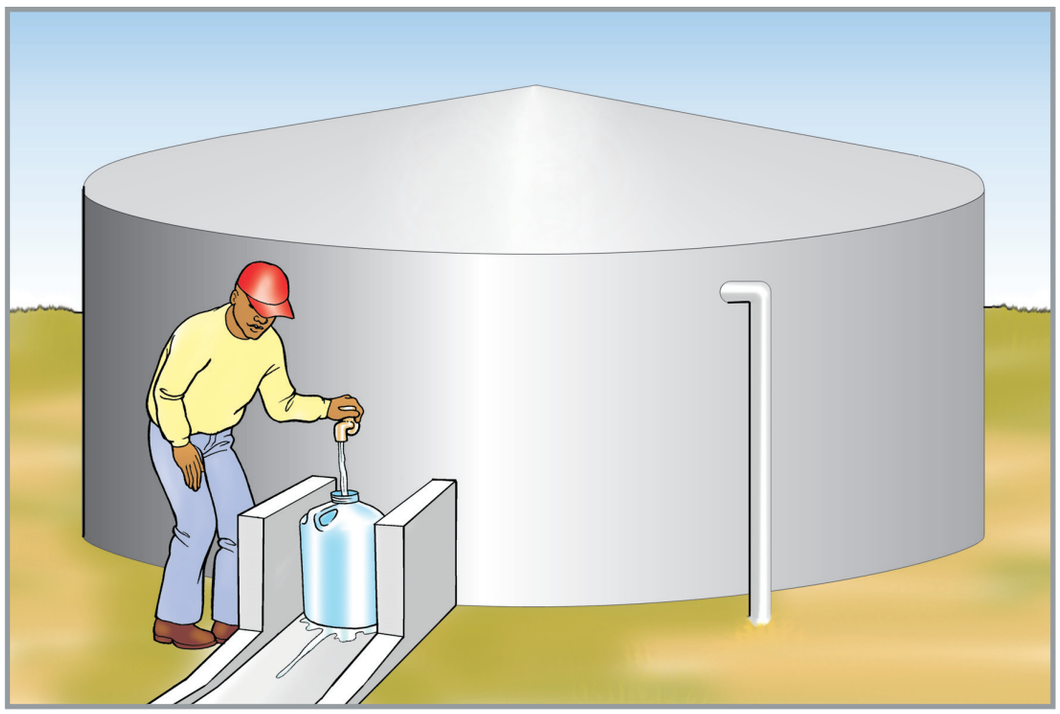
   b. How does it solve the problem?

.....

.....

.....

Protect water from contamination



4. Covered tanks.

   a. Possible Problem

.....

.....

.....

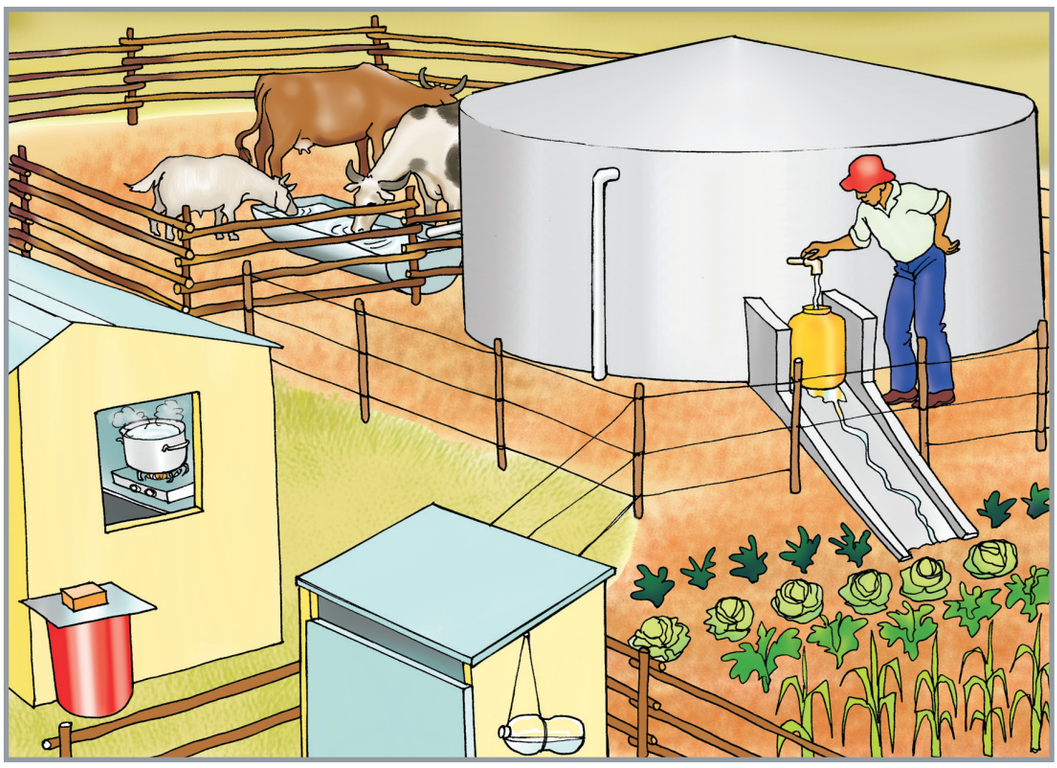
   b. How does it solve the problem?

.....

.....

.....

