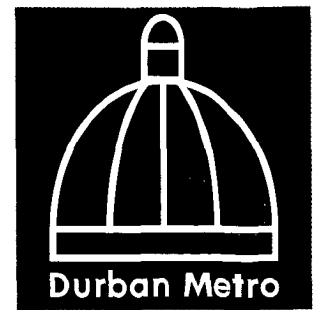


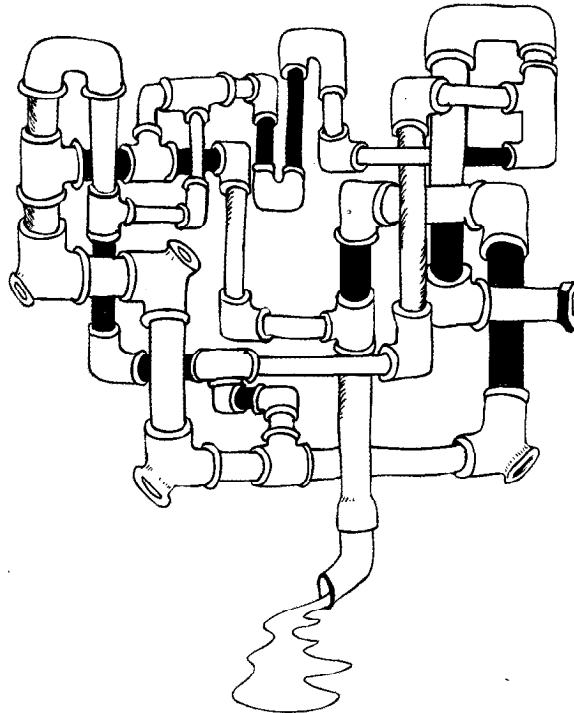
Department of

WASTEWATER MANAGEMENT



DURBAN METRO'S SEWERS

it's all connected



An Outcomes-based, cross-curricular guide for developing
LEARNING PROGRAMMES
That are based on real-world issues related to
SEWAGE AND SANITATION
In the Durban Metropolitan Area

For teachers of the Intermediate and Senior Phases of the
GENERAL EDUCATION AND TRAINING Band (Grades 4 - 9)

compiled by: **Jacky Kruger**

illustration by: **Gill Andrew**

DTP: **Original Art Co.**

ACKNOWLEDGEMENTS:

The Business Branch of the Durban Metro's Department of Wastewater Management, headed up by Bill Pfaff, with support from Teddy Gounden and Bernard Gabela, are acknowledged for commissioning this resource. They are thanked for their support, open-mindedness and friendly rapport. It is sincerely hoped that this resource will contribute to reducing the numbers of sewer blockages in the Durban Metropolitan Area as a result of user ignorance or abuse.

The South African Environmental Education community proved itself generous as ever! Thank you to all those who contributed by generating ideas, sharing resources, participating in workshops or commenting on earlier drafts. The following persons are thanked especially: Linda Paxton; Sue Müller; Steve Camp; Richard Boon; Lyn Britz; Alistair and Glynis Clacherty; Wayne and Caroline Selkirk; Ursula van Harmelen; Nicola Jenkin; Rob O'Donoghue; Alan Pillay and Jeff Keegan.

Gill Andrew (artist) and Frances Andrew (desk top publisher) of the Original Art Company were both an integral part of developing this resource. It was a privilege to work with them!

Jackie Kruger

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This teachers resource was developed through consultation with the Environmental Education Community in KwaZulu-Natal including the EECF (Environmental Education Curriculum Forum) of the Kwa -Zulu- Natal department of Education and Culture. Whereas the resource has been developed by the Durban Metro Wastewater Management Department as part of their on-going education to schools and communities to raise the awareness of the importance of wastewater management, the activities are all ideal for the OBE Classroom. We believe that teachers will find it extremely useful and it will be included in the Schools' Environmental Policy Resource Pack as part of the EE basket of materials. We are grateful for the support shown by our EECF partners in developing excellent materials such as this.



C S MULLER
CONVENOR: ENVIRONMENTAL EDUCATION
KWAZULU-NATAL DEPARTMENT OF EDUCATION AND CULTURE

A MESSAGE TO TEACHERS

from



**Department of
Wastewater
Management**

Access to water is one of life's most basic and essential needs. The South African government is working hard to deliver clean water to every community for drinking, washing and cleaning. But that is not where it all ends. Used water (called sewage) from kitchens, bathrooms, laundries and industries can contain many harmful germs, that cause diseases, and a variety of dangerous chemicals. The sewage has to be 'cleaned-up' or treated before it is returned to the environment, where it re-enters the water-cycle. In Durban, this is the job of the Wastewater Management Department of Durban Metro.

This Department operates 31 sewage treatment plants with a combined capacity of 735 million litres per day. Sewage collection is provided for about 300 000 premises in a 1 364 square kilometre area. The Metro operates 265 pumping stations and approximately 5 500 km of sewer lines, the largest pipe being 1 600 mm in diameter. Pipes connecting homes to the sewer systems are 100 mm in diameter.

This all sounds impressive, but the effectiveness and efficiency of the sewage disposal system is greatly affected by the conduct of the users (us!). Abuse of the system, such as the irresponsible use of sewage pipes and toilets as dumps for solid wastes and rubbish not only hinders the treatment process, but leads to sewer blockages and overflows of sewage into watercourses, rivers and the sea. This can be a serious health hazard in itself, but also results in poor water quality which can affect the health of people and the environment. Any careless and wasteful use of water in homes and industries is also very costly as all the water that enters the sewers has to go through the expensive treatment process.

South Africa is a dry country. We cannot afford to waste our precious water resources. South Africa is also a developing country. We cannot afford to waste our financial resources on unnecessary sewage treatment and sewer maintenance. That money would be better spent in providing new services.

South Africa's new education curriculum is committed to transforming our country into one in which we all want to live. We trust that you, the teacher, will be inspired to use this resource on sewage and sanitation meaningfully. Along with sensible hygiene practices, South Africans need to choose to use our water resources responsibly if we are to achieve the personal and environmental health that is needed to take us successfully into the next century.

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INFOSHEETS AND ACTIVITIES

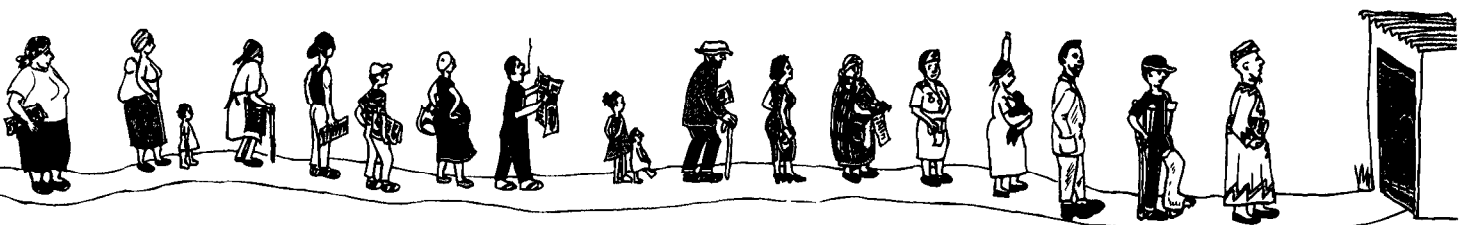
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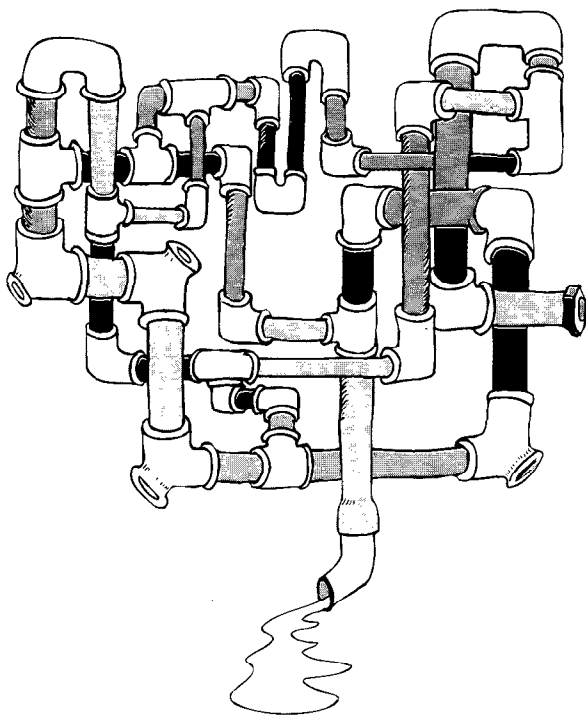
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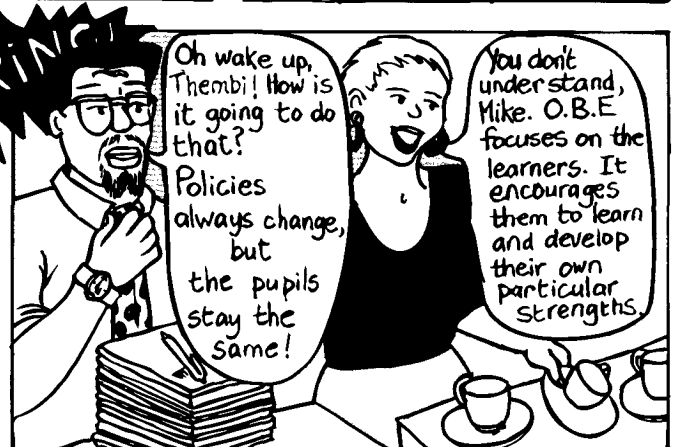
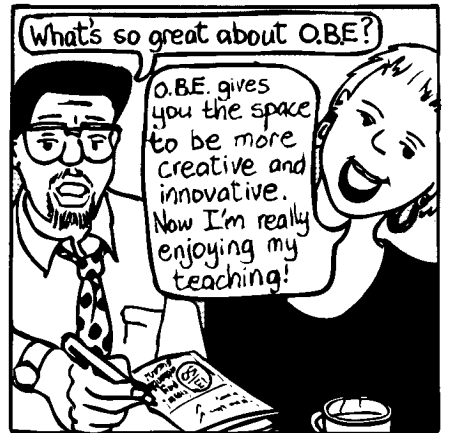
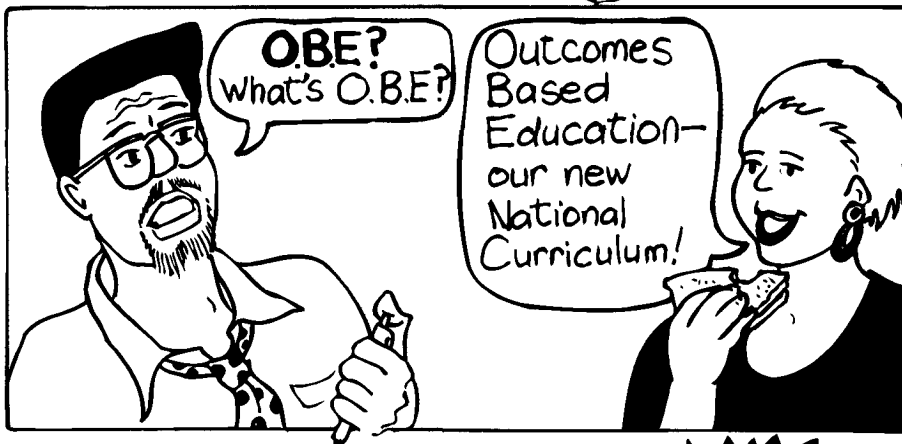
BACK POCKET

- Envirofact sheet on Wetlands
- Poster on the Northern Sewage Treatment Works
- Poster of stormwater drains and sewers
- Durban Metro Sewerage Map





in with outcomes.



.... Better still, deciding what should be done about problems and taking action. Talk about **EMPOWERING** a nation.

SPORT DAILY NEWS
LOCAL SCHOOL SOCCER TEAMS RAISES FUNDS FOR HOSPITAL
LOCAL PUPILS CLEAN UP POLLUTED RIVER

SOUNDS LIKE CHAOS to me!

Not at all! Many of the approaches are even possible with **BIG CLASSES!**

Hmm? Like what?

Group work, for example. Pupils swap ideas, change ideas and grow new ideas. It encourages thinking and communication.

HOMework. LEARN ALL FACTS OFF-BY HEART.

Well, I feel more comfortable sticking to the syllabus.

LEARN P273-409 FOR TEST.

Relax, Mike, teachers don't have to be experts you know!

Learning isn't only about facts, it's also about **HOW** you learn!

Our job is to make sure that the learning process is varied and fun. As far as knowledge goes, we may even land up learning with our pupils!

OK! So these are some interesting ideas, but how on earth are you going to squeeze them into the already jam-packed syllabus?

Mike, **BIG CHANGES** are coming! OBE. has to be relevant and flexible....

There won't be a syllabus as we know it...

SYLLABUS

WHAT? NO SYLLABUS??!

Khoyi bo! faint!

There will be **LEARNING PROGRAMMES** instead. At last, teachers, their pupils and even the community will have a say in these learning programmes!

WO! slowly with all this new jargon.....

What's a **LEARNING PROGRAMME?**

LEARNING PROGRAMME

It's a set of learning and teaching activities, as well as ideas on how the learning outcomes will be assessed.

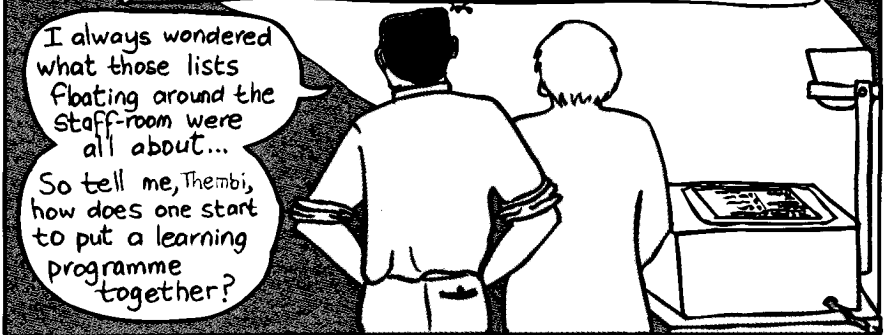


LEARNING PROGRAMMES must take into account the **CRITICAL and SPECIFIC OUTCOMES** which have been set by the **NATIONAL DEPARTMENT OF EDUCATION**.
 OUR **NEW NATIONAL CURRICULUM** has been organised into

8 AREAS of LEARNING

The **CRITICAL OUTCOMES** apply to **ALL** the **8 AREAS of LEARNING!**
 In turn **EACH** AREA OF LEARNING has its own **SPECIFIC OUTCOMES.**

- The 8 AREAS of LEARNING.**
- | | |
|--|-------------------------------------|
| ① Communication, Literacy and Language learning. | ⑤ Culture and the Arts. |
| ② Numeracy and Mathematics. | ⑥ Economic and Management Sciences. |
| ③ Human and Social Sciences. | ⑦ Life Orientation. |
| ④ Natural Sciences. | ⑧ Technology. |

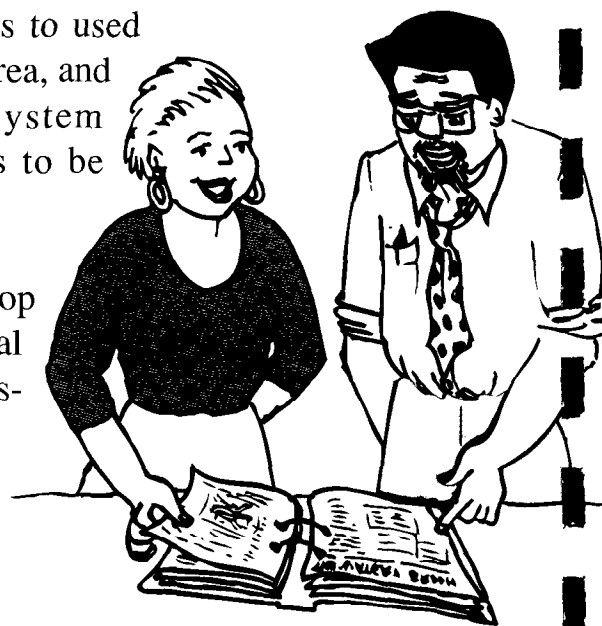


INTRODUCTION TO THIS FILE

•FOCUS

The ideas given in the file focus mainly on what happens to used water (called sewage) in the greater Durban Metropolitan area, and how and why people should use the sewerage system responsibly if community and environmental health is to be ensured.

Ideally, teams of teachers should use this resource to develop cross-curricular Learning Programmes based around a local sewage issue. This approach is well suited to Outcomes-Based Education.



•ABOUT THIS FILE

This resource is not a text-book, nor is it a recipe for a Learning Programme. It has been developed as a 'toolbox' of ideas related to sewage disposal issues which you, the teacher, can use and adapt to develop exciting Learning Programmes that are relevant to your pupils.

The file format has been used as it allows you to 'grow your toolbox' as you find new resources and relevant articles. Worksheets or activities which you, your colleagues or your pupils have developed or adapted can be added into the appropriate sections. You may even wish to add new sections!

Some guidance is provided about an issues-based approach to Learning Programme development. This is just one of the ways to develop a locally relevant curriculum. Over time you may wish to adapt some of these ideas to better suit your situation and experience.

Durban Metro would like to hear your views on how this file, the infosheets or the activities could be improved.

Write to: The Education Division
Dept. Wastewater Management
PO Box 1038
Durban
4000

•FILE LAYOUT

In this file you will find:

Pink Sheets - Introductions:

These include information about this file, some background on Outcomes Based Education (OBE), and guidance on issues-based teaching.

Green sheets - Infosheets:

These provide background information on sewage related topics and will help you in your preparation of lessons.

White sheets - Activity Sheets:

Each infosheet is supported by a range of activity sheets, which will help suggest ways in which learners can participate in the lesson(s).