Protect water from contamination



5. Fenced off water sources.

   a. Possible Problem

.....

.....

.....

   b. How does it solve the problem?

.....

.....

.....

Protect water from contamination

Other ways to solve the problem (Optional):

1. .....

2. .....

3. .....

4. .....

5. .....

Work with your partner for this activity.

- Revisit your solutions and brainstorm on how to bring about awareness regarding the risk of faecal contamination
- Your poster / brochure / pamphlets should be designed using the following guides:

Shock value

If it shocks its viewer it will stick in the mind and be remembered for some time. However, beware of alienating your audience. Ensure that it will have a positive effect.

Comic value

A humorous way of getting the message through is very effective. People remember jokes more than they remember most things, and a funny piece may catch the viewer's attention and stick in their minds more effectively. However, be careful not to get so caught up in entertaining your audience that you don't get the message across strongly enough.

Information overload

Each word must be relevant. Economy of expression is the key to creating posters and flyers - the message must be short and to the point. Beware of overloading your viewer so that they stop reading before they've got the message. Your message must be understandable and memorable to everyone who sees it, even if they cannot read very well.

Attention grabbing

To make your piece noticeable and memorable, use colour, large words and big pictures - draw things people can easily recognise and grab their attention.

15 Protect water from contamination

Assessment

Criteria	You were able to explore the pictures and participated in a class discussion about the causes and effect of contaminated water	You were able to design a poster/brochure or pamphlet that effectively communicates information	You were able to apply creative writings skills to educate others about environmental health issues	You were able to work effectively with the group
Not Achieved 0-29%				
Elementary Achievement 30-39 %				
Moderate Achievement 40-49 %				
Adequate Achievement 50-59 %				
Substantial Achievement 60-69 %				
Meritorious achievement 70-79%				
Outstanding Achievement 80- 100 %				

- EMS: Term 1 week 6 (Standard of living)
- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- Social Science: Term 3 (Topic: Settlement)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)

Water Safety

Activity

In this activity we will:

- Study general water safety tips
- Learn basic water safety tips applicable to different water-related environments
- Read more about the safety tips in other aquatic environments
- Design posters that will be used to educate other learners and children about water safety

Background information

Many children, mainly between the ages 15 – 18, view a river, pool or ocean as a tempting means of cooling during hot conditions. Beaches, community pools, rivers and dams are always packed during summer times. Children usually enjoy water, but neglect the harmful effects that the cold water can have on their strength to sustain themselves in water. Staying in the water too long can lead to fatigue, which might eventually lead to drowning. Most of the young people who drown are often the victims of their own misjudgement of their swimming ability. Knowing how to swim would minimise the dangers of drowning, which is considered the third most common cause of death among young people.

Activity 16a: General water safety tips

Do you remember these safety tips?

- The best thing to do to stay safe is to learn how to swim.
- Always swim in the company of adults or in areas supervised by a lifeguard.
- Read and obey all rules and posted signs.
- Adults should ensure that children or inexperienced swimmers swim in shallow water and wear approved personal flotation devices (PFD's) when around the water.
- Do not swim when too tired, too cold, too far from safety, having had too much sun, or after you have done too much strenuous activity.
- Know the local weather conditions and forecasts. Don't swim if the weather is bad or if there are signs of bad weather.
- Enter the water feet first.
- Enter headfirst only when the area is clearly marked for diving and has no obstructions.
- Do not mix alcohol with swimming, diving or boating.
- Know how to prevent, recognise, and respond to emergencies.
- Select and mark a supervised safe swimming area.
- Never enter head first into a river, lake or dam.

16 Be water wise

What to do

The following are some of the general tips that you need to know when playing in different types of aquatic environments. Read the tips and complete the quiz.

Beach safety

- Protect your skin from direct sunlight between 10:00 a.m. and 4:00 p.m. and wear sunscreen.
- Drink plenty of water even if you do not feel thirsty.
- Watch for signs of heat stroke: heat stroke is life-threatening.
- Wear eye protection.
- Wear foot protection.

Lakes and rivers

- Learn how to swim.
- Select a supervised area. A trained lifeguard who can help in an emergency is the best safety factor. Even good swimmers can have an unexpected medical emergency in the water.
- Never swim alone.
- Select an area that is clean and well maintained.
- Select an area that has good water quality and safe natural conditions.
- Make sure the water is deep enough before entering headfirst. A feet-first entry is much safer than diving.

Ocean safety

- Learn how to swim.
- Stay within the designated swimming area, ideally within the visibility of a lifeguard.
- Never swim alone.
- Check the surf conditions before you enter the water. Check to see if a warning flag is up or check with a lifeguard for water conditions, beach conditions, or any potential hazards.
- Stay away from piers, pilings, and diving platforms when in the water.
- Keep a lookout for aquatic life. Water plants and animals may be dangerous. Avoid patches of plants. Leave animals alone
- Make sure you always have enough energy to swim back to shore. Don't try to swim against a current if caught in one. Swim out using the flow of the current.

Home pools

- Learn how to swim. The best thing anyone can do to stay safe in and around the water is to learn how to swim - this includes adults and children.
- Never leave a child unobserved around water. Your eyes must be on the child at all times. Adult supervision is recommended.
- Enclose the pool completely with a self-locking, self-closing fence with vertical bars.
- Never leave furniture near the fence that would enable a child to climb over the fence.
- Always keep basic lifesaving equipment like a pole, rope, and personal flotation devices (PFDs) by the pool and know how to use it.
- Keep toys away from the pool when they are not in use. Toys can attract young children into the pool.

Keeping children safe in, on, and around the water

- Maintain constant supervision. Watch children around any water environment (pool, stream, lake, tub, toilet, bucket of water), no matter what skills your child has acquired and no matter how shallow the water. For younger children, practice "reach supervision" by staying within an arm's length reach.
- Don't rely on substitutes. The use of flotation devices and inflatable toys cannot replace parental supervision.
- Enrol children in a water safety course or Learn-to-Swim classes.

Quiz

Use the above general safety tips to answer the following quiz:

1. What is a common general water safety tip applicable to the above aquatic environments?
2. Why is open water so dangerous to swim in? Give at least three reasons.
3. In which aquatic environment, a river or a pool, is it safer to swim? Give at least three reasons.
4. How can cold water affect your swimming ability?
5. Why is diving into shallow water dangerous?
6. Say you find your friend drowning, what are the things that you can use to rescue him/her? List three things.
7. Why is it a bad idea to jump in to try to save someone?

Activity 16b: Understanding signs

To keep yourself safe, always look for the signs that will warn you of the dangers in an aquatic environment.

Study the following sheet with water safety signs and use it to answer the quiz.

1. What do these signs mean?

2. Have you seen any of these signs in your area? Yes ☐ No ☐
3. Give a brief description of the area in which you normally see any of these signs.

.....

.....

.....

Extension

- In this activity, you can choose any of the aquatic environments and design a poster that will educate members of the public about the dangers of aquatic environment

Respect water safety rules, and you will be safe. Knowing your water safety signs will keep you alive.

Assessment

Criteria	You were able to read basic water safety tips and responded appropriately to the questions	You were able to design a poster that will be used to educate other learners about water safety	You were able to complete the water quiz
Not Achieved 0-29%			
Elementary Achievement 30-39 %			
Moderate Achievement 40-49 %			
Adequate Achievement 50-59 %			
Substantial Achievement 60-69 %			
Meritorious Achievement 70-79%			
Outstanding Achievement 80- 100 %			

Forestry & IAP's

- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)
- Creative arts: Drama Term 2 Topic 3 (Indigenous poems); Term 4 Topic 3 (Indigenous storytelling)

Activity

In this activity you will be able to:

- Compare two pictures

Background Information

A species of a plant or animal which does not occur naturally in an area (i.e. is not indigenous), but which has been introduced there by people is called alien. Examples of plants which had been brought to South Africa by people include roses and mealies. Not all alien species become invasive, that is, spread so rapidly that they take over the local environment and become a threat to indigenous species.

Invasive alien plants are one of the greatest threats to natural ecosystems and cost the country a lot of money. They reduce our already scarce water supplies, are a threat to biodiversity, take over agricultural land, create great fire hazards, and in these and other ways, cause great economic losses – the equivalent of 4% of our Gross Domestic Product each year.

Some invasive alien plants contain toxins that may be lethal to certain animals. In some cases, invasive alien plant invaders are driving our rarest species close to extinction.

Guidelines for the activity

- The following are the pictures of the same area
- The first picture shows the river and surrounding vegetation before the invasive alien plants had been cleared
- The second picture shows the same area after the invasive alien plants had been cleared

Activity 17a: What are invasive alien plants

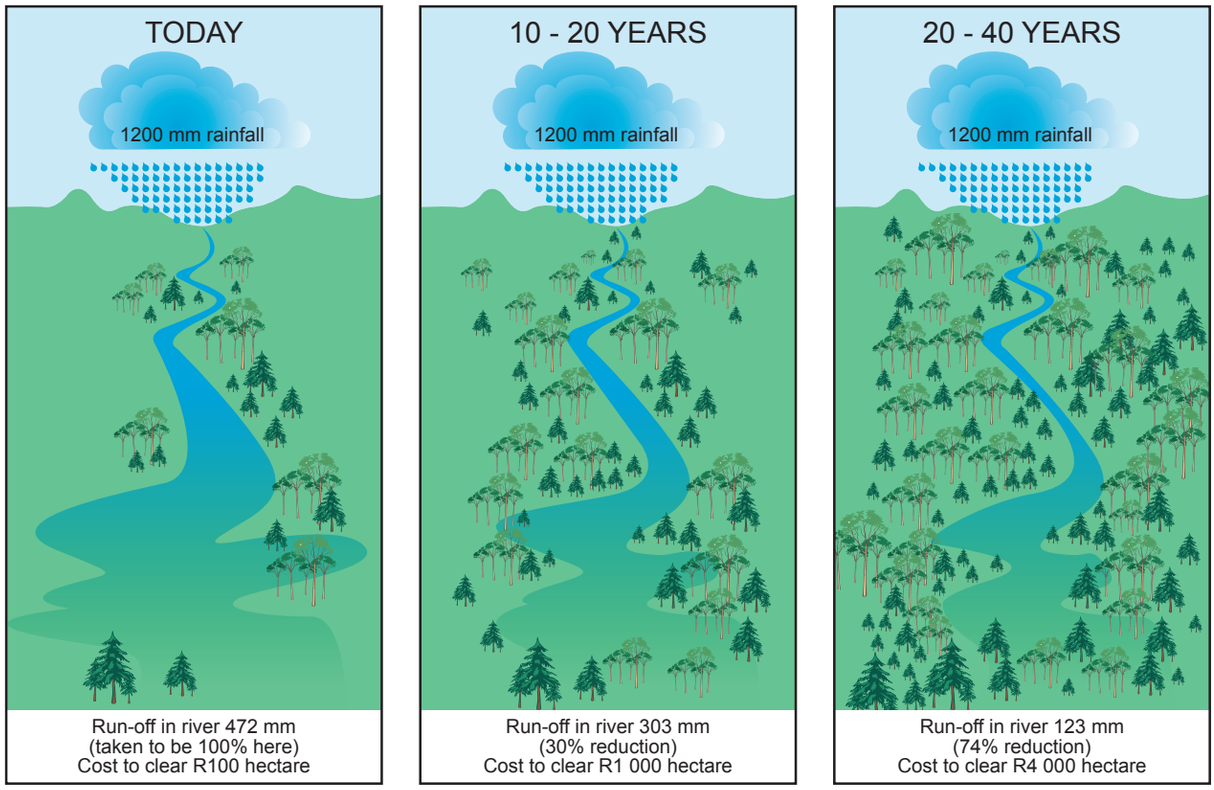
The North Bank of a dam that was overrun by black wattles.