Beige Sheets - Support Sheets:

This section includes:

- An answer sheet.
- OBE support materials, including an example of a lesson plan and lists of specific outcomes for all 8 Areas of Learning.
- Useful addresses and phone numbers. These organisations can either provide resource materials, answer sewage related questions or offer workshops and courses related to sewage.
- A glossary.

Back pocket:

Resources included with this file:

- An A2 poster of the Northern Sewage Treatment Works.
- An A2 poster of stormwater drains and sewers.
- An A2 Durban Metro Sewerage Map.
- An Envirofact Sheet: Wetlands.

You will need these resources for some of the activities included in this file.

•EXPLANATIONS OF WORDS

Throughout the file you will find some words written in bold type. These are explained in the section called "Glossary".



INTRODUCTION TO ISSUES-BASED TEACHING

Issues-based teaching should always be interesting, relevant and flexible.

Critical Outcome Number 1: Identify and solve problems in which responses display that responsible decisions using critical and creative thinking have been made.

Where different teachers are responsible for different Learning Areas, it is recommended that a *team-teaching* approach be adopted when developing issues-based learning and teaching programmes.

Exposing learners to experiences that are real to them in their life is good education practice. Learning involves the mind, the body and the emotions. All these are naturally stimulated into action when locally relevant issues are focused on at school. This approach is called *issues-based teaching*.

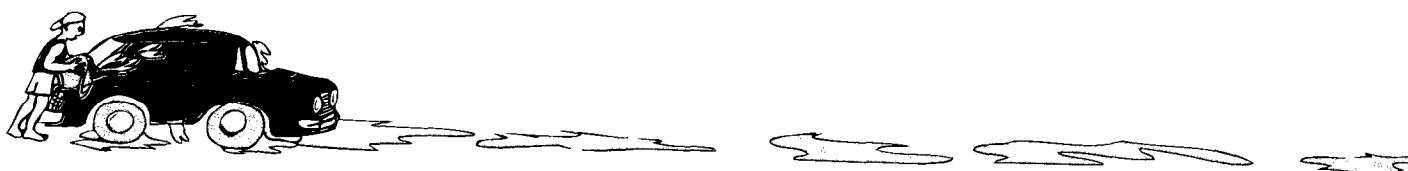
Issues-based teaching strongly supports the achievement of *Critical Crossfield Outcome No. 2* as it follows a problem-solving approach to learning.

The following 'steps' offer one set of suggestions on how you, the teacher, can select appropriate learning activities, teaching methods and specific outcomes when dealing with a local sewage issue.

Plan for learners to:

1. participate in recognising the problem.
2. explore the problem through 'hands-on' activities.
3. identify and understand all the facets of the problem.
4. develop possible solutions to the problem.
5. embark on group action to resolve the problem.

These 5 steps are described in more detail, with examples, below.



1. RECOGNISING THE PROBLEM

The teacher, preferably together with colleagues and learners, selects a local issue. Some local sewage-related issues may include:

- the poor state of the school toilets.
- blocked, overflowing street sewers in your community.
- an epidemic of gastroenteritis in the community.

Arrange for learners to visit the site of the sewage issue, or hand out relevant photographs, drawings, cartoons or newspaper clippings.

Discussion, debate, role-play or written responses are a variety of ways in which the problem can be 'recognised' by the learners.

2. EXPLORING THE PROBLEM FURTHER

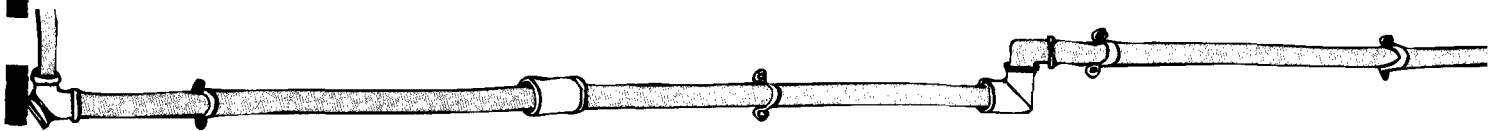
IMPORTANT! This file includes InfoSheets and Activities covering a variety of sewage-related topics. There are strong links between most of these topics. For easy reference they have been divided under the following headings:

- sewage and waterborne sewerage systems.
- sewage treatment.
- sewerage system problems.
- sewage disposal and health.
- sewerage tomorrow.

Working from front to back is probably not the best way of using this file. It is recommended that teachers first familiarise themselves with the infosheets and activities in this file in order to select the most appropriate starting activities and to develop the learning and teaching programme in a logical way in response to the learners.

When exploring your local sewage issue further, start with activities immediately related to that issue. For example, if the school toilets are the issue, explore the problem further by starting with the activity: *School Toilet Audit*. The activity: *A Day with the Drain Doctor* would be a more suitable activity for exploring the problem of blocked, overflowing street sewers. A project on Waterborne Diseases would be a useful activity to begin exploring the issue of a gastroenteritis epidemic in your local community.

Teachers will need to adapt the activities to suit the 'level' of their learners



3. IDENTIFYING AND UNDERSTANDING THE FACETS OF THE PROBLEM:

As the learners explore their issue, the many different facets of the problem will begin to emerge. The teacher who is familiar with the infosheets and activities in the file will then be able to develop the programme in response to 'discoveries' made by learners, interests expressed by them or questions asked by them. This allows for a natural, more logical progression in the learning and teaching programme.

For example, after exploring the state of the school toilets, learners may be asking whether the toilets are a health hazard. Others may be wondering to where the sewage flows. In order to understand the facets of the problem further, it would now be appropriate to introduce the activities following the infosheet *Sanitation Saves*. Should your learners be more interested in finding out to where the sewage flows, it would be appropriate to move on to the activities following the infosheet *Different Drains*, followed by a visit to a sewage treatment works and the activities related to that topic. The learning and teaching programme can then develop until all the facets of the topic are explored fully and satisfactorily.

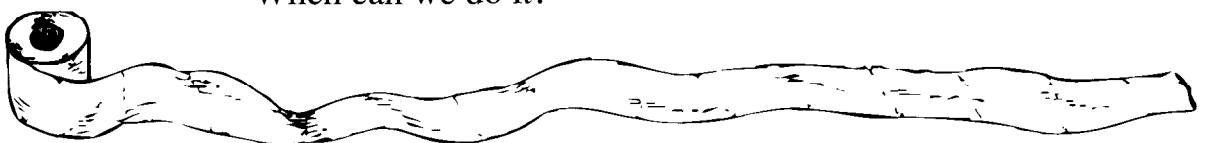
Note: It is possible that it may become necessary to explore facets of a problem that are not covered in this file. Teachers are encouraged to develop their own activities in response to these facets rather than ignore them. It is good to maintain flexibility, but be sure to remain on track!

4. DEVELOPING POSSIBLE SOLUTIONS TO THE PROBLEM:

IMPORTANT! As learners move towards meaningful action, expect them to re-visit some of the earlier 'steps' again and again. Reflecting, re-planning and re-doing are usually part of any successful Action Plan!

Some useful questions that learners could ask themselves when developing solutions could include:

- What can we do?
- How will we do it?
- Who will do it?
- Will it cost money?
- When can we do it?



5. EMBARKING ON GROUP ACTION TO RESOLVE THE PROBLEM:

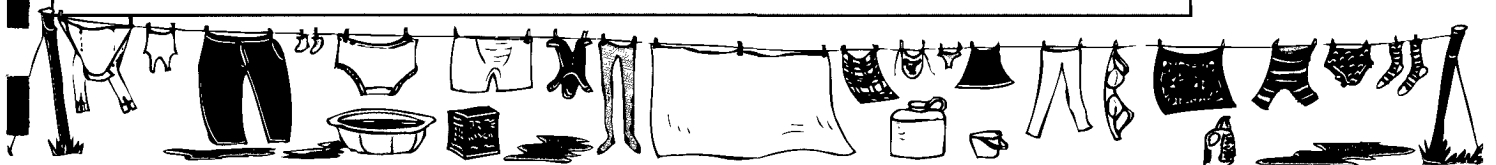
Solving problems is never simple. It often requires co-operation and interaction between a wide range of people and organisations. The time-frame set by teachers should be long enough to allow learners to deal with a particular issue meaningfully. Be sure to allow enough time for action to take place!

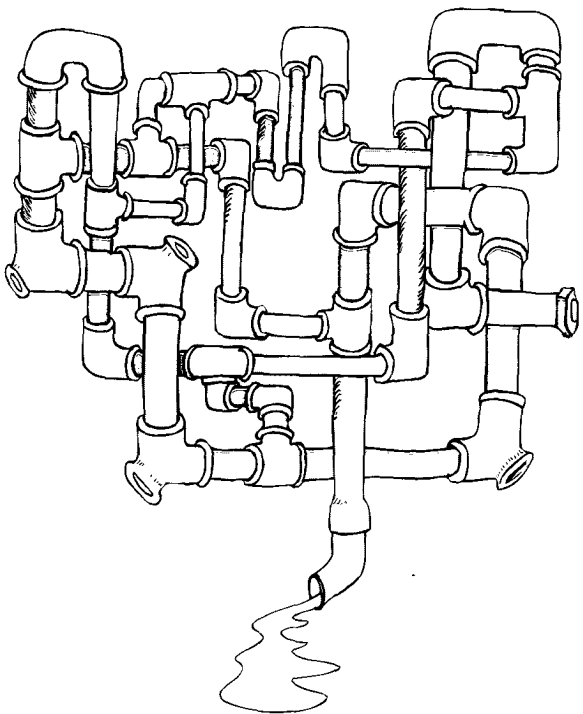
SELECTING SPECIFIC OUTCOMES:

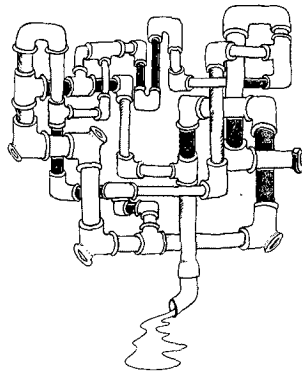
Appropriate Specific Outcomes can be clustered from across all 8 Learning Areas according to the type of issue being addressed, and the ways in which learners and the teachers from various Learning Areas involve themselves in the issue. Remember to look out for the unexpected or co-incident Outcomes that emerge during the learning and teaching programme.

Depending on how the activities are used by different groups of teachers in different schools, it is likely that slightly different sets of Specific Outcomes will apply. The following is a set of Specific Outcomes for the activity *A Day With the Drain Doctor* (see pages H.3 and H.4). It is offered here merely as an example of a set of appropriate Specific Outcomes that may be selected. Yours may differ...

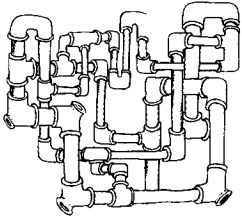
•ARTS AND CULTURE	SO6; SO7
•NATURAL SCIENCES	SO2; SO4; SO5; SO9
•TECHNOLOGY	SO1; SO2
•MATHEMATICAL LITERACY, MATHEMATICS AND MATHEMATICAL SCIENCES	SO1; SO2; SO4
•ECONOMIC AND MANAGEMENT SCIENCES	SO2; SO5; SO7; SO8
•LIFE ORIENTATION	SO2; SO4; SO7; SO8
•LANGUAGES, LITERACY AND COMMUNICATION	SO1; SO2; SO3; SO4; SO5; SO6
•HUMAN AND SOCIAL SCIENCES	SO3; SO4; SO6; SO7







sewage & waterborne
sewerage systems



infosheet

WATER: THE LIQUID BROOM

Everyday people in homes, offices and schools use water for drinking, washing, flushing the toilet and preparing food. Industries also use water when making their products. All dirty, used water which goes down the plugholes, toilets or drains is called **sewage**. Many parts of the Durban Metropolitan Area are serviced by a **waterborne sewerage** system. This means that water is used as a 'broom' to sweep up and carry away some types of waste. The dirty water enters a system of underground pipes which direct it to a sewage treatment works. In a typical **metropolitan** area like Durban, 60 to 80% of all water used everyday goes down the sewage pipes. Sometimes sewage is also called 'wastewater'.

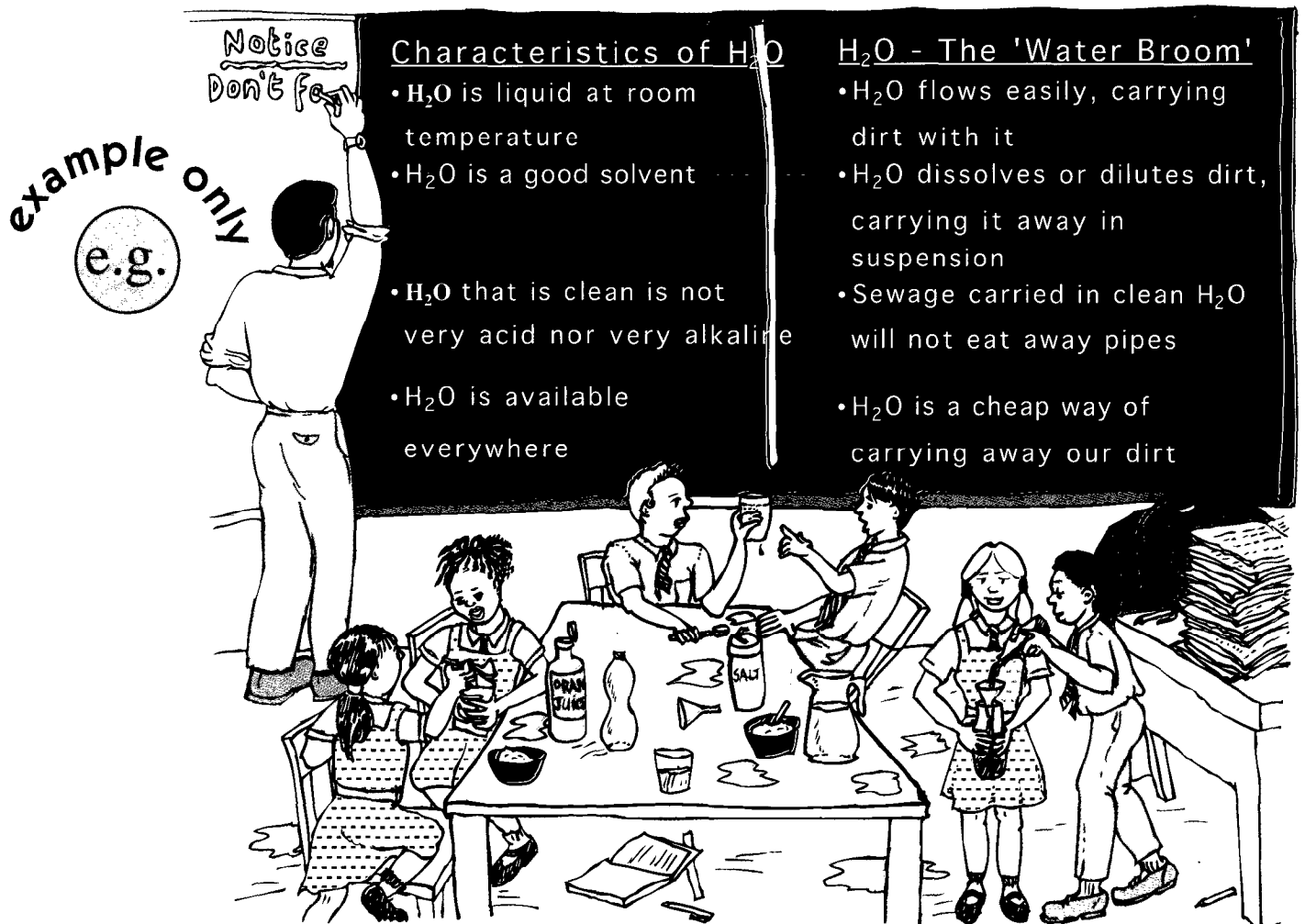




INVESTIGATING THE 'WATER BROOM'

Hand out cups of clean water to the class and have them participate in a discussion on why water is such a useful 'broom' for carrying away 'dirt' and other matter. This exercise should be guided by the teacher, but with the learners contributing the ideas. In the course of the discussion learners should taste and smell the water, measure the pH, dissolve sugar / salt in it, dilute orange juice and pour it into containers of different shapes.

Now ask learners to think about how each characteristic of water helps to make it such an effective 'broom' for carrying away sewage from our homes. Their ideas should be written up. The format given on the blackboard may be useful.



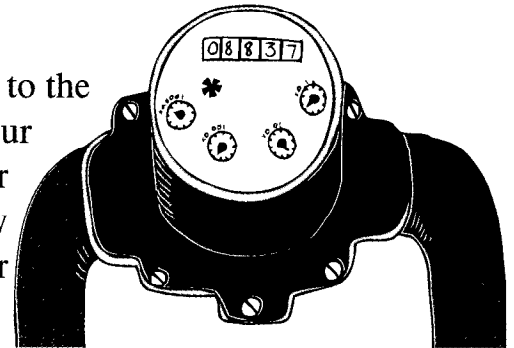
Hold a class discussion on how the Durban Metro area benefits from a waterborne **sewerage** system.



USING THE WATER-BROOM WISELY

It costs lots of money to produce clean water. Enough water-broom has to be used to ensure good hygiene and sanitation, but we should make sure that it is not wasted unnecessarily.