A stream in the same area where invading wattles have been cleared and stream flow and biodiversity have returned.

1. Compare the two pictures using the following guidelines:
   a. Plants growing in the area.
   b. Amount of water visible.
   c. Amount of sunlight that the river receives.
2. Use your knowledge of invasive alien plants to give a possible reason for the water level of the river in picture 1.
3. What do you think brought about the change in the water level in picture 2?
4. All the plants in this picture 2 are non-invasive (indigenous) plants. What does it tell us about the water requirements of these plants?
5. Why are invasive alien plants such a problem?

Activity 17b: Control IAP

The following pictures show how invasive alien plants can change a catchment area in a period of 40 years.



1. Calculate the amount that the run-off will reduce in 40 years.

.....

.....

2. What

   a. increases in the pictures?

.....

.....

   b. decreases in the pictures?

.....

.....

3. Formulate a conclusion about the effect of invasive alien plants on our water resources.

.....

.....

.....

.....

.....

.....

Assessment

3	2	1	0
Compared pictures accurately on 3 levels	Compared pictures accurately on 2 levels	Only 1 level	Inaccurate / made no attempts
	Gives a sensible reason for the water level in picture 2.	Reason is incomplete but makes sense.	Not relevant / made no attempt
	Conclusion concerning the needs of indigenous plants is accurate.	Sensible but incomplete	Not relevant / no attempt made
	Sees the relationship between an increase in IAP's and the increase / decrease of water in that area.	Makes sense but incomplete.	Made no attempt / does not see relationship.
	Calculation accurate	Calculation correct	Calculation incorrect

Forestry

Activity

At the end of this activity you will be able to:

- Know the difference between indigenous and non-indigenous trees.
- Develop a poster that highlights the uses of trees.

- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- English First Additional Language: Term 1 weeks 9-10 (writing & presenting)
- English Home Language: Term 1 weeks 9-10 (writing & presenting)
- Creative arts: Drama Term 2 Topic 3 (Indigenous poems); Term 4 Topic 3 (Indigenous storytelling)

Background Information

Indigenous trees

- Trees that naturally occur in a particular region, area, ecosystem or habitat.
- They grow without direct or indirect human actions.
- They are trees that are naturally found in an area.

Non-indigenous alien trees

- Also known as Alien or foreign trees.
- They are trees that were brought in from other countries, regions, areas, habitats or ecosystems.
- Trees are moved or brought in by people and even animals.
- They were brought in for many reasons, such as to beautify an area, to act as windbreakers and to stabilise sand dunes.

Invasive alien areas

- Some of the non-indigenous trees are invasive aliens.
- They spread rapidly.
- They take over the local environment.
- They have a negative impact on the environment.

Negative impact of invasive alien trees on the environment

- They are a great threat to natural environmental ecosystems.
- The roots of some trees go deep down and they use up vital groundwater.
- They use more of the already scarce supply of drinking water.
- They are a threat to the biodiversity.(Biodiversity is the variety of our indigenous plants, animals and habitats.)

- They take over cultural land.
- They create great fire hazards. (Fynbos needs fire, but the alien trees causes' fire that is too hot.)
- Alien trees are a great threat to eco-tourism.
- They are a threat to the medicinal potential of indigenous trees.
- They increase erosion.

Activity 18a: Classification of IAP's on our environment

1. Ask learners to choose the correct word: (biodiversity, indigenous, non-indigenous, invasive alien plants) **(3)**

   a. They grow naturally in a particular habitat. .....

   b. They grow fast and they take over local areas.....

   c. They were planted to stabilise sand dunes.....

2. Name any 3 non-indigenous plants. **(3)**

   a. .....

   b. .....

   c. .....

3. Name any 2 invasive alien trees. **(2)**

   a. .....

   b. .....

4. Ask learners to mention any 5 reasons why we say that invasive alien trees have a negative impact in our environment.

   a. .....

   b. .....

   c. .....

   d. .....

   e. .....

5. Let the learners fill in the missing words.

Biodiversity is the variety of our indigenous .....

and .....

Total: {15}

Formal Assessment

Learner's	Code	Marks allocated
Performance has exceeded the requirements of the learning outcome of this grade.	4	12-15 Marks
Performance has satisfied the requirements of the learning outcome of this grade.	3	8-11 Marks
Performance has partially satisfied the requirements of the learning outcome of this grade.	2	6-7 Marks
Performance has not satisfied the requirements of the learning outcome of this grade.	1	Under 5 marks

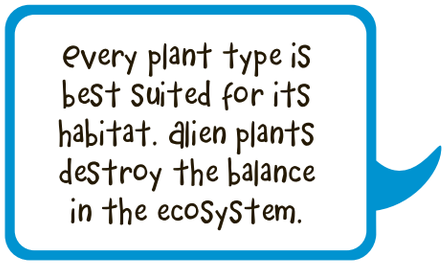
Code:.....

Teacher:.....

Date:.....

Activity 18b: Uses of trees

Work in groups for this activity. You can draw, cut and paste newspaper pictures to highlight the uses of trees. Pictures must be labelled.



Group Assessment

	1	2	3	4
1. The poster has a topic				
2. Pictures relates to the topic				
3. Pictures have labels				
4. The poster has a border				
5. Words and pictures on the poster are big enough to see from a distance of at least 2 metres				

Teacher .....

Date .....

Name of learners:

1.....

2. .....

3. .....

4. .....

Indigenous and non-indigenous trees

Assessment

Criteria	Were you able to design a topic for the poster	The pictures relates to the topic	The pictures have labels and has a boarder	Words and pictures on the poster are big enough to see from a distance of at least 2 metres	Were you able to work effectively with the group
Not Achieved 0-29%					
Elementary Achievement 30-39 %					
Moderate Achievement 40-49 %					
Adequate Achievement 50-59 %					
Substantial Achievement 60-69 %					
Meritorious Achievement 70-79%					
Outstanding Achievement 80- 100 %					

Climate Change

- Life Orientation: Term 3 weeks 4-6 (Health, Social and environmental responsibility)
- Social Science: Term 2 (Topic: Climate regions)
- English First Additional Language: Term 1 weeks 7-8 (reading & viewing); weeks 9-10 (writing & presenting); Term 3 weeks 3-4 (reading & viewing)
- English Home Language: Term 1 weeks 7-8 (reading & viewing); weeks 9-10 (writing & presenting); Term 3 weeks 3-4 (reading & viewing)

Activity

At the end of this chapter you will have

- Summarised an article on the poles, effect climate change has had on the poles and its ecosystem.
- Have developed a policy for the school regarding its carbon foot print.
- Have researched the impact climate change has had on South Africa and its natural habitat.

Background Information

Poles

Many people know that Earth's Polar Regions, which exist at the north and south extremes of the planet, are both icy, cold places. However, the Arctic and the Antarctic actually differ in significant ways. For instance, the North Pole has no set landmass; the Arctic is an ocean, covered by ice and surrounded by land (notably Alaska, Canada, Greenland, Iceland, Norway, and Russia). In contrast, the South Pole is located on the continent of Antarctica, marked ceremonially by an actual pole; the Antarctic is land surrounded by water (the Southern Ocean).

North pole

South pole

There are differences in the types of ice found at the poles, as well. For example, while both regions have glaciers, the Antarctic has far more glacial ice than the Arctic; massive glaciers, called ice sheets, cover Antarctica and contain about 85 percent of the world's ice. Differences in ocean currents and winds also influence the patterns of sea ice formation. For example, Antarctic sea ice is fairly symmetric around the continent because the ocean currents and winds flow freely there. In contrast, some parts of the Arctic have

more sea ice than others because there are variations in currents and winds along the different coasts. In addition, while both poles experience winter growth of sea ice, most Antarctic sea ice melts away in the summer because it can float to warmer waters. However, because the Arctic Ocean is nearly enclosed by land, the sea ice that forms there is relatively thick and does not completely melt each year. As a result, the central Arctic is always covered in sea ice, known as multiyear or perennial ice. In recent years, however, there has been a significant reduction in Arctic ice cover, and there have been openings in the perennial ice at the North Pole.

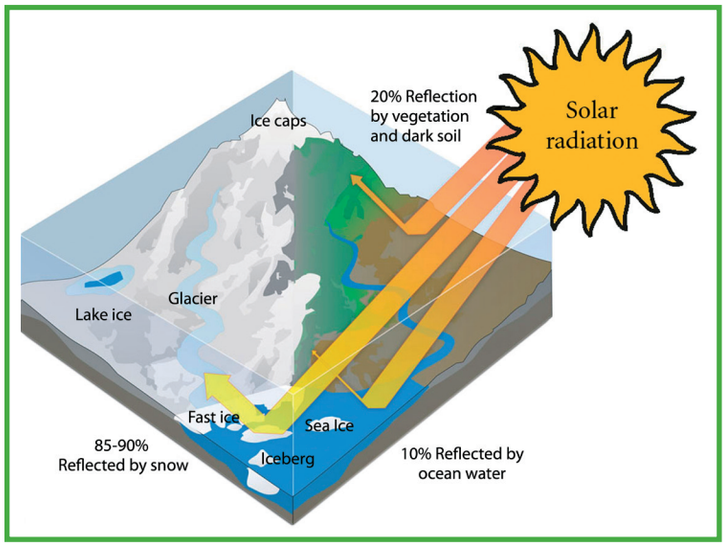
Regional geography makes the Antarctic colder than the Arctic. Water near the surface of the ocean never gets much colder than about –2°C (the temperature at which sea water freezes), which is relatively warm compared to the average air temperatures. Arctic sea ice is not more than a few meters thick, and so heat from the ocean can easily travel through the ice to the air. However, this heating effect is much less significant through the landmass of Antarctica. In addition, air temperature decreases as altitude increases. This does not affect the Arctic, which is at sea level, but because Antarctica has an average elevation of about 2 300 meters, there is a significant decrease in temperature due to elevation.