Find your school or home water meter. It is usually fitted to the place where the water pipes from the reservoir enter your school or house. Make sure that you can read the number on the meter. Read this number at the same time everyday for 6 days in a row. Record your readings on your 'Water-use record sheet'.



remember:
1 kilolitre = 1000 litres

Prepare your own Water-Use Record Sheet:

DATE	DAY	TIME	READING (in litres)	LITRES USED (in a day)
2 June	Mon	08:00	617730.68	
3 June	Tues	08:00	637730.68	20000
4 June	Wed	08:00		
5 June	Thurs	08:00		
6 June	Fri	08:00		
7 June	Sat	08:00		



•Each day work out how many litres have been used. Do this by doing a subtraction sum, for example:

$$\begin{array}{r} 63\,7730.68 \\ -61\,7730.68 \\ \hline 20000.00 \text{ litres} \end{array}$$

•To find out the average amount of water you use in a day, first add up the litres you used each day. Divide this total by the number of days you have recorded, for example:

$$148\,000 \text{ l} \div 6 = 24\,666 \text{ l per day}$$

•60 - 80% of the water used each day goes down the sewer as sewage. Work out how much water your school or home uses each day as a 'liquid broom'. This is done by working out 60% of your daily average, for example:

$$\frac{60}{100} \times 24\,666 \text{ l} = 14\,799.6 \text{ l per day}$$

$$\frac{80}{100} \times 24\,666 \text{ l} = 19\,732.8 \text{ l per day}$$

Do this for 60%, 70%, 75%, 80%

•In South Africa water is a scarce and precious resource. It also costs lots of money to clean it up and pipe it to homes and schools. By working more carefully, less of the watery-broom needs to go down the drains each day. How much water could your school or home save if you worked towards allowing only 60% instead of 80% of the daily amount of water used at present to flow down the drain as sewage? Do a subtraction sum to work this out, for example:

$$\begin{array}{r} 19\,732.8 \\ -14\,799.6 \\ \hline 4\,933.2 \text{ l per day} \end{array}$$



it's a fact!
saving water
makes cents



DIRT DETECTIVES

•Ask Learners to observe and draw up lists of all the matter that flows, together with water, down the sewage pipes in their homes and at their school. This can take place over a number of days. The final list should show the place where the sewage enters the sewerage system. See the table below.

HOME				SCHOOL			
BATHROOM	KITCHEN	LAUNDRY	OUTSIDE SINK	KITCHEN	TOILETS	HOME-ECON ROOM	SCIENCE LAB
Toothpaste soluble non-living biodegradable							

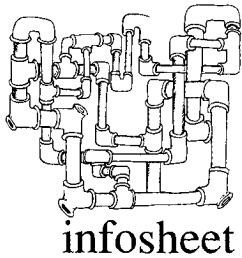
•Draw up a list on the blackboard, combining all the information from learners' lists. This is also an opportunity to introduce some of the more formal synonyms (such as faeces or urine) for a variety of common terms that will no doubt be used.

Expect lots of giggling and blushing!
Remind the learners that everybody has to 'go' - including the headmaster and the state president!

•Explain and discuss the characteristics of the terms **living** and **non-living**; **soluble** and **insoluble**; **biodegradable** and **non-biodegradable** (refer to the glossary if necessary). Where possible, learners should match the relevant terms to the 'dirty' items which are listed in their table.

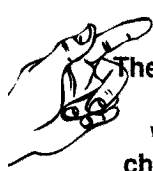
•Explain to learners that matter that does not float or get suspended will settle to the bottom of sewer pipes and lead to a blockage. Ask learners to circle items on their lists which should not be put into waterborne sewage systems. Ask learners to discuss other ways of getting rid of wastes that should not go down the sewage pipes.





YESTERDAY'S WATER IS TODAY'S WATER IS TOMORROW'S WATER

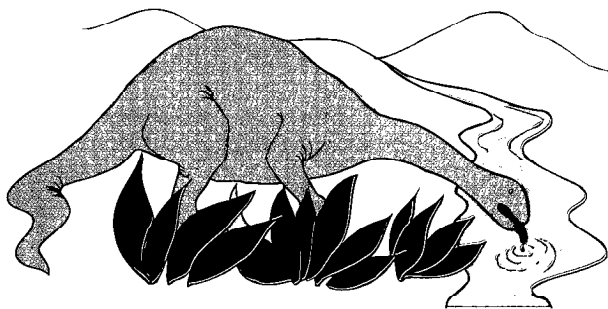
Nothing can live without water! But it cannot be made, it can only be borrowed from nature. Once the plug is pulled or the toilet flushed, all the used water will eventually find its way back into the rivers and oceans where it once again joins the natural water cycle.



it's a fact!
The total volume of water in the overall water cycle has not changed since the days of the dinosaurs

Nature has a number of ways of cleaning water. However, the **sewage** from houses, schools, office buildings, farms and factories contains all types of chemicals and materials that are not naturally found in our rivers and oceans. Some of these chemicals are poisonous and can be very dangerous, even in very small amounts. Other wastes such as human

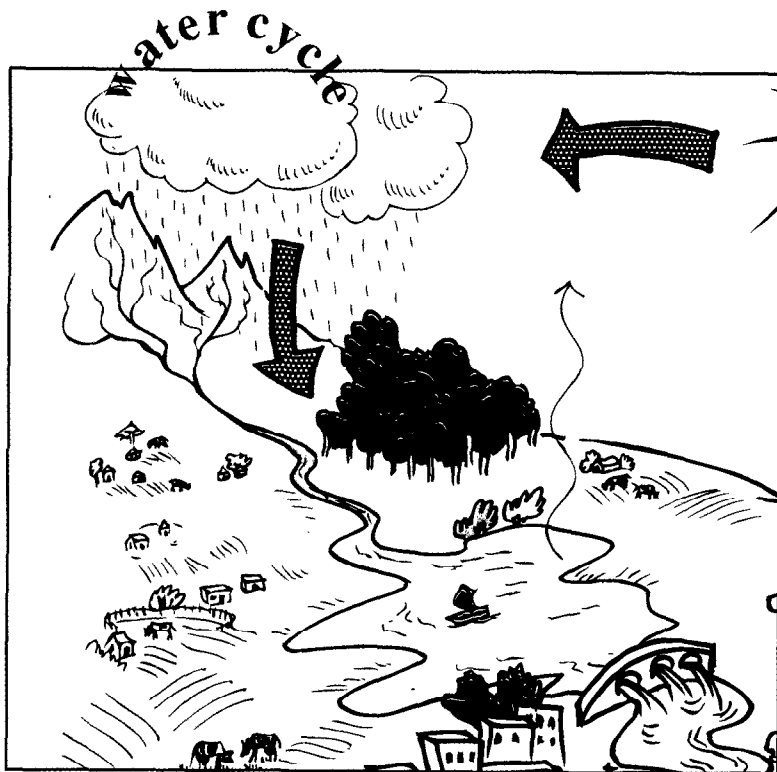
faeces are produced in such great amounts that natural systems simply cannot cope with breaking them down. If we, our great-grandchildren and the natural environment are to stay healthy, we need to work with nature by 'cleaning up' or treating our sewage before it is put back into the rivers and oceans.



In crowded parts of the world, the water which leaves one town or city will be used again by another, further down the river. This is one very good reason why we should use water carefully and not pollute it. **THE WATER WE POLLUTE TODAY MAY BE THE WATER WE HAVE TO DRINK TOMORROW!**



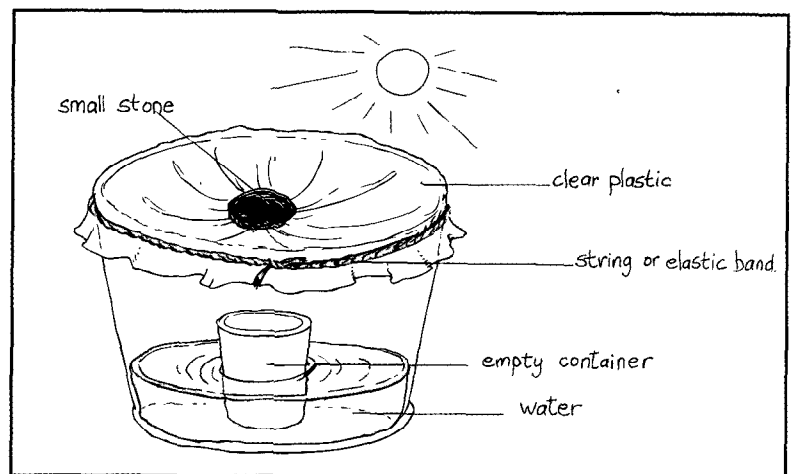
WATER HAS NO BEGINNING AND NO END

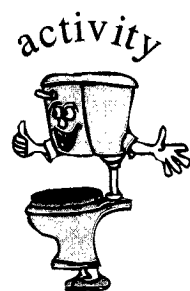


- ★ Plan and present a participative lesson on the water cycle. Support your discussion by drawing a picture of the cycle on the board, or by using a poster. The sketch opposite may help you with your drawing. A poster on the cycle can be purchased from Umgeni Water (See useful addresses in the beige Support Sheets).

★ MAKE YOUR OWN WATER CYCLE:

- Set up the opposite demonstration and have the pupils draw it into their workbooks.
- Learners need to record the date, season, weather, time of day and length of time over which the demonstration is monitored.
- In point form, have the learners write a description of what they see happening to the water.
- Ask learners to provide reasons for what happens to the water during the demonstration.
- Repeat the demonstration under different weather conditions, and / or different times of the day. Learners should compare results and explain any differences.





CYCLES WITHIN THE CYCLE

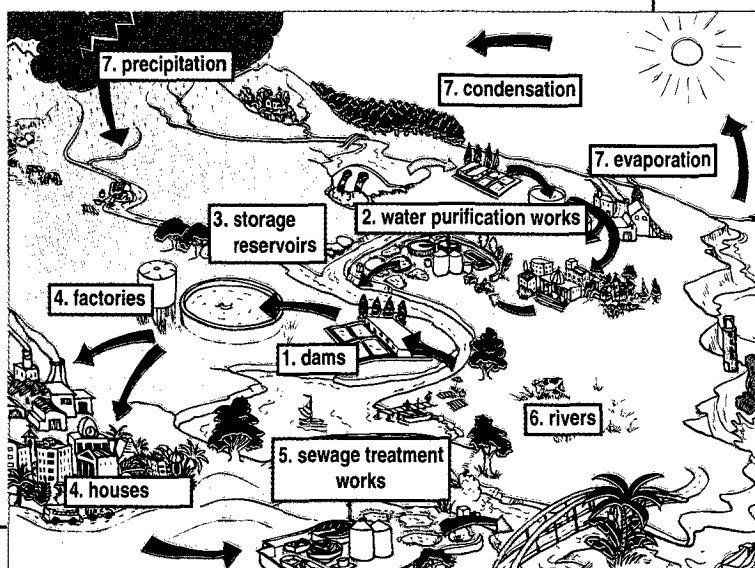
People need water for many purposes, including living, household use, recreation and industry. As water is a limited resource that has to be used over and over again, century after century, people have created their own water cycles within nature's great water cycle. By doing this we can ensure that everyone enjoys the benefits of water and a healthy, natural environment now and in the future.

- Photocopy and hand out to each learner a copy of the 'Man-Made Water Cycle'. Ask learners to fill in the wording.

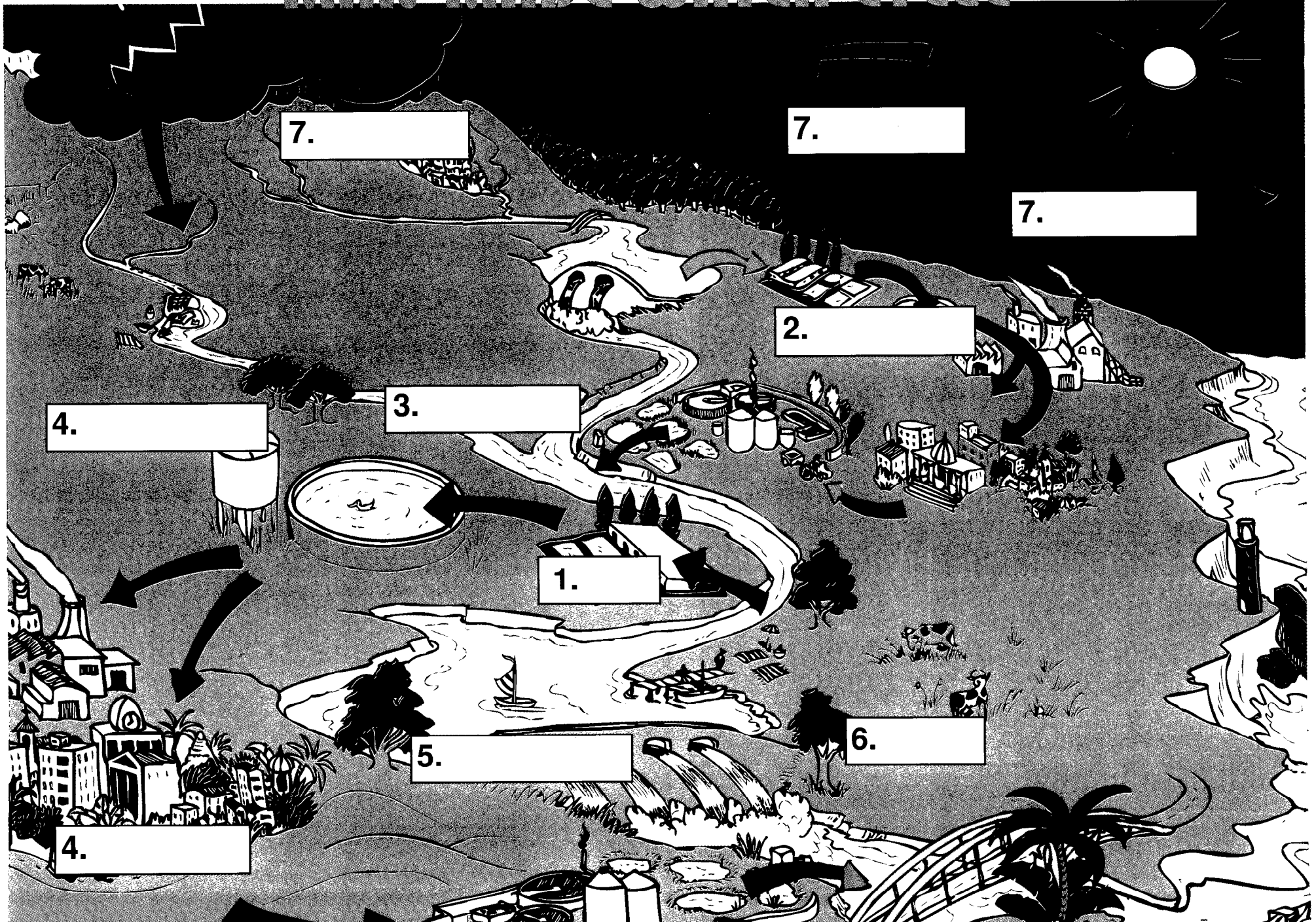
• If necessary, the following information can be used to lead learners through the exercise:

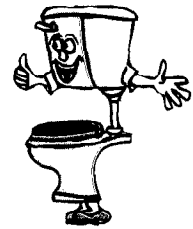
1. Some rivers flow into dams (constructed by people) before eventually flowing out into the sea.
2. Water is drawn off a dam and piped to a waterworks (constructed by people) in a particular area. Here the raw water goes through a purification process which involves the uses of certain chemicals. This includes the use of chlorine which kills disease-causing germs in the cleaning process.
3. After purification, the water is stored in reservoirs (constructed by people).
4. From here, water is piped to our homes, factories and other places where water is used. The water becomes dirty after use.
5. All the water that flows down the drains, for example bath water, washing and cooking water and water flushed down the toilet, is piped to a sewage treatment works where it is 'cleaned up' to certain standards.

6. After treatment, the sewage effluent is once again released into the river course to eventually flow into the next dam from which the cycle is repeated.
7. Water from the rivers, dams and sea also evaporates and is present as water vapour in the atmosphere. The water vapour in the atmosphere condenses to form clouds. When the water vapour in the clouds becomes cold and gets heavy it falls back to earth as rain, hail or snow.



MAN-MADE WATER CYCLE

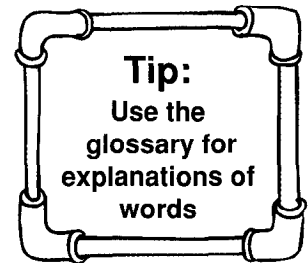




WETLANDS - NATURE'S WATER TREATMENT WORKS

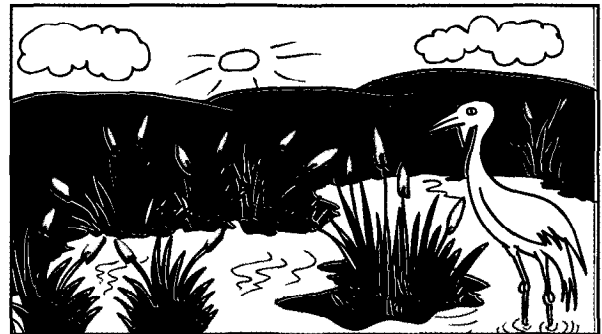
Wetlands, such as swamps, mangroves and vleis, are very important places. One of their most important roles is to clean water. They are very good natural filters that can trap:

- **sediments**
- **nutrients** (including nitrogen and phosphorus)
- **pathogenic bacteria** (disease-causing germs)
- **some heavy metals** (including mercury and lead)
- **some pesticides**



The water leaving the wetland is cleaner than the water entering it!

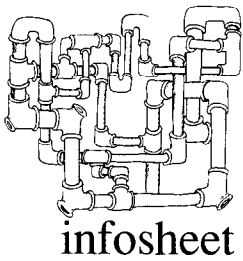
- Plan for the learners to do a project on how wetlands 'clean' the water. They would need to visit the local library. Should your library not be well equipped, you could use the Enviro-Fact Sheet called "Wetlands", which is included in the file pocket at the back of this file. You could also order the low cost booklets which are suggested in the 'Bright Idea' box.



- Plan an excursion to a wetland close to your school, or to a mangrove swamp. To visit the mangroves you will need to phone either the Natal Parks Board (ph: 251271) or Portnet (ph: 3618751).
- Explore the concepts of **renewable** and **non-renewable resources** with the class. Ask learners to categorise water as a renewable resource and to explain the role that wetlands play in making water renewable. Their explanations can be written up as posters.