The relatively warm temperatures of the Arctic support a variety of plants and wildlife: shrubs and other vegetation grow on the Arctic tundra, and marine and bird life are active. In addition, because the surrounding land allows animals to migrate, the Arctic has a great diversity of land mammals such as caribou, fox, hare, wolf, and polar bears. Approximately four million people live in the Arctic, including indigenous cultures that subsist on the land and sea. In contrast, while the Antarctic supports marine and bird life, there is no vegetation, the largest animal that lives solely on land is the midge (a fly no more than a few millimetres long), and the only people are visiting research scientists.

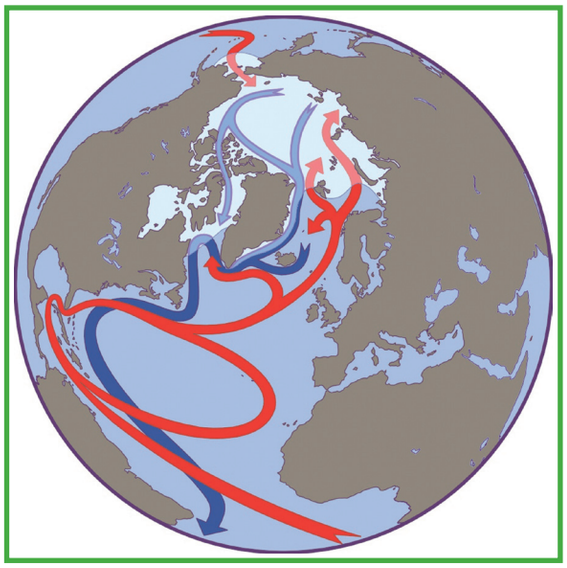
Some people define the Arctic as the area north of the Arctic Circle (67° N, the latitude above which areas experience polar day and polar night—when the Sun appears above or below the horizon, respectively, for more than 24 hours); others define the Arctic as the region north of the tree line (the border beyond which trees are unable to grow) or as the region where the average temperature for the warmest month is below 10°C (which generally corresponds to the area north of the tree line). Regardless of the particular definition, "the Arctic" evokes images of an icy and snow-covered landscape.

However, the Arctic is not simply snow and ice: the region encompasses a large area and exhibits great environmental variability. The Arctic consists of an ocean surrounded by land. While the central Arctic is covered by sea ice year-round and is rather lifeless, other regions are not so plain and barren. These regions include ice, ocean, land, mountains, and tundra vegetation (such as grasses, mosses, lichens, and shrubs), which is more abundant at the lower latitudes and in more hospitable climates.

19 Climate change and water resources



Solar radiation plays a major role in determining Arctic climate. Incoming sunlight is less intense at the poles because of Earth's shape and position in relation to the Sun. In addition, snow and ice have high "albedos." Surfaces with a high albedo do not absorb as much solar energy; instead, they reflect a greater proportion of it back into space. Land, water, and even wet snow have lower albedos and absorb more energy. Thus, because the lower latitudes of the Arctic absorb more solar radiation, they are generally warmer and support more plant growth. Furthermore, the absorption of solar radiation also varies with topography. For instance, the south-facing side of a slope receives more solar radiation than other areas. Topography becomes an increasingly important climatic factor at higher latitudes; because of the low angle of incidence of solar radiation, even slight differences in topography (such as a hill) can cause variations in local climate due to shading.



The ocean also influences the Arctic climate. In particular, warm water currents that bring heat from lower latitudes keep some areas of the Arctic warmer than others. For example, winters are not as cold in northern Norway, located near a northward flowing warm current, as they are in a location at the same latitude in Greenland. In addition, because warmer temperatures increase evaporation and the amount of moisture in the air, the warm currents also lead to increased precipitation. Water also has a higher heat capacity than land; in other words, water retains heat longer and cools more slowly than land. As a result, locations near the ocean experience smaller temperature variations and have a more moderate climate than inland areas. People who live in the Arctic are generally located at the lower latitudes and along the coast, where not only is the climate less extreme, but they also have easier access to resources necessary for survival, such as fish, seals, whales, and plants.

The well-documented retreat of the world's glaciers is widely viewed as a direct result of global warming. Though scientists cannot be sure whether or when these frozen repositories will add their entire freshwater contents to the world's seas, they do know that their melt water would raise global sea level. Moreover, a rapid rise in sea level -- which we are more and more certain, is occurring through accelerated atmospheric warming - would have consequences that are not immediately apparent.

19 Climate change and water resources

Today, glaciers are found on all of Earth's continents except Australia. The two largest - the Antarctic and Greenland ice sheets - contain about 90 percent of the planet's freshwater supply, which is enough to raise global sea levels 60 meters (200 feet). Glaciers can form either at an altitude or at sea level anywhere that snow and ice remain year-round. They grow slowly over thousands of years, as snowflakes from one snowfall are compacted and eventually turn to ice under the weight of subsequent snowfalls. Glaciers grow only if new snow exceeds what is lost through melting or evaporation.