The 'Hands-on' booklets, "Vlei and Wetlands" and "East Coast Estuaries and Mangroves" will be of use for your preparations. Both are obtainable from Umgeni Water or Share-Net.



A STINKING SAGA: THE HISTORY OF SEWAGE DISPOSAL



Sewage disposal's history began with people moving into the cities. Walking down a city street in days of old was a risky business. After washing up and cleaning, residents of homes would simply throw the sewage out the door! You had to be quick to avoid getting soaked with a bucket of dirty, smelly water! The Romans were the first to build sewer channels and pipes. They gave nature the job of cleaning the polluted water by directing the sewage into the rivers and sea. Most major civilisations copied these ideas.



Cities were often plagued by diseases such as cholera and typhoid. Thousands and thousands of people died. In 1848, a London doctor, John Snow, finally discovered the link between disease and polluted water. City authorities made plans to **discharge** the sewage downstream from where the population's drinking water was taken.

Did you know?

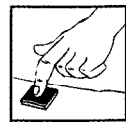
Londoners called 1858 'the Year of the Great Stink'. And in Australia, the city of Melbourne earned the name of 'Marvellous Smellbourne'.



For many years the system of emptying household sewage into open drains carried on. This mixed with wastes from stables and industries in open street channels and became extremely smelly! The rivers became open sewers that flowed into the nearest bay. In 1858, so much sewage poured into the River Thames in London that Members of Parliament could not work in the Houses of Parliament because of the smell.

Eventually, during the **Industrial Revolution**, so many people moved to bigger cities that it became necessary to introduce a system to help nature treat the sewage. Some of the principles introduced then still continue today. But it was not until the 1970's that the whole world started to realise that lakes, rivers and seas were dying because of all the raw sewage that was being dumped into them. Sometimes evidence of the sewage even washed up onto public swimming beaches! More and more cities realised that, whatever the expense, **sewage treatment works** are needed if people and the environment are to stay healthy. These works 'clean-up' the sewage before it is returned to nature.





PHOTOCOPY

SEWAGE DISPOSAL IN DURBAN'S PAST: 1875 - 1897

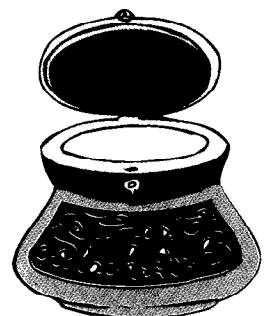
bright idea!
Follow the history
further for later years
by doing research at
the Don Africana
Library

- Read the following pages of extracts from the Durban Mayor's Minutes for the years 1875 to 1897. These minutes were presented to the town councillors in July of each year. Copies of the Minutes are stored at the Don Africana Reference Library, which is situated in BP Centre, corner of Aliwal and West Street, Durban.

The extracts give information about how sewage was disposed of in Durban from 1875 up until 1897, the year after the first **waterborne sewerage** system started working. This 'new' sewerage system helped a lot to improve health standards in the Borough of Durban, especially among small children. Many of the ideas used in this sewerage system are still used today.

bright idea!
It may be great
fun to role-play
some of the
extracts

- Working in small groups, discuss each extract to make sure that you understand it properly. Where necessary, use a dictionary to explain words that you do not know. It may be useful to re-write all or some of the extracts using language that is easier to understand.
- Write a short essay (between half and three quarters of a page) on the history of Durban's Sewage Disposal: 1875 - 1896. You will need to summarise much of the information you have been given. Be sure to choose the most important and interesting points. The final essay should be fun to read.
- There are still parts of the Durban Metro area that do not enjoy the benefits of waterborne sewerage. In fact, in some informal settlements, there is no sewerage available at all! Compare and discuss life in these areas today, with life in Durban in the late 1800's.



Mayor's Minutes July 1875:

The 1000 galvanised iron pails...when tarred will be ready for use. A pattern Night Soil Cart has been made... Premises...have been purchased...in view of forming a depot for the deposit of Night Soil.

Mayor's Minutes July 1876

The new pail system is now in perfect order with scarcely a complaint. The greatest relief is felt everywhere in Town... ..the Night Soil is removed every 48 hours, and clean pails left in place of the ones removed. This removal commences at daybreak, with hand-barrows...

Mayor's Minutes July 1878

The only sewage which has not received any attention whatever, being 'slops', which means greasy, soapy, vegetable and otherwise dirty water, with a small proportion of urine. It is scarcely necessary to remark upon the present unhealthy, obnoxious, and dangerous means now adopted of throwing slops into the streets, gardens and yards.

Mayor's Minutes July 1881

It is estimated that for a daily removal of slops from the town, 7 400 gallon carts, and at least 16 horses would be required... The prevailing custom of throwing slops into the flood water drains, never intended for such purpose, is now, with the population growing so rapidly, becoming a serious nuisance..

Dysentery and Diarrhoea were prevalent almost the whole year... ..the deaths of the numbers of infants...swells considerably the lists of mortality.

Mayor's Minutes July 1882

The present site of the Night Soil Depot is found to be a serious impediment... A specially constructed pail to be used as a Urinal has been supplied to the hotels and public places, which is removed daily by the slop carts.

Mayor's Minutes July 1883

...the Night Soil is now removed outside the Borough...

...diarrhoea and dysentery were raging with severity the most part of the year.

Mayor's Minutes July 1887

There is a shady side...the enormously great infant mortality. If we could find, and probably remove, the cause of this great mortality of infants, this town would be the healthiest inhabited place on the face of the earth.

(The water supply) quality has always been excellent...it is entirely harmless.

Mayor's Minutes July 1888

...the infant mortality...from year to year takes more serious dimensions. ...it would be worth spending a large sum of money (to get) some great Medical Authority to advise us how to avoid the death of so many of our children.

Mayor's Minutes July 1889

The present method of removing Night Soil by means of pails, and of slops by tanks of wheels, is partial and offensive... The adoption of a...reliable system for the automatic collection and disposal of sewage of the Borough is now a question of supreme importance to the inhabitants of Durban. ...The main principle...consists in the use of two perfectly separate sets of drains, the one for surface water and the other for sewage matter.

Mayor's Minutes July 1890

The great complaint of the year, Dysentery, spread the whole year and attacked all ages and both sexes with equal severity.

Mayor's Minutes July 1891

...the Bill duly authorising a complete and satisfactory (sewage) system...has been passed through the Legislative Council... That this work, when completed, will prove of incalculable advantage to the Town I need hardly say.

The mortality from Enteric Fever, Dysentery and Diarrhoea...has been very great. However, these may be looked upon as preventable diseases, and I anticipate a great improvement in the mortality from these diseases, as the sanitary condition of the Borough improves under the now copious water supply, and the sewage scheme which is about to be undertaken.

Mayor's Minutes July 1893

Until the full works of the Umlaas Water (Supply) Scheme are in working order, the present sanitary system is preferable to an imperfect and incomplete sewerage scheme - ample water for flushing...is of paramount importance.

Mayor's Minutes July 1894

This work (on the sewage scheme) has been commenced during the year...

It is proposed to establish a museum of sanitary appliances so that all interested property owners may have the means of readily acquainting themselves with the best principles...however perfect the sewers may be, without proper house sanitation, it will not be possible to secure those health conditions which such works are intended to afford.

The usual difficulties have been experienced in carrying out the (Night Soil) service satisfactorily. It will afford this Department immense relief, and advance sanitation generally, when the long-looked-for Sewerage Service, now in progress and construction, will do away with this and all waste liquid services in the Town.

Mayor's Minutes July 1896

It is a matter for congratulations that our Sewage System...has now reached that stage of completion... Many of our principle buildings are already enjoying the new system and as rapidly as possible house connections will be made, until the whole town is served.

We are fortunate in having...the Indian Ocean to receive our sewage, saving us as it does all further expense and anxiety as to its disposal. At the outfall works, on a distant beach, the sewage is treated first by dilution, and subsequently by double screenings...the effluent being merely discoloured water (which is) discharged into the ebb tide... The screenings are at once conveyed to the 'refuse destructors' where they are destroyed in furnaces at a temperature of 1500 degrees Fahrenheit, and so finally disposed of.

Within...the Point and Town Districts, the night soil is removed by handbarrows and rapidly disposed of in the sewers through special receivers; from the outside districts it is conveyed in carts to convenient points for disposal into the sewerage system...

Mayor's Minutes July 1897

The Borough is to be congratulated upon the introduction of the Sewage Scheme... It is hoped that...a proper sewerage service is extended to the whole Borough, in substitution for the present Night Soil System, which...has the danger attached to it of disseminating...Dysentery...by splashing of the buckets into the streets and roads.



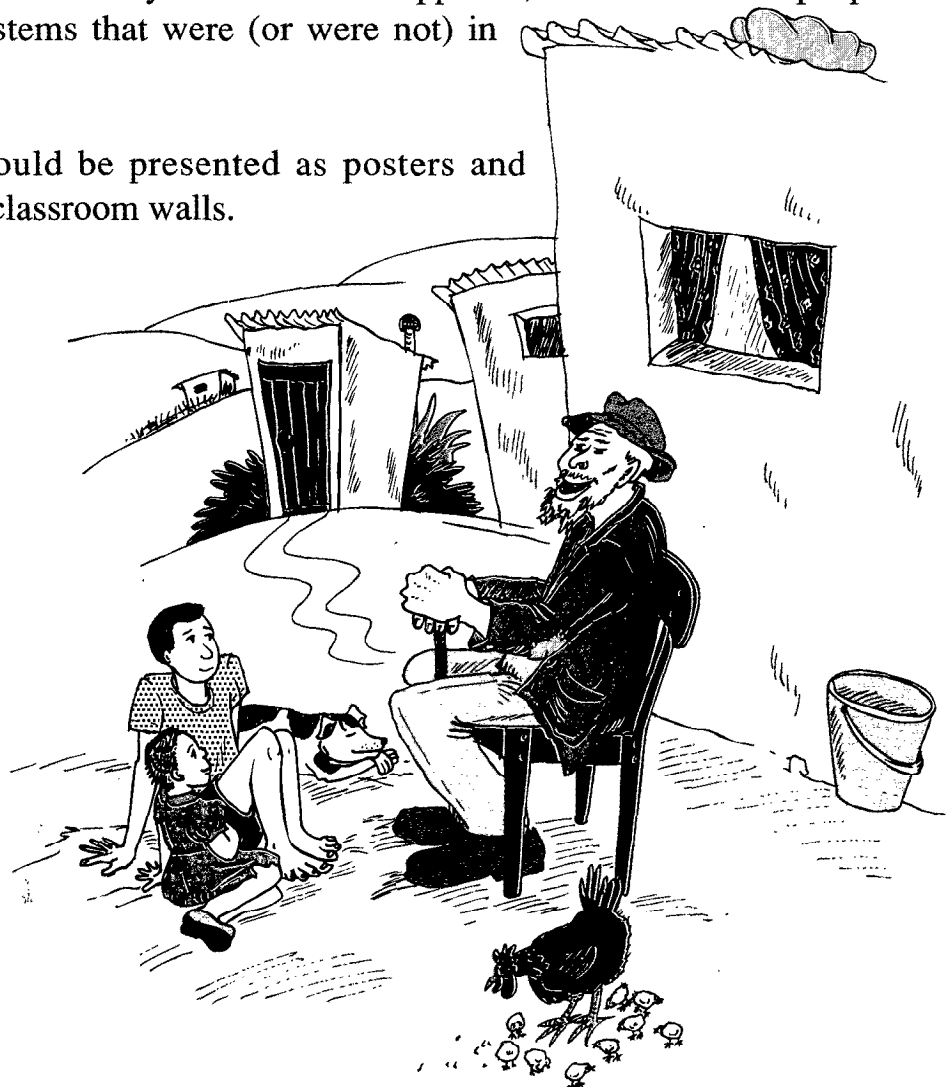
MY LOCAL SEWAGE DISPOSAL HISTORY

Working either alone or in small groups, ask learners to talk to a few old people in the community to find out how sewage was disposed of 20 - 50 (or more) years ago in that area. It may be useful to develop a questionnaire. (See activity: 'Sewage in Informal Areas', which follows the infosheet 'Plugholes, Pipes and Durban's Drains', for some ideas on questions.)

It would also be interesting to find out from these old people if and how sewage disposal in urban areas differed from sewage disposal in rural areas 20 - 50 years ago.

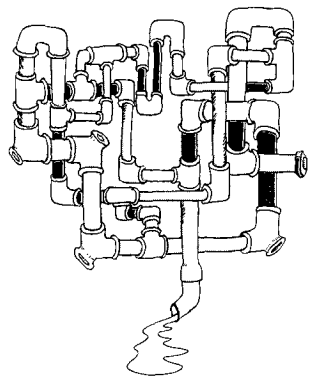
The learners should not only find out what happened, but also how the people felt about the systems that were (or were not) in place.

The findings should be presented as posters and displayed on the classroom walls.

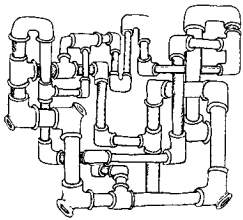


bright idea!

Invite an old person to come and share details about life 20 - 50 years ago



sewage treatment

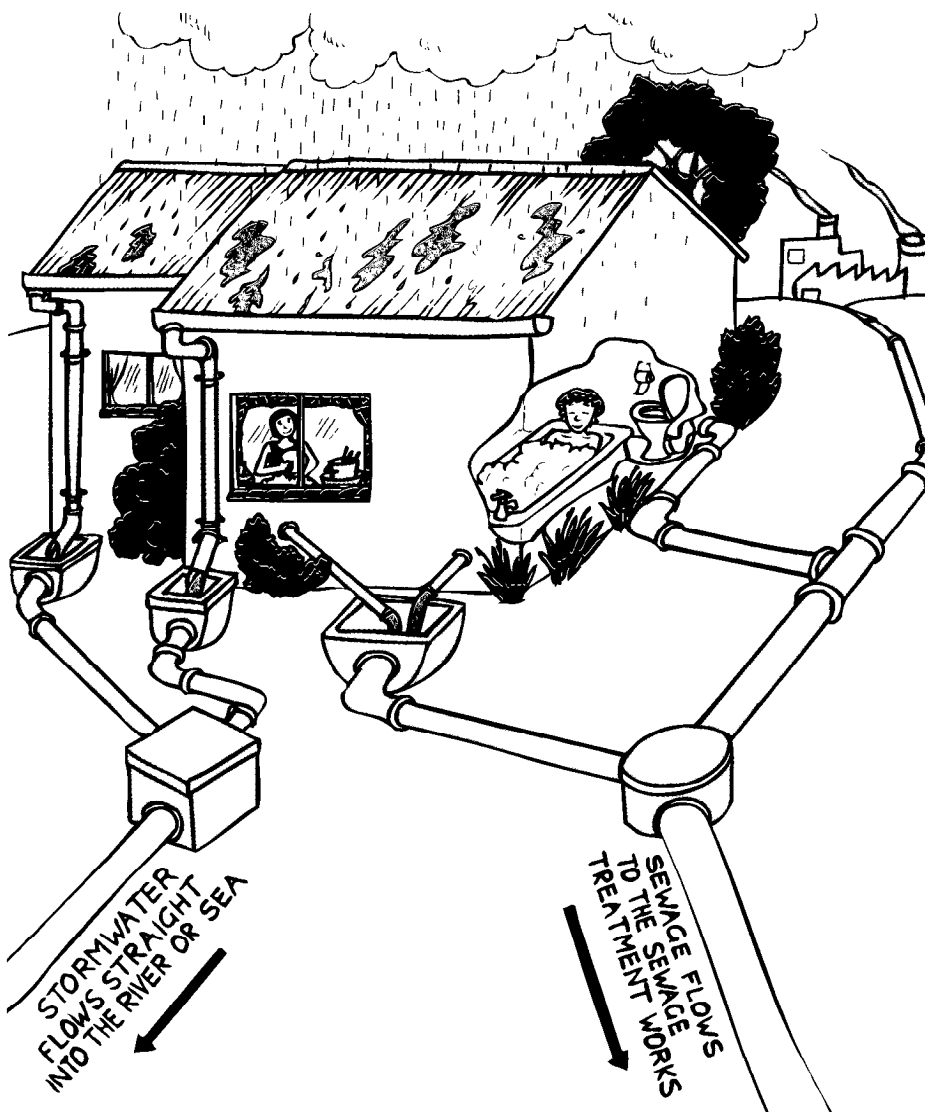


infosheet

PLUGHOLES, PIPES, DRAINS AND SEWERS

Drains are all around us. The ground, rivers and seas are natural drains. When people build houses, factories and streets, water cannot drain away naturally, so pipes and drains are built to do the job.

In Durban there are 2 separate drainage systems:



- The **waterborne sewerage** system carries used water from homes, schools, offices and factories. Over 5 500 km of pipes carry the used water to sewage treatment works for treatment before it is discharged back into the rivers and sea.

- The other is a stormwater system. Rainwater that runs off roofs, streets and pavements flows into stormwater drains. This is a 'straight through' system. Anything that moves along with the stormwater flows directly into the rivers or sea. It does not go through a treatment process.

It costs a lot of money to maintain and operate these sewage and stormwater systems.

VERY IMPORTANT!
Sewers and stormwater drains must **NEVER EVER** be joined!



If it is not suitable to visit an informal area, invite a resident to come and address the class and answer learners' questions.

SEWAGE IN INFORMAL AREAS

- Ask learners to conduct a **survey** of at least 5 houses in an informal settlement to find out what people do with their 'used' water . Learners should also establish whether toilets are available, what sort of toilets these are and whether the people actually use them.

It may be useful to draw up a questionnaire with the learners. Here are some ideas of what you may wish to ask:

House 3

- What happens to water used for cooking? _____
- What happens to water used for washing dishes? _____
- What happens to water used for washing clothes? _____
- What happens to water used for washing people? _____
- Are toilets available? _____
 - if yes, what type? _____
 - if no, where do people defecate / urinate? _____
- Does everyone use the toilets? _____
 - if no - who doesn't? _____
 - why not? _____
- Does the family get sick often? _____
 - if yes, who gets sick the most? _____

- Arrange for the class to share their findings and to write up a paragraph on sewage disposal in an informal settlement. The learners should also comment on their findings and suggest what can be done to solve some of the problems.

activity



DIFFERENT DRAINS

Introduction

- Using the poster 'Stormwater drains and sewers' which can be found in the pocket in the back of this file, present a participative lesson on the 2 different drainage systems operating in the Durban Metropolitan Area.