One reason glaciologists study glaciers is to learn more about their past so that they can better predict how glaciers will respond to climate change in the future. In addition, glacial deposits archive data that can be used to reconstruct environmental conditions in the past. For example, bands of light and dark snow in ice core samples indicate seasonal changes. Light layers are deposited in summer, and dark layers in winter. The layers vary in colour because summer and winter snows have different densities and crystal shape. Taken together with other historical climate data concerning solar radiation, the presence of atmospheric dust, and the atmosphere's chemical composition, glacial deposits provide a timeline record of past environmental change that includes changes in air temperature as well as tectonic events such as volcanic eruptions.

A scientific report endorsed by the United Nations states that unless greenhouse gas emissions are curtailed, average global temperatures may rise between one and three degrees Celsius (two and six degrees Fahrenheit) in the next hundred years. The ramifications of a temperature change at just the low end of this range would be severe. A one-degree Celsius (two-degree-Fahrenheit) change in temperature is predicted to result in a one-meter (three-foot) rise in sea level, which would displace millions of people in coastal cities and low-lying islands. For example, virtually all of the agricultural land in Bangladesh would be covered in seawater and rendered unusable. Another consequence of increased global temperatures would be an acceleration of glacial melt in mountain valleys, which would in turn result in massive flooding in their drainage basins. Rivers that are currently glacier-fed would dry up, impacting agriculture and other economic activities.

It has been widely reported in the media, massive icebergs have sheared off Antarctica's West Ice Sheet in recent years. An iceberg forms when a large chunk of ice breaks free, or calves, from an ice shelf -- a floating extension of a landed ice sheet. As with an ice cube floating in a glass of water, an iceberg displaces the same volume of water that it contains. So, if it were to melt, the sea level would stay exactly the same.

The fact that sea ice doesn't affect sea level when it melts doesn't mean that the breakup of an ice shelf is inconsequential. An ice shelf acts as a buttress that prevents a landed ice sheet -- whose melting would cause sea level to rise -- from sliding into the sea and increasing the volume of water. In fact, if you divided the volume of the water frozen in the entire West Sheet by the total surface area of the seas in which it would melt, you would determine that its demise would raise the global sea level by as much as 6 meters. It is estimated that a sea-level rise of less than half a

meter would inundate up to 300 meters of seashore, and that such flooding would displace millions of people in coastal cities and low-lying islands worldwide.

Rising global temperatures are thought to be responsible for accelerated glacial movement. Climate records over the past 50 years show that air temperatures have increased 2.5°C in the Antarctic Peninsula, which juts off the West Sheet. This is about five times greater than warming measured for the rest of the world. Other evidence, such as the increased incidence of ice stream formation, corroborates the proposed connection between increased temperatures and decreased ice in Antarctica.

After the observed Larsen Ice Shelf collapse in 2002, measurements of glacial movement on the West Sheet indicate that some glaciers are moving eight times as fast as before this breakup, dumping nearly 25 cubic kilometres more ice into the ocean each year. These results demonstrate that not all parts of the globe respond to increased temperatures equally, and that the ice-covered regions of the Antarctic appear to be particularly sensitive to even small changes in global temperature.

Polar Bears: Observations linked to global warming

The effects of global warming are most profound in the southern part of the polar bear's range, and this is indeed where significant degradation of local populations has been observed. The Western Hudson Bay subpopulation, in a southern part of the range, also happens to be one of the best-studied polar bear subpopulations. This subpopulation feeds heavily on ringed seals in late spring, when newly weaned and easily hunted seal pups are abundant. The late spring hunting season ends for polar bears when the ice begins to melt and break up, and they fast or eat little during the summer until the sea freezes again.

Due to warming air temperatures, ice-flow breakup in western Hudson Bay is currently occurring three weeks earlier than it did 30 years ago, reducing the duration of the polar bear feeding season. The body condition of polar bears has declined during this period; the average weight of one (and likely pregnant) female polar bear was approximately 290 kg (640 lb) in 1980 and 230 kg (510 lb) in 2004. Between 1987 and 2004, the Western Hudson Bay population declined by 22%.

Mothers and cubs have high nutritional requirements, which are not met if the seal-hunting season is too short.

In Alaska, the effects of sea ice shrinkage have contributed to higher mortality rates in polar bear cubs, and have led to changes in the denning locations of pregnant females. Recently, polar bears in the Arctic have undertaken longer than usual swims to find prey, resulting in four recorded drownings in the unusually large ice pack regression of 2005.

19 Climate change and water resources

Pollution

Polar bears accumulated high levels of persistent organic pollutants such as polychlorinated biphenyl (PCBs) and chlorinated pesticides. Due to their position at the top of the food pyramid, with a diet heavy in blubber in which halocarbons concentrate, their bodies are among the most contaminated of Arctic mammals. Halocarbons are known to be toxic to other animals because they mimic hormone chemistry, and biomarkers such as immunoglobulin G and retinol suggest similar effects on polar bears. PCBs have received the most study, and they have been associated with birth defects and immune system deficiency.

The most notorious of these chemicals, such as PCBs and DDT, have been internationally banned. Their concentrations in polar bear tissues continued to rise for decades after the ban as these chemicals spread through the food chain, however the trend seems to have abated, with tissue concentrations of PCBs declining between studies performed in 1989 - 1993 and studies performed in 1996 - 2002. Sometimes excess heavy metal have also been observed in the polar bear.