Participate in the
'Adopt-A-Drain Project'
which is run by the
**Keep Durban
Beautiful Association and
The Daily News.**
phone 3681587 for
more details.

stormwater drains

- Ask learners to brainstorm a list of all the litter and other materials that are found on the roads, verges and pavements that could get washed into the stormwater drains. Remind them that this is a straight-through system. Everything lands up in the rivers or in the sea! Ask learners to discuss why this is a problem.
- Photocopy and hand out the sheet entitled "If the River Could Speak". Ask learners to complete and colour the drawing of the stormwater outlet by adding in all the rubbish that was identified in the above activity. Have them write a short poem or essay using the suggested heading.

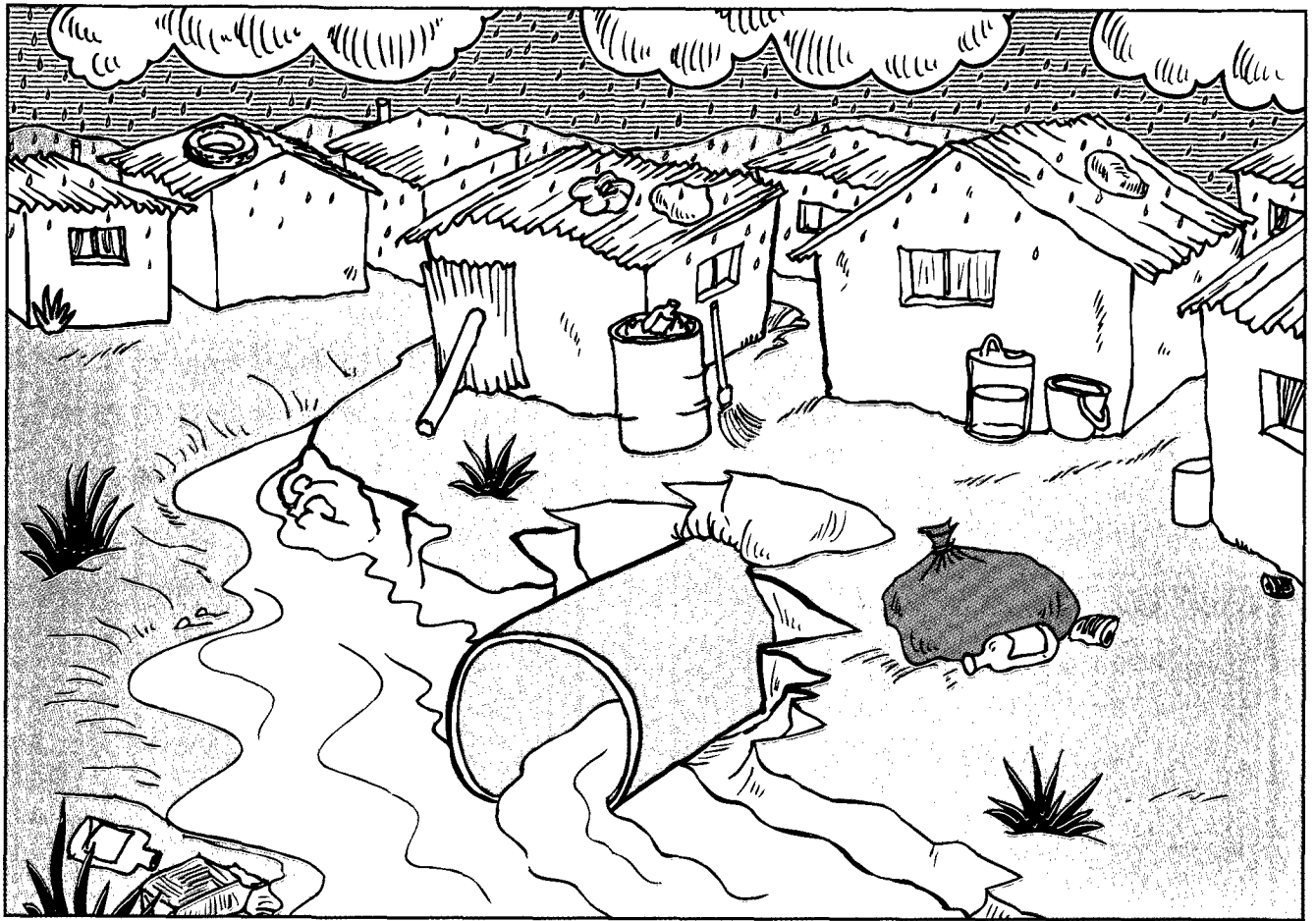
sewage pipes and sewers

- Learners could build a model of a house drain such as a kitchen sink or bath, leading into a street sewer. Any range of materials could be used, including recyclable waste (cooldrink bottles, cans, plastic), drinking straws, prestick and plaster of paris.



Learners could ask permission from their local council to paint logos onto the street stormwater drains.

- eg. • **THIS DRAIN IS ONLY FOR RAIN!**
- **DRAINS TO BUY!**
- **DUMP NO WASTE, DRAINS TO RIVER!**



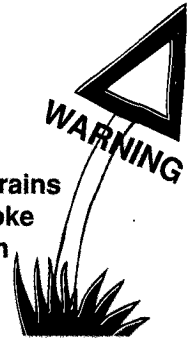
“IF THE RIVER COULD SPEAK!”



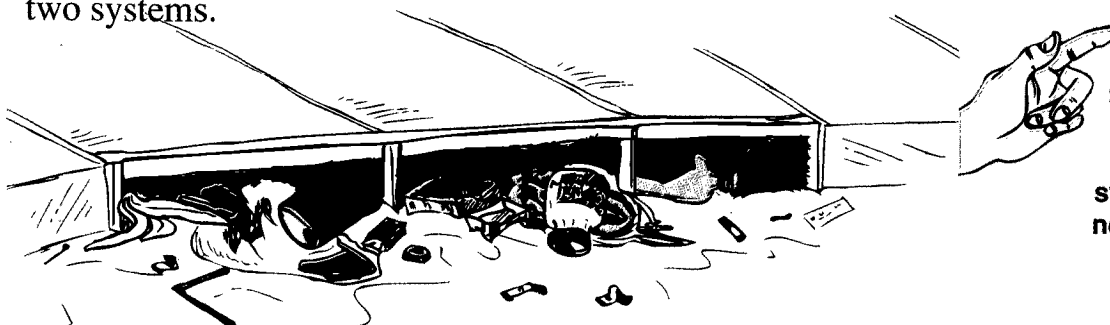
MY SEWERAGE AND STORMWATER MAP

- Ask learners to find all the plugholes, sewage pipes and stormwater drains at their houses. They should investigate where each one starts and finishes and what job it is doing.
- Ask learners to count the total number of sewage pipes that are needed to take sewage away from the house.
- Ask learners to count the total number of stormwater pipes that are needed to take stormwater away from the house.
- Ask learners to measure the circumference of these pipes using a piece of string which is then measured against a ruler.
- Ask learners to locate and measure the distance between the stormwater drains along the sides of the road. They should also measure the distance between their houses and the closest sewage manhole.
- Ask learners to locate and measure the distance between stormwater manholes in the street stormwater drains and the . They should also measure the distance between their houses and the closest stormwater manhole.
- Ask learners to draw a map showing the position of their house in relation to the closest sewage manhole, and the position of the sewage pipes. They should also include their stormwater drains and closest stormwater manhole. It would be preferable to use a different colour for each of the two systems.

Look for the drains
- but don't poke
around in them

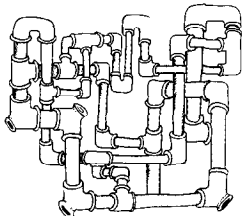


Do this activity at
school first before
sending learners off to
investigate their
homes.



it's a fact!

Stormwater drains
and sewers are
separate drainage
systems. They must
never ever be joined!



infosheet

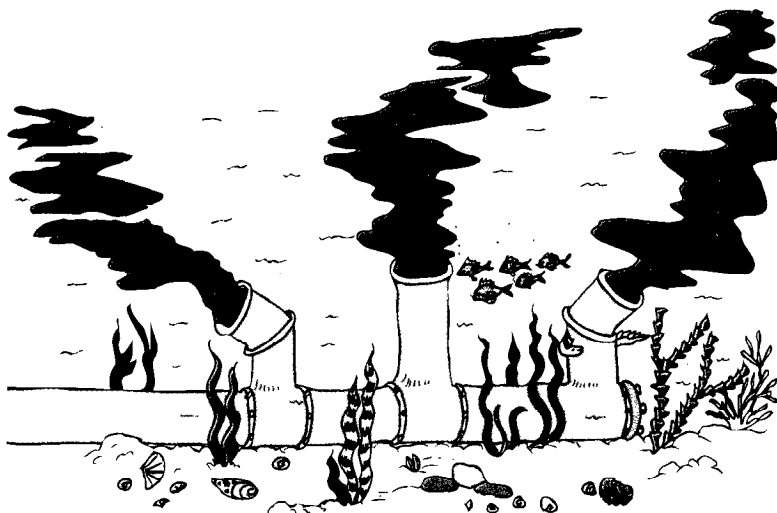
DURBAN'S SEWAGE TREATMENT WORKS



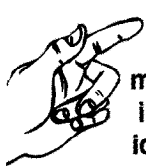
Did you know!
sewage treatment
works are great
places for bird
watching!

Each day, Durban Metro's Wastewater Management Department has to deal with 435 million litres of **domestic** and industrial **sewage**. As this is a **waterborne** system, about 99.5% of the sewage is water. This used water, also known as liquid waste, has to be 'cleaned-up' or treated to certain standards before it can be put back into the rivers or the Indian Ocean. There are 35 sewage treatment works in the Greater Durban Metropolitan Area. They operate 365 days a year and are staffed 24 hours a day in 3 shifts.

Two of the works, Southern and Central, discharge **sewage effluent** into the sea through ocean **outfall pipes**. This effluent includes both the liquid sewage and a certain amount of the solid wastes. These pipes are about 4 km long. The treated sewage is released during the last 400 m of pipe through a series of chimney-like **diffusers**, at a depth of 60 m. An offshore current is responsible for spreading the effluent over a wide area. The **micro-organisms** in the sea are given the job of cleaning up the sewage. The ocean and beaches are carefully **monitored** each week to make sure that the health of the public and the environment is not endangered.



The remaining treatment works discharge final effluent into river systems. These land-based treatment works use natural micro-organisms (bacteria) found in the sewage to help with the 'clean-up' process. These micro-organisms feed on **biodegradable pollutants** in the liquid waste, causing them to **decompose** quickly. The Department of Wastewater Management helps the micro-organisms to do their jobs faster and more thoroughly by giving them just the right amount of food, oxygen and heat. The full process is described on the poster of the Northern Sewage Treatment Works which is found in the pocket at the back of this file.



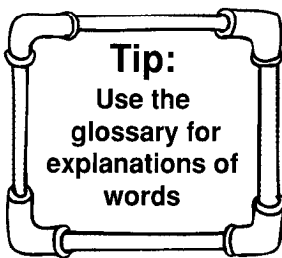
it's a fact!
many of our best
innovations are
ideas 'borrowed'
from nature!



THE WORKS: UNDERSTANDING SEWAGE TREATMENT

It is highly recommended that learners visit one of Durban Metro's sewage treatment works. To arrange this phone the Education Office of the Department of Wastewater Management at 3024784 for more details.

- Using the poster of the Northern Sewage Treatment Works, which can be found in the pocket at the back of this file, take pupils through the sewage treatment processes. A description is provided at the back of the poster.
- Hand out A4 copies of the treatment works and ask learners to explain the process by completing the blocks in their own words.
- Explain and discuss the following terminology

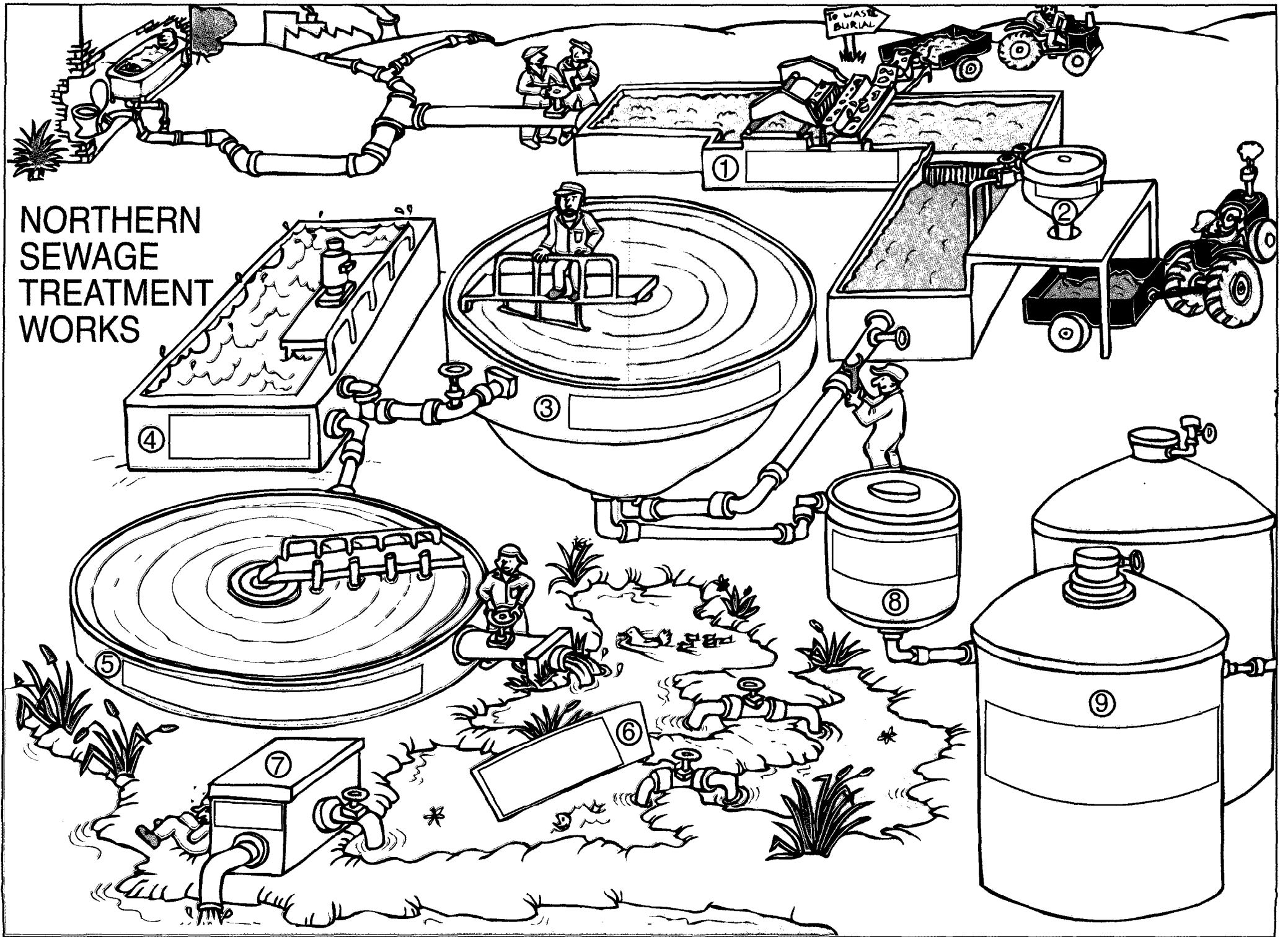


- biological processes** (eg. the breakdown of bacteria through decomposition)
- physical processes** (eg. the settling of sludge in tanks)
- chemical processes** (eg. the chlorination of the sewage effluent)
- mechanical processes** (eg. the screening of sewage)
- aerobic cleansing** (eg. by bacteria in aeration tanks)
- anaerobic cleansing** (eg. by bacteria in sludge digesters)

Ask learners to identify and describe where and how these processes are used in the treatment of sewage. It may be useful to colour-code the process above. Ask learners to colour in their picture of the works using the colours that describe the processes that are taking place in each of the numbered sections.



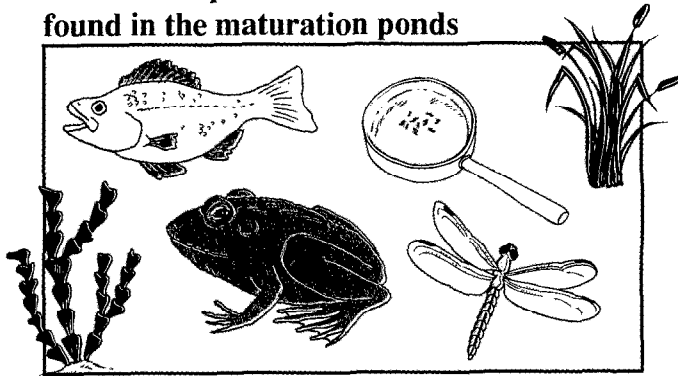
NORTHERN SEWAGE TREATMENT WORKS





PONDS FOR POLISHING SEWAGE:

Some of the plants and animals found in the maturation ponds



wear plastic gloves if there is a need to touch the water



The booklet "Hands On Stream and Pond Life", is available from Umgeni Water or Share - Net. It may be useful for identifying the creatures and finding information about what they eat.

- During the visit to the treatment works, ask the learners to observe and record the full variety of plants and animals that live in the maturation ponds. (For safety reasons and to prevent over-trampling of the edges of the ponds, it may be wise to select only 2 or 3 learners to explore the ponds under the supervision of the excursion leader. A teacher can help the other learners to get on with the Bird Watching Activity suggested in this section.)
- Once back at school, ask the learners to share their findings with the class. In small groups, learners should then develop a
 - food chain or
 - food webthat may occur in the maturation ponds.
- During this activity learners can be introduced to the following concepts. Where relevant they should identify these in their study of the ponds:
 - ★ producers (autotrophic)
 - ★ consumers
 - ★ herbivores
 - ★ carnivores
 - ★ omnivores
 - ★ decomposers
 - ★ energy flow
 - ★ ecology
 - ★ living and non-living components
- Ask learners to explain and discuss how the plants and animals do their 'job' of further 'cleaning-up' or polishing the sewage in the ponds.

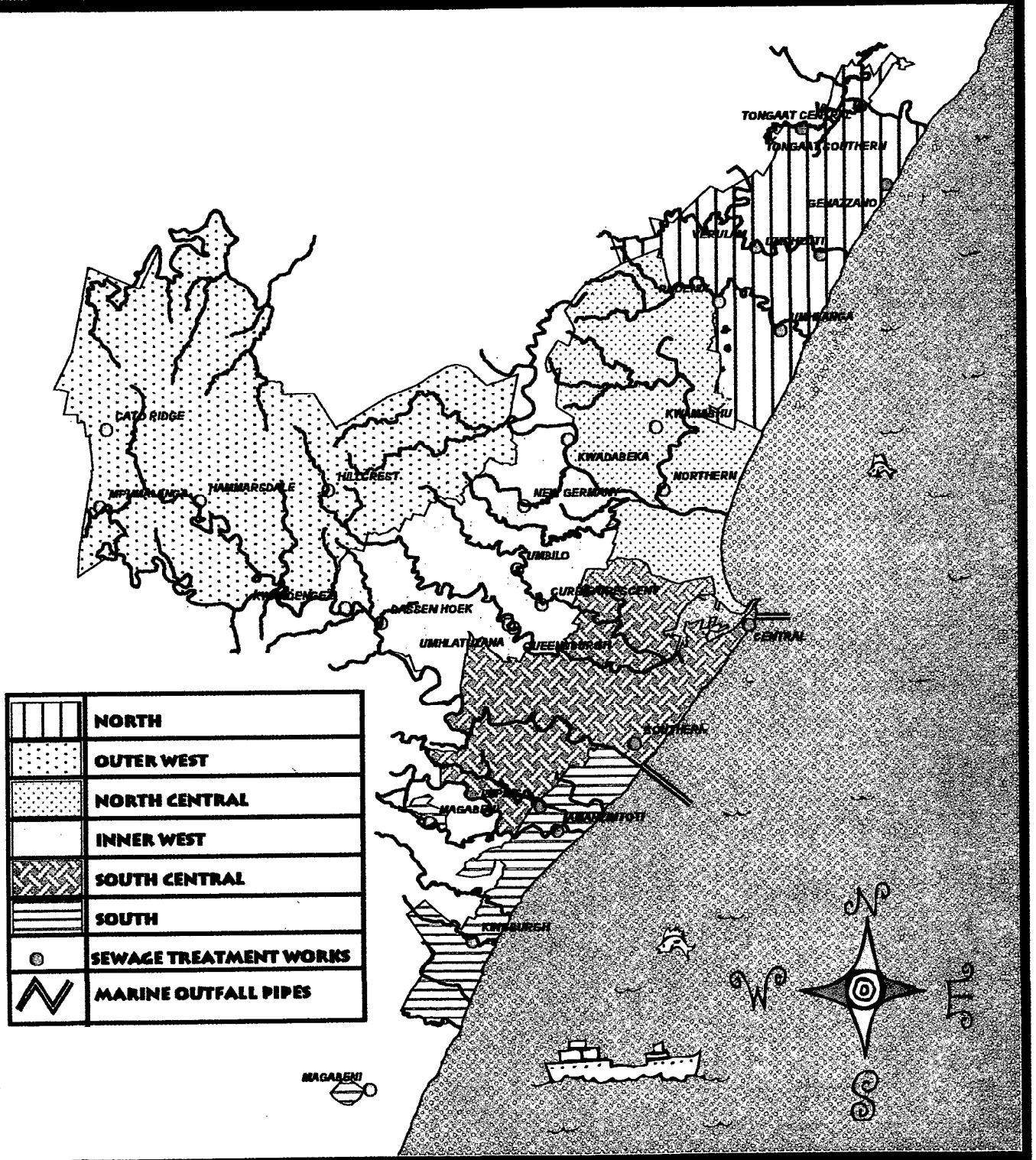


DURBAN METRO'S SEWERAGE SYSTEM

Pin up the A2 Durban Metro Sewerage Map which can be found in the pocket at the back of this file.

- Discuss the words **sewage** and **sewerage** with the learners.
- Provide each learner with an A4 copy of the Durban Metro Sewerage Map.
- Ask them to locate and count the following:
 - the sewage treatment works
 - the marine outfall pipes
- Ask learners to work out the route that their sewage, from home and school, is likely to follow.

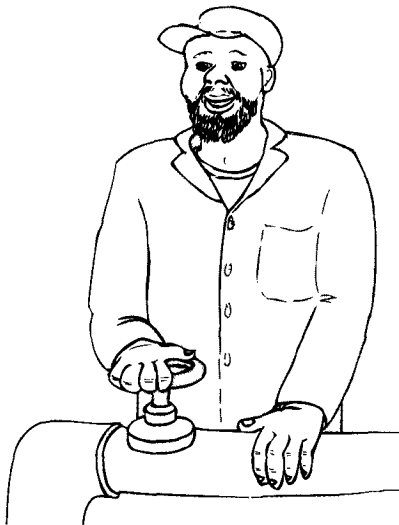
DURBAN METRO SEWERAGE MAP





THE PEOPLE WHO WORK AT THE SEWAGE TREATMENT WORKS:

Let the learners have fun role-playing the different careers. Photocopy (if possible enlarge) a number of copies of the Sewage Works Career Cartoons and pin them up in the classroom for learners to read. Prepare strips of paper with the 7 career titles. In groups of seven, have each learner select one of the careers out of a hat. Each one then has a chance to role-play their chosen career while the others have to guess. If arranged the day before, learners can even bring props, i.e. items that will support them in their role play. It may include clothing or equipment. Each group can select the most entertaining role-play and these can be presented to the whole class.



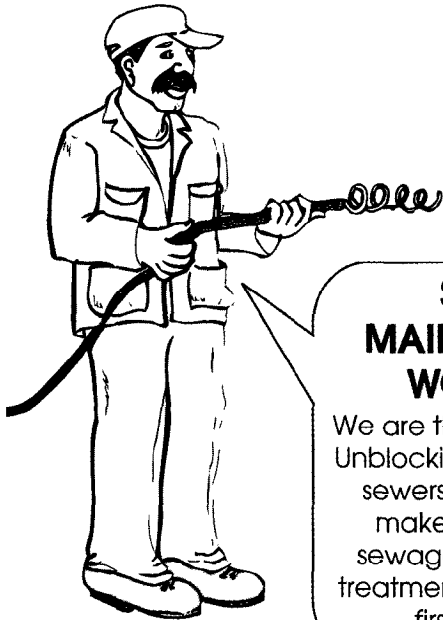
OPERATORS:

We operate the equipment that cleans the sewage. This involves working with pumps, pipes, valves, engines and generators.

CHEMISTS:

We do very specialised and complex tests on the sewage to make sure that the treatment process is working properly. We have to be very sure that the treated sewage meets all the legal requirements.





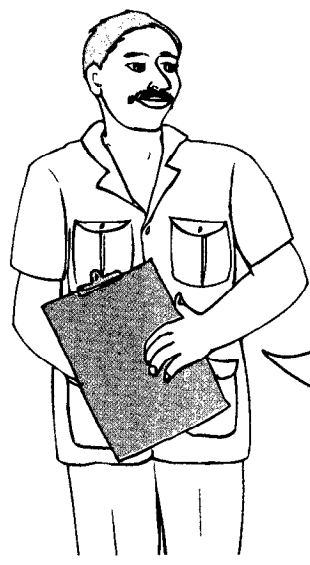
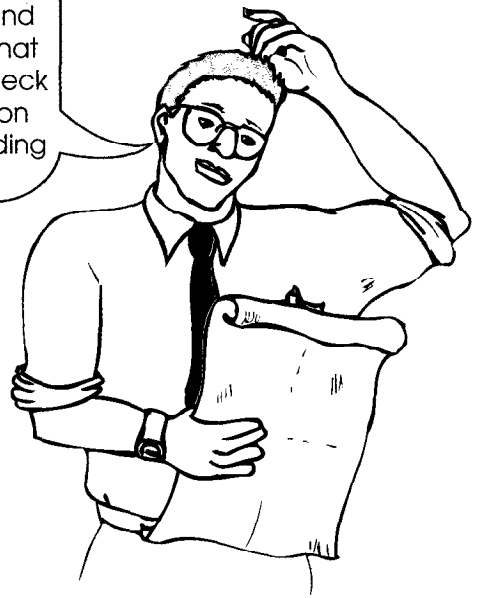
**SEWER
MAINTENANCE
WORKERS:**

We are the drain doctors! Unblocking and repairing sewers is our job. We make sure that the sewage gets to the treatment works in the first place.

**LABORATORY
TECHNICIANS:**
We regularly test sewage - before, during and after the treatment process. All of this is done to make sure that the quality of treated sewage, that is finally discharged into nature, is of a high standard.



ENGINEERS:
Designing sewage treatment works and sewer systems is what we do. We also check that all construction goes strictly according to the plans!



SUPERINTENDENT:
The buck stops with me! As the manager of the treatment works I have to make sure that the administration, operation and maintenance functions are all running smoothly.

FITTER-'N'-TURNERS:
We maintain and repair the pumps, pipes and just about anything that needs to be kept in good working order at the treatment works. We are the handy-men around here!



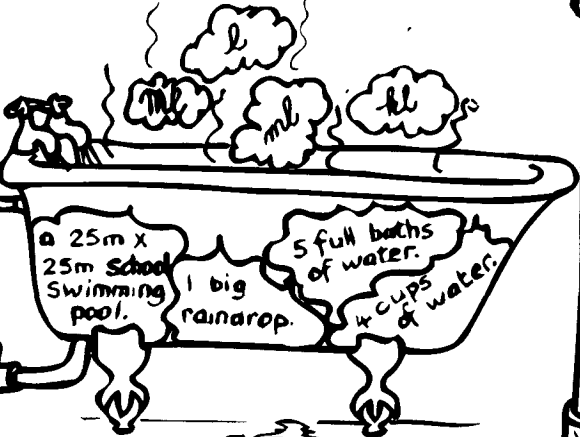
MATHS (DOWN) THE DRAIN!



Work hard and you'll all be flushed with success!

① From the bathtub, select the matching abbreviation and volume for each measure.

1 millilitre =  = 1 big raindrop
 1 litre =  = _____
 1 kilolitre =  = _____
 1 megalitre =  = _____



② Do you know these basics?

How many ml in 1 l? _____
 How many l in 1 kl? _____
 How many kl in 1 ML? _____
 How many l in 1 ML? _____
 How many ml in 1 ML? _____

③ Circle the correct answer from each box.

- a) 1 l =

1000 ml	100 ml	10 000 ml
---------	--------	-----------
- b) 1 ML =

1000 ml	1000 l	1000 kl
---------	--------	---------
- c) A teaspoon holds

15 ml	5 ml	50 ml
-------	------	-------
- d) A teacup holds

250 ml	1 l	750 ml
--------	-----	--------
- e) A kl equals

1000 ml	1000 l	1000 ML
---------	--------	---------
- f) A bucket holds

100 l	1 l	5 l
-------	-----	-----
- g) A full bath holds

100 l	10 l	1 kl
-------	------	------
- h) A ML is

10	1000	1 000 000
----	------	-----------

 times bigger than a litre.
- i) 100 ML =

100 000 kl	100 000 l
------------	-----------

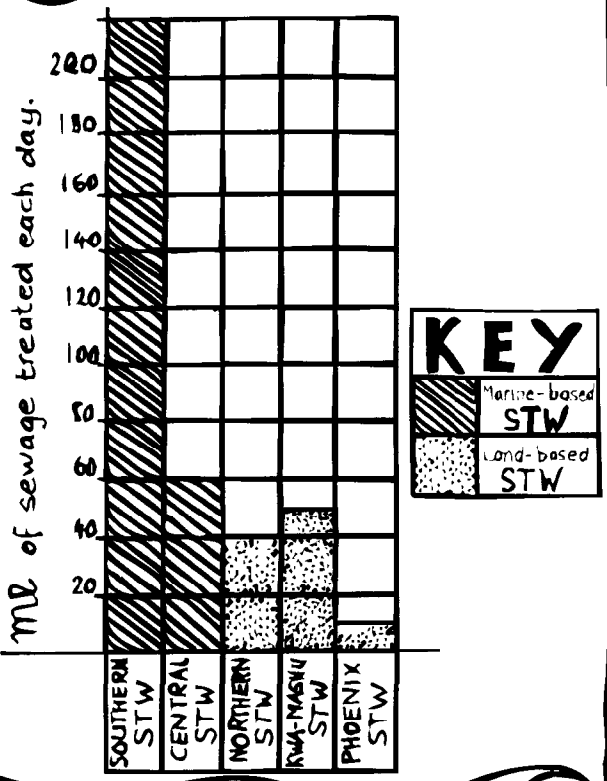
HARD TO BELIEVE!!

Altogether, Durban's 5 biggest sewage treatment works treat **350 MEGALITRES** of sewage EVERY DAY! That's like 72 Soccer fields each 1 metre deep in sewage every day!

④ EVEN SEWAGE COSTS

- a) At land-based sewage works, sewage is given the FULL TREATMENT, which costs about 23c per KL. Complete the following sentence by writing 23c as rands:- THIS SEWAGE COSTS R _____ per KL TO TREAT.
- b) At marine-based sewage works, sewage is only PARTIALLY treated, which costs about 11c per KL. Write 11c as rands in the following sentence:- THIS SEWAGE COSTS R _____ per KL TO TREAT.

5 Study this bar-graph carefully. Note that S.T.W. stands for Sewage Treatment Works.



KEY
 Marine-based STW
 Land-based STW

What does each block on the vertical or Y-axis of this graph stand for?

6 How many ML of sewage are treated per day at:

- a) Southern STW _____
- b) Central STW _____
- c) Northern STW _____
- d) Kwa-Mashu STW _____
- e) Phoenix STW _____

7 Next, work out how many *kl* of sewage are treated per day at:

- a) Southern STW _____
- b) Central STW _____
- c) Northern STW _____
- d) Kwa-Mashu STW _____
- e) Phoenix STW _____

8 Now, work out how many litres of sewage are treated per day at:

- a) Southern STW _____
- b) Central STW _____
- c) Northern STW _____
- d) Kwa-Mashu STW _____
- e) Phoenix STW _____

9 How much does it cost in rands to treat the sewage every day at:

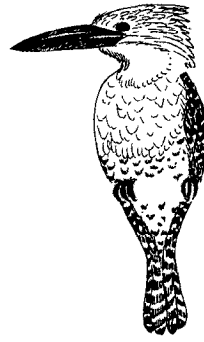
- a) Southern STW _____
- b) Central STW _____
- c) Northern STW _____
- d) Kwa-Mashu STW _____
- e) Phoenix STW _____

f) Calculate the TOTAL cost of treating sewage in Durban's 5 biggest sewage treatment works PER DAY? _____

g) Sewage works operate every day of the year. What is the total cost of treating sewage in Durban's 5 biggest Sewage treatment works PER YEAR? _____

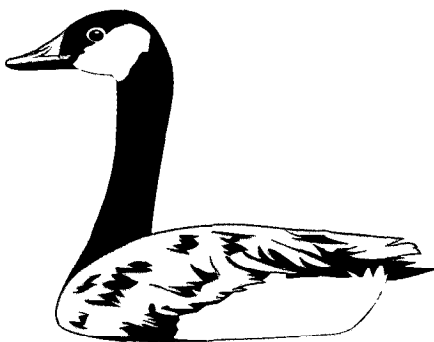
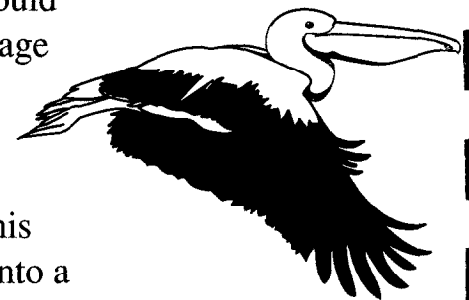
DISCUSS... Who actually PAYS for the treatment of Durban's sewage? Discuss the matter of local taxes, payment for services and the government's MASAKHANE campaign.

HOW DID YOU COPE WITH THIS WORK-SHEET?

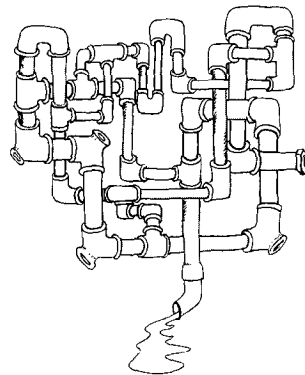


BIRD WATCHING!

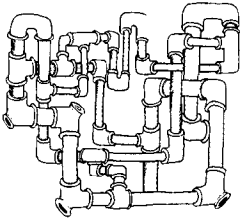
- Ask each learner to identify and draw simple sketches of 5 different birds during their visit to the sewage treatment works. They should make notes about beak and leg shapes and colouring, feathers and markings, where each bird was seen and what it was busy doing.
- While observing the birds, learners should think about and discuss the different beak shapes and how these are adapted for different styles of feeding. The same should be done for feet, with discussion on which birds are adapted for perching, swimming or standing on the ground, etc.
- Back at school, learners can use this information, together with library books or other relevant resources, to identify the birds, find out what they eat and discover other interesting facts. They should also discuss why these birds gather in large numbers at the sewage treatment works.
- Ask learners to re-do their sketches neatly and write up their information about each bird on separate pages. At the end of this exercise, the best ones on each species of bird can be collated into a booklet, ring-bound and put into the school library.