Oil and gas development

Oil and gas development in polar bear habitat can affect the bears in a variety of ways. An oil spill in the Arctic would most likely concentrate in the areas where polar bears and their prey are also concentrated, such as sea ice leads. Because polar bears rely partly on their fur for insulation and soiling of the fur by oil reduces its insulative value, oil spills put bears at risk of dying from hypothermia. Polar bears exposed to oil spill conditions have been observed to lick the oil from their fur, leading to fatal kidney failure. Maternity dens, used by pregnant females and by females with infants, can also be disturbed by nearby oil exploration and development. Disturbance of these sensitive sites may trigger the mother to abandon her den prematurely, or abandon her litter altogether.

Predictions

The U.S. Geological Survey predicts two-thirds of the world's polar bears will disappear by 2050, based on moderate projections for the shrinking of summer sea ice caused by global warming. The bears would disappear from Europe, Asia, and Alaska, and be depleted from the Arctic archipelago of Canada and areas off the northern Greenland coast. By 2080, they would disappear from Greenland entirely and from the northern Canadian coast, leaving only dwindling numbers in the interior Arctic archipelago.

Predictions vary on the extent to which polar bears could adapt to climate change by switching to terrestrial food sources. Mitchell Taylor, who was director of Wildlife Research for the Government of Nunavut, wrote to the US Fish and Wildlife Service arguing that local studies are insufficient evidence for global protection

at this time. The letter stated, "At present, the polar bear is one of the best managed of the large Arctic mammals. If all Arctic nations continue to abide by the terms and intent of the Polar Bear Agreement, the future of polar bears is secure.... Clearly polar bears can adapt to climate change. They have evolved and persisted for thousands of years in a period characterized by fluctuating climate." Ken Taylor, deputy commissioner for the Alaska Department of Fish and Game, has said, "I wouldn't be surprised if polar bears learned to feed on spawning salmon like grizzly bears.

However, many scientists consider these theories to be naive; it is noted that black and brown bears at high latitudes are smaller than elsewhere, because of the scarcity of terrestrial food resources. An additional risk to the species is that if individuals spend more time on land, they will hybridize with brown or grizzly bears. The IUCN wrote: "Polar bears exhibit low reproductive rates with long generational spans. These factors make facultative adaptation by polar bears to significantly reduced ice coverage scenarios unlikely. Polar bears did adapt to warmer climate periods of the past. Due to their long generation time and the current greater speed of global warming, it seems unlikely that polar bears will be able to adapt to the current warming trend in the Arctic. If climatic trends continue, polar bears may become extirpated from most of their range within 100 years. "

Controversy over species protection

Warnings about the future of the polar bear are often contrasted with the fact that worldwide population estimates have increased over the past 50 years and are relatively stable today. Some estimates of the global population are around 5,000–10,000 in the early 1970s; other estimates were 20,000–40,000 during the 1980s. Current estimates put the global population at between 20,000 and 25,000.

There are several reasons for the apparent discordance between past and projected population trends: Estimates from the 1950s and 1960s were based on stories from explorers and hunters rather than on scientific surveys. Second, controls of harvesting were introduced that allowed this previously overhunted species to recover. Third, the recent effects of global warming have affected sea ice abundance in different areas to varying degrees. According to WWF data, only 1 out of the 19 polar bear subpopulations is currently known to be increasing; 3 are stable; 8 are declining; and the remaining 7 currently have insufficient data to provide an assessment of population trends.

Activity 19a: Walk in their paws

What to do

Once your class has been divided into 4 groups:

- Read the background information, research the effect climate change has had on a local ecosystem and prepare a story pretending to be an animal whose (ecosystem) way of life has been impacted by climate change. (Must be an ecosystem found in South Africa)

Activity 19b: Summarise what you have learnt

In no more than 250 words, summarise the information you have read and decide what the key messages in the passages are.

Activity 19a: Walking in their paws

Once you have been divided into groups, investigate what South Africa's climate change policy is and what we're doing to reduce our carbon footprint. Using this information develop your own policy for your school in order to reduce its carbon footprint.

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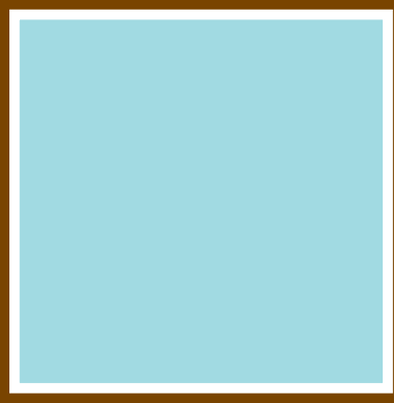
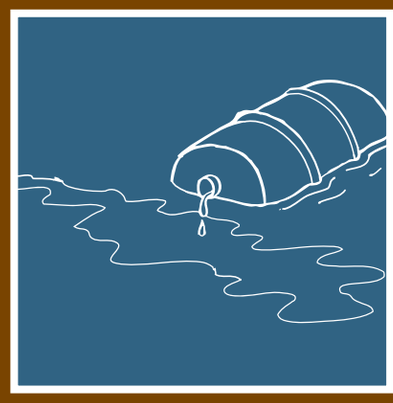


SAVE WATER



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