The booklet, "Some Common Waterbirds", available from Share - Net and Umgeni Water will be useful for this activity.

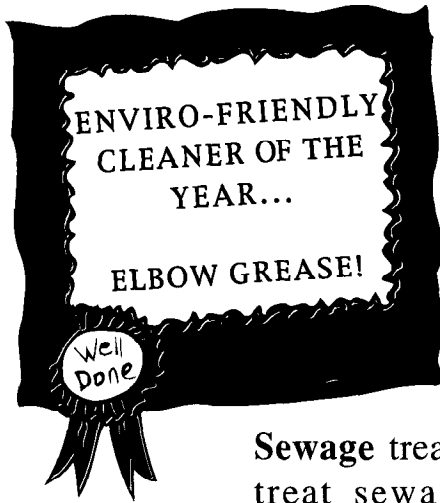


sewerage system
problems



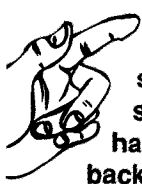
infosheet

CHEMICAL COCKTAILS: INDUSTRIAL AND HOUSEHOLD HAZARDOUS WASTE



Every time we clean the bath, wash the dishes, bleach our whites, do a load of washing or disinfect the toilet, we introduce chemical mixtures down the sewage pipes. Some chemicals break down quickly and become harmless. Others take weeks or months to break down. Worse still, some do not break down at all! Another danger is that these chemicals mix together in the sewers, and can sometimes form new, even more poisonous mixtures.

Sewage treatment works are designed to treat sewage, not harmful chemical products. These chemicals can interfere with the sewage treatment process. They also increase the costs of treating the 'used' water.



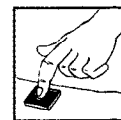
it's a fact!

some factory sewage is too harmful to be put back into nature, and is not accepted for treatment at all

Industries often use strong chemicals in their manufacturing processes and produce hot water in their cooling processes. These can be very harmful to the health of the people and the environment. The Durban Metro Wastewater Management department has very strict laws which regulate the kind of **sewage effluent** that trade and industry can discharge into the sewers. The Department ensures that industries pre-treat their sewage to certain standards before it is discharged into the system.

Industries are charged for sewage disposal on the **Polluter Pays Principle**: Those with a very high volume of sewage, or those with a very high concentration of chemicals in the sewage, are required to pay more as they put a heavy load on the sewage treatment process.





PHOTOCOPY

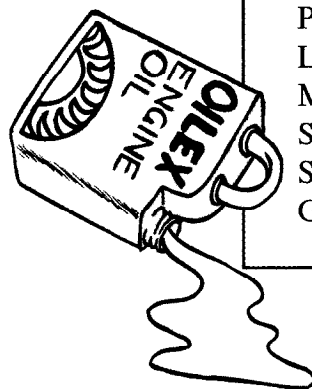
THINK BEFORE POURING IT DOWN THE SINK!

Speak to your family and friends about household hazardous waste and its safe disposal.

Sewage treatment works are designed to treat only sewage, not hazardous wastes. People's homes are full of **hazardous** wastes. If they land up in the sewage they will prevent the sewage from being 'cleaned-up' properly, and they will increase the costs of the treatment process. It is important to learn to identify hazardous wastes in your home.

NEVER POUR THESE MATERIALS DOWN THE DRAINS!

Type of Hazardous Waste	Place Where it is Kept at Home	Recommended Disposal Method
Fertilizer	_____	Rubbish Bin*
Insecticide	_____	Rubbish Bin*
Rat Poison	_____	Rubbish Bin
Weed Killer	_____	Rubbish Bin*
Floor care products	_____	Rubbish Bin
Furniture Polish	_____	Rubbish Bin
Silver/Brassware Polish	_____	Rubbish Bin
Medicines	_____	Return to pharmacy*
Nail Polish	_____	Rubbish Bin
Battery Acid	_____	Rubbish Bin / Recycle*
Brake Fluid	_____	Rubbish Bin*
Diesel	_____	Rubbish Bin*
Petrol	_____	Rubbish Bin*
2-stroke oil	_____	Return to selected stations
Car oil	_____	Return to selected stations
Paraffin	_____	Rubbish Bin*
Turpentine	_____	Rubbish Bin*
Varnish	_____	Rubbish Bin
Paint	_____	Rubbish Bin
Primer	_____	Rubbish Bin
Lighter fluid	_____	Rubbish Bin
Moth Balls	_____	Rubbish Bin
Shoe Polish	_____	Rubbish Bin
Swimming Pool Acid	_____	Rubbish Bin
Gun cleaning solvents	_____	Rubbish Bin

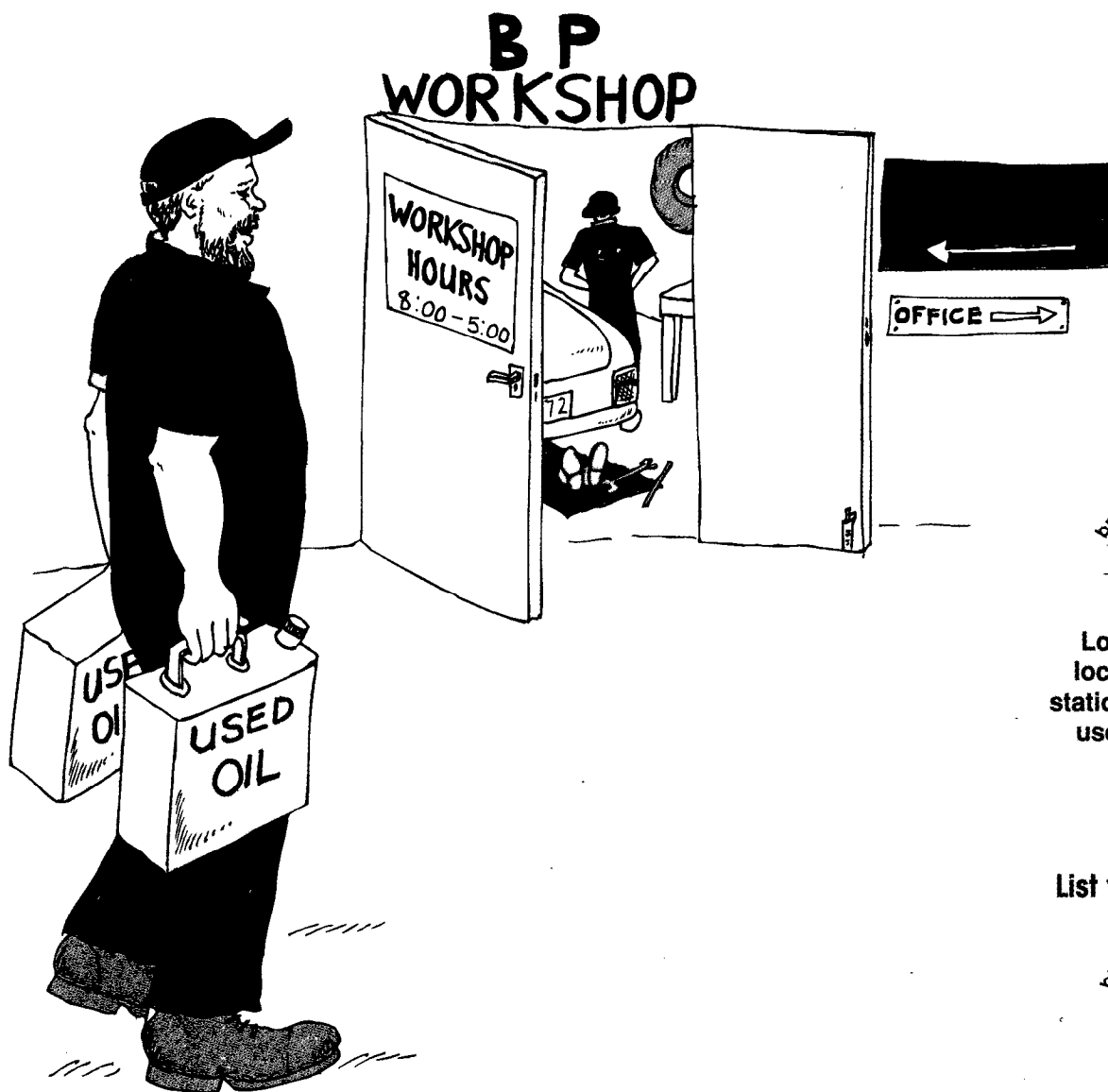


* - South Africa doesn't yet have facilities for the disposal of these sorts of hazardous wastes. Best option for now is to dispose of them in the municipal rubbish bin.

Throwing any of the above items into the rubbish bin is not really a good idea as environmental pollution will still take place from the rubbish dump. However, South Africa doesn't yet have facilities for the disposal of these sorts of *household hazardous waste*. The best option for now is to dispose of them in the municipal rubbish bin. According to Durban Metro's Department of Wastewater Management, those wastes marked with an *, if in small quantities and thoroughly diluted in water, can be spread evenly over grass.



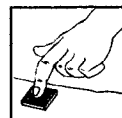
Encourage your local municipality to establish a facility for disposal of household hazardous waste.



Lobby your local service station to accept used car oil.

List your own





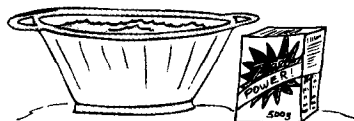
PHOTOCOPY

CHEMICALS AND CAREFUL CONSUMERS

When shopping, read the labels of household cleaning products carefully - look out for:

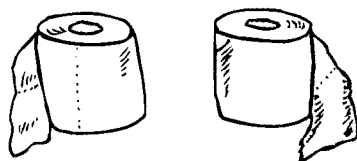
BRIGHTENERS:

These chemicals are usually added to make washing look whiter and brighter.



CHLORINE BLEACHES:

These chemicals are usually added to make washing whiter.



Some important information about the chemicals:

Brighteners break down very slowly, and usually pass through the sewage treatment works.

Bleaches break down to produce organo-chlorides. These substances are seldom found in nature and often kill helpful bacteria. They do not break down easily and pass through the sewage treatment works.

The impact of the chemicals on the environment:

Brighteners are known to effect micro-organisms. In particular, they restrict growth and cause mutations.

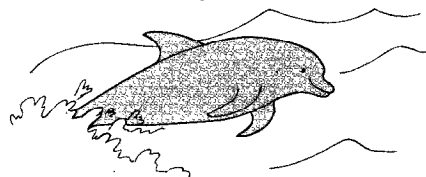


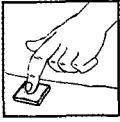
Organo-chlorides are very poisonous and are known to cause cancer. Many people are worried about the high death rate of young marine mammals such as whales and dolphins, because of the increasing levels of organo-chlorides stored in their blubber.

For You To Do:

Hold a class discussion around the question, 'Do we really need to have everything so white and bright?' Try to examine what is behind the 'white and bright' emphasis. Question whether society can afford this in the future.

Find out more about the different uses of chlorine. What are the benefits of using it? What are the disadvantages of using it? Comment on your findings.





PHOTOCOPY

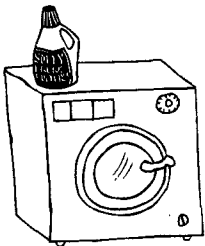
When shopping, read the labels of household cleaning products carefully - look out for:

PHOSPHATES:

These are found in shampoos, detergents and laundry powders.



PERFUMES:



OILS:

This includes any petroleum based products.



Some important information about the chemicals:

Phosphates act like fertiliser. They pass through the sewage treatment works into the rivers and sea. They cause the algae in the water to grow rapidly, sometimes resulting in an algal bloom.

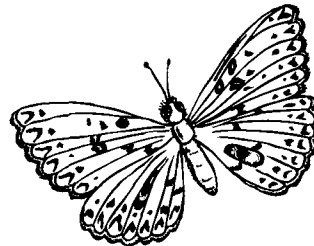
Many perfumes pass through the sewage treatment works.

Five litres of oil on water can spread over an area twice the size of a rugby field!

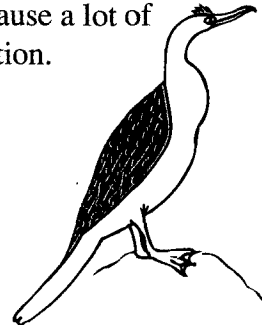
The impact of the chemicals on the environment:

The algae uses up most of the oxygen in the water, resulting in the death of other water-living (aquatic) plants and animals. This problem increases when the algae die off as even more oxygen is used in the process of decomposition.

Some perfumes are known to interfere with insects' sense of smell.



If it reaches the river or the seas, even a little oil can cause a lot of pollution.



For You To Do:

See activities linked to the infosheet 'Washing Powders and Dead Fish'.




For fun, find out how insects smell and for what purposes they use this sense.

Do a short project on the effects of oil pollution on the natural environment (plants and animals). Look at both river systems and the sea.



HOME-MADE ENVIRO-FRIENDLY PRODUCTS

Most of our cleaning products get washed away with our **sewage**. We are not always aware of the harmful chemicals in these products. Many pass straight through the sewage treatment works and have a bad effect on the plants and animals in the rivers and sea. One of the ways to reduce the number of chemicals that we use is to shop for Environment-friendly products. Another way is to try out the following home-made ideas. Ask learners to experiment with these and to comment on how they work. The activity sheet 'Chemicals and Careful Consumers' may inspire learners to develop their own alternatives: Add any new ideas to the list.



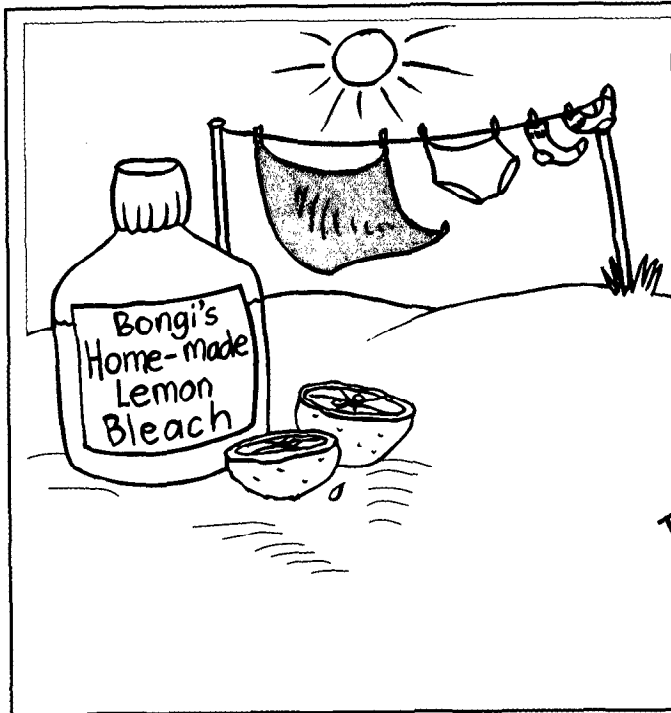
Furniture Polish
Mix 1 tablespoon of vinegar with 3 tablespoons of olive oil.

Insect Repellent
Plant lemon grass, garlic or lavender. For ants, sprinkle their route with baby powder or rub with lemon juice.

All-purpose Cleaner
Mix $\frac{1}{2}$ cup white vinegar,
 $\frac{1}{4}$ cup bicarbonate of soda
8 cups water



Mirror & Glass cleaner
Mix vinegar and water. Use crumpled newspaper to shine.



Washing clothes

To Bleach Mix 1 cup of lemon juice with $\frac{1}{2}$ bucket of water. Soak the clothes before washing .

To Clean For a 5kg load, grate $\frac{1}{2}$ cup of pure soap.

To Brighten Add 2 tablespoons of bicarbonate of soda or sodium bicarbonate.

To Soften Use $\frac{1}{4}$ cup of vinegar in rinsing water.

Drain Cleaner

Pour hot water into drain followed by half a cup washing soda (sodium bicarb). Wait for 1 minute and then pour more hot water.

If badly clogged, use a quarter of a cup vinegar and cover tightly for 1 minute. Then flush with boiling water.

Disinfectant

Dissolve 1 tablespoon of borax in half a litre of hot water.

Air Freshener

Make your own using rose petals, peppermints or cloves.

HOW THEY HELP:

BICARBONATE OF SODA: cleans, deodorises, softens water, cuts grease

BORAX: cleans, deodorises, disinfects, softens water

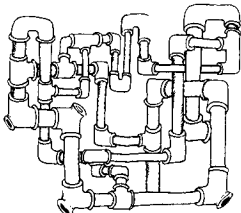
WASHING SODA: cuts grease, removes stains, disinfects

WHITE VINEGAR: cuts grease, freshens

HOT WATER: cuts grease

ALWAYS
HANDLE
CLEANING
PRODUCTS WITH
CARE!
KEEP OUT OF
REACH OF
CHILDREN

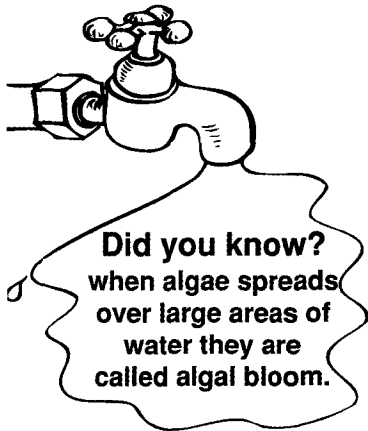




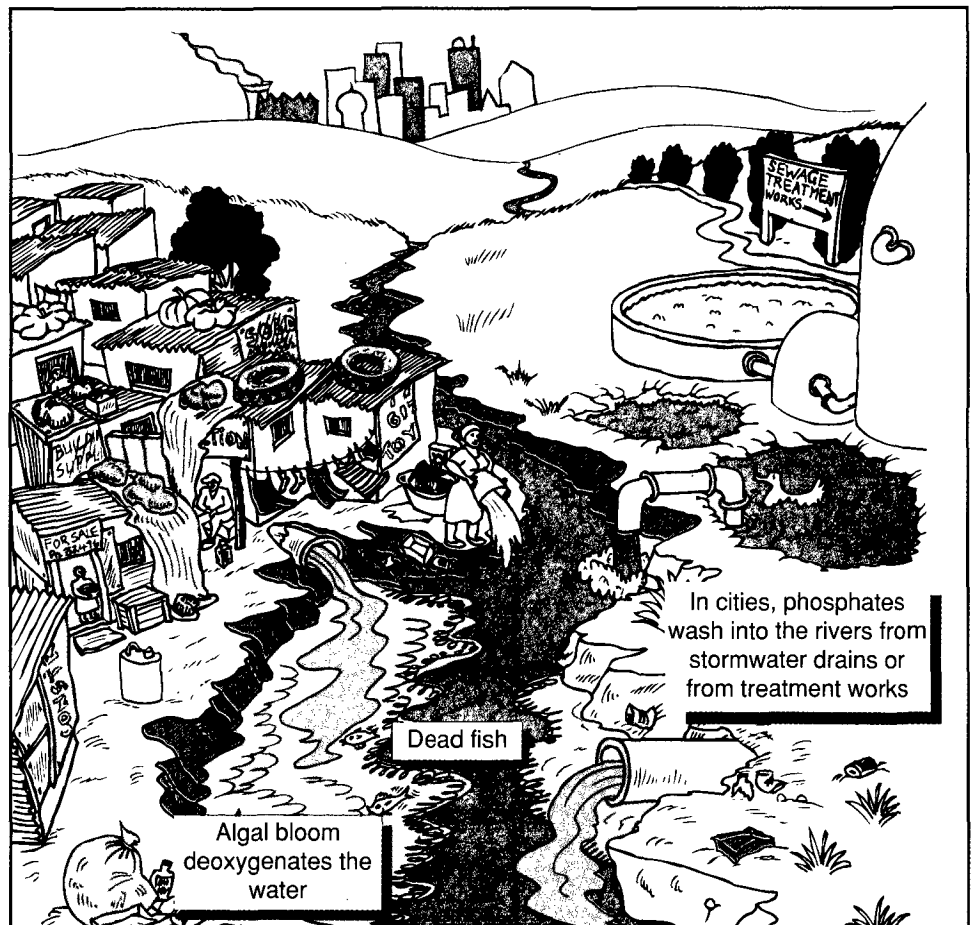
infosheet

WASHING POWDERS AND DEAD FISH

Phosphates are chemicals used in many household cleaning products including washing powder and shampoo. They soften the water so that the cleaning product can dissolve more easily and break up dirt. They are also used in fertilisers on farms because they help plants to grow faster.



When phosphate-rich sewage washes into the rivers or sea, it acts as a fertiliser speeding up the growth of tiny water plants, called algae. When the algae die, they are broken down by bacteria. As they work, the bacteria use up oxygen in the water. If they use too much oxygen, the fish and other small creatures can die. This can upset the ecology of the river. Phosphates also encourage fast growth in larger plants such as water-weeds, often leading to the same impact as an algal bloom. Communities should always report sudden increases in the numbers of dead fish in nearby streams, rivers or dams to their local Council



it's a fact!
about 25% of phosphates found in fresh water come from household detergents.



SHOPPING SURVEY TO SAVE OUR RIVERS



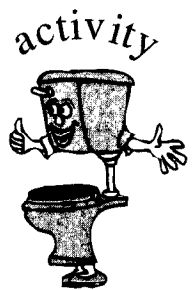
•Using the infosheet (*Washing Powders and Dead Fish*), present a lesson on the effects of overfertilisation of rivers to discuss why it is important not to upset the ecology of rivers.

•Ask learners to visit their local supermarket to investigate the contents of household cleaning products. They will need to read the labels carefully. It may be useful for learners to draw up a chart like the one below.

BRAND NAME	LISTED INGREDIENTS	WORDS USED TO SELL THE PRODUCT	ENVIRONMENTAL INFORMATION ON THE LABEL	PRICE per Kg
Omo Washing Powder	<ul style="list-style-type: none"> < 5% Polycarboxylates 5-15% Silicates (Soda Ash) 15-30% Anionic Surfactant (Phosphates) Enzymes Perfume Optical - Brightener 	<ul style="list-style-type: none"> • New improved power foam • Longer lasting (use less) • Recommended by leading manufacturers • Cold water 	<ul style="list-style-type: none"> • Made with concern for the environment • Surface active ingredients are biodegradable • 80% of the box is made from recycled paper • use in cold water (saves electricity) 	R9,95



•Ask learners to identify products that are more 'environmentally friendly' than others. It would be interesting for learners to discuss whether they would be prepared to use those products above others and to explain why or why not.



MAKING THE ALGAE BLOOM:

•Ask the learners to do the following:

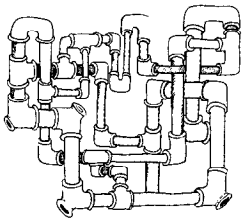
1. Fill five clean jamjars with the same amount of either rain water or clean pond water.
2. Stand the jars on a sunny window-sill.
3. After a few days the water will go green. This is because tiny plants called algae grow in it. Similar algae grow in ponds, rivers, streams, dams and the sea.
4. Into the first jar put a small amount of oil, into the second a small amount of washing powder, into the third a small amount of washing-up liquid, and into the fourth a small amount of vinegar. Leave the fifth jar as it is. Label the jars.
5. Watch what happens over the next few days. Record your findings.

•Ask learners to discuss how oils, household cleaning products and foodstuffs get into the streams, rivers, dams and sea.

•Ask the learners to discuss and describe the effects of these substances on water plants and animals.

•Ask learners to think of ways of preventing these substances from washing into our rivers.





infosheet

BLOCKAGES, BAD SMELLS AND BACTERIA: BEWARE!

One flush of the toilet, or one pull of the plug, and all the 'used' water is supposed to flow down the sewage pipes to the treatment works and finally back into our rivers and ocean. However, problems often occur: At home, at school and at work, toilets and sewers get blocked and overflow into the roads and gardens. At the **sewage** works, pumps get blocked and stop working properly. Repairing these blockages is very costly!

In the Durban Metropolitan Area, many blockages occur because people use the sink or toilets as a rubbish bin for leftover food, old cooking oil, newspapers, sanitary pads, cigarette butts, cotton wool, earbuds and just about anything you can possibly imagine! Sewer blockages also occur when people remove the manhole covers in the roads. All sorts of rubbish is thrown into the manholes, including old tyres, bricks, used car-oil and even dead animals. These blockages often result in sewage overflows that cause very unpleasant smells and can lead to the outbreak of serious diseases. Nearly all these blockages can be prevented.



it's a fact!

the only paper
that sewage pipes
can deal with is
toilet paper!

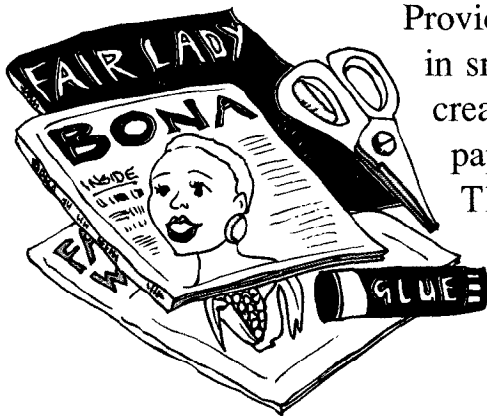
It is important to understand that the sewerage system, and especially the sewage treatment works, is designed to treat only 'used' water and not our rubbish! **Non-biodegradable** products, such as plastics, actually prevent the bacteria from doing a good job of 'cleaning up' the liquid sewage and

the **sludge**. **Organic matter**, such as leftover food, places an extra load on the sewage system. **Toxic chemicals**, which are found in many household products, actually kill the bacteria that are used in the treatment of sewage. None of these wastes must ever go down the sewage pipes!

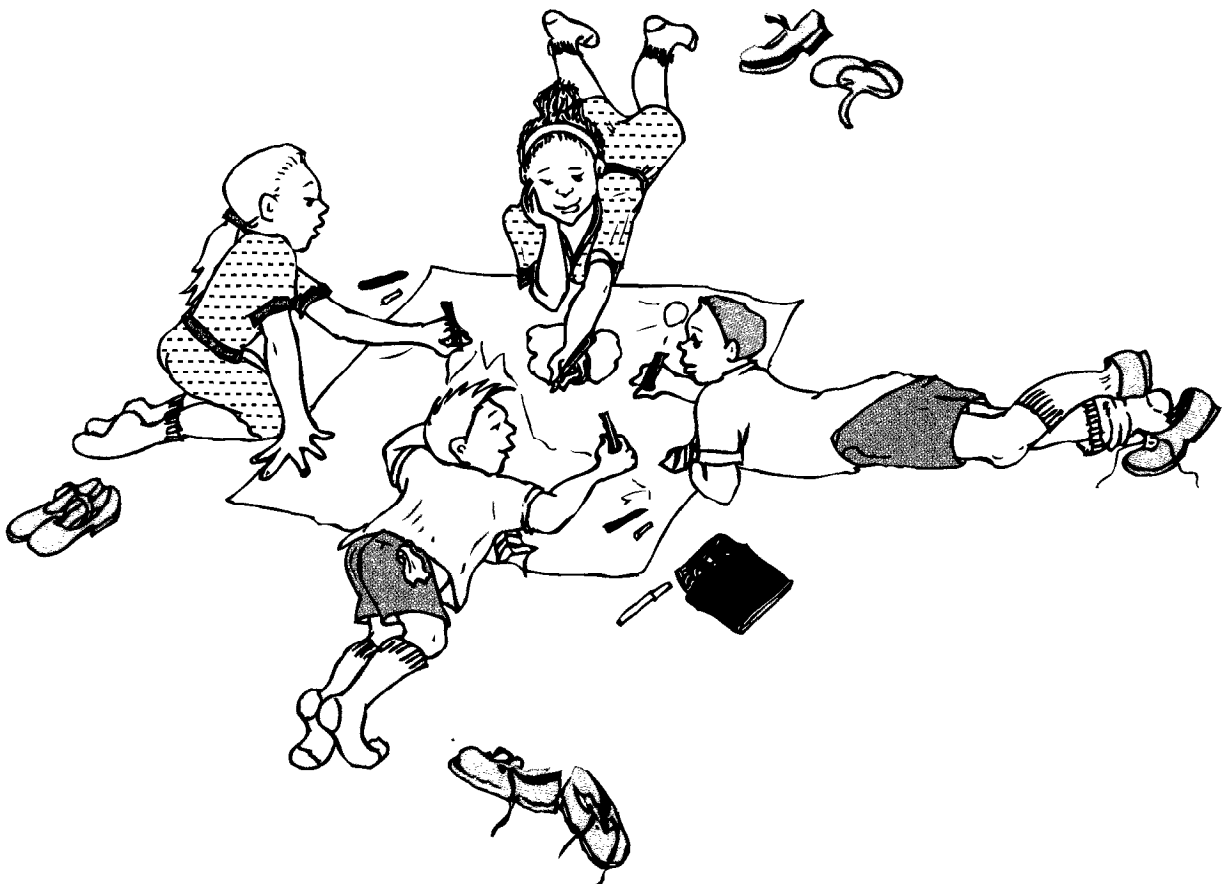




EYE-CATCHING COLLAGES



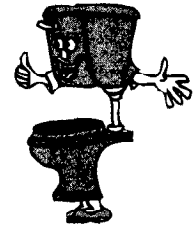
Provide the class with old magazines, scissors and glue. Working in small groups, ask learners to put together a collage that will create an awareness in the school that nothing other than toilet paper should be discarded down the toilets or sewage pipes. These posters can be pinned up in prominent places - including the school kitchen and toilets.





PHOTOCOPY

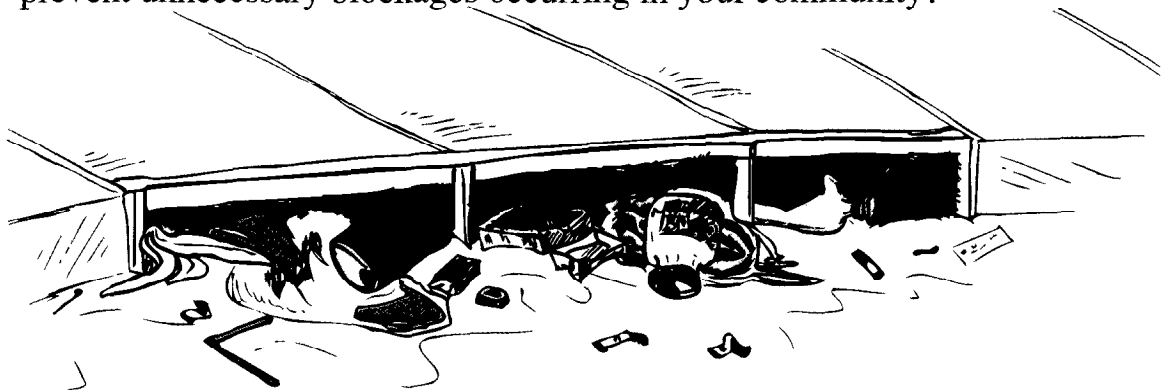
activity



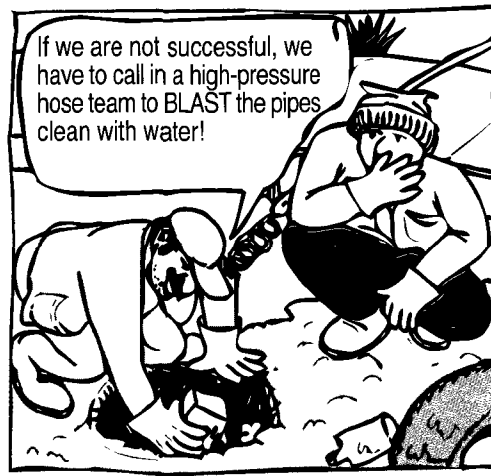
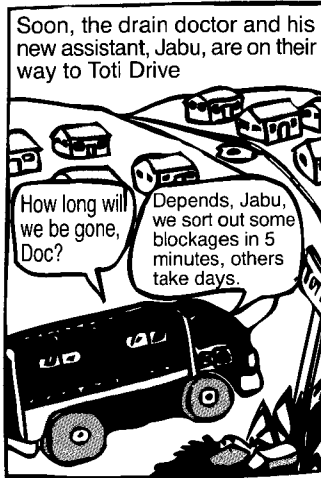
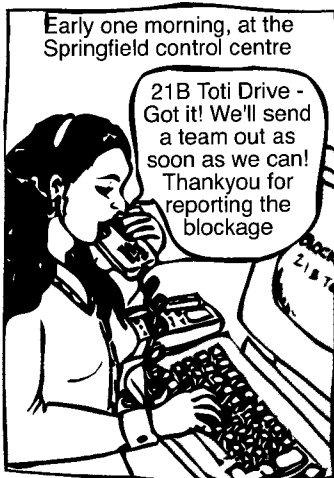
THE DRAIN DOCTOR

Hand out copies of the 'Drain Doctor' cartoon to each learner and have them discuss the following in small groups.

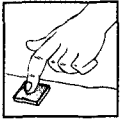
1. What is the toll-free number for reporting sewer blockages?
What does toll-free mean?
2. Why is the 'Drain Doctor' worried about the sewage running into the stormwater drain?
3. Why is the 'Drain Doctor' worried about the small children playing near the sewage?
4. What is the total cost of replacing 20 manhole covers a month?
5. What does Jabu mean when he says, "the thieves are forcing the community to pay for the same thing over and over and over again"?
Discuss your views on this matter with your group.
6. Replacing manhole covers is one cost. What other not so obvious costs are involved with unblocking sewers?
7. Why do children in the community throw things into manholes?
How can this be stopped?
8. Why do adults throw things into manholes?
How can this be stopped?
9. What creative actions could you, your class or your school take to prevent unnecessary blockages occurring in your community?



A DAY DRAIN DOCTOR

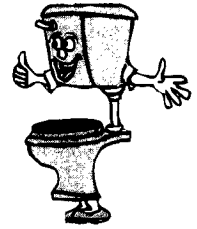


REPORT ALL SEWER BLOCKAGES TO
0800 323235



PHOTOCOPY

activity



THE WORD SEARCH PUZZLE: BEGINNERS

In the block below are 10 words. See if you can find all the words hidden in the word search puzzle. Some words are written across and some downwards. Once you have found a word, draw a line around it

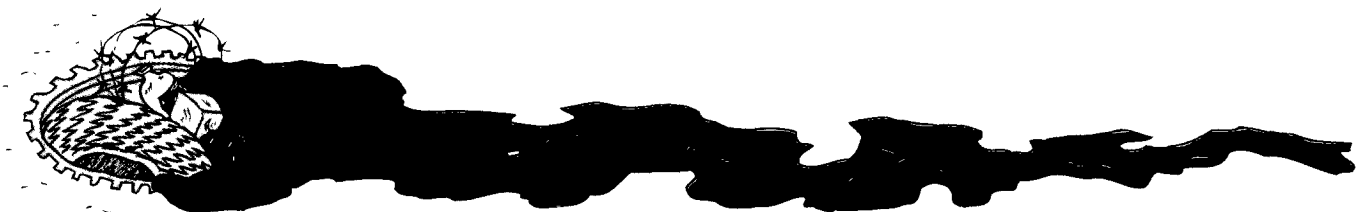
BLOCKAGE
 OVERFLOW
 SEWAGE
 SAND
 RAGS
 NEWSPAPER
 RUBBISH
 MANHOLE
 DISEASES ✓
 SMELL

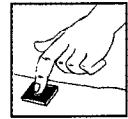


1. Make 10 sentences, each time using one of the hidden words.

2. Find the secret word:

Starting from the top left and working down row for row, write down all the letters that are not included in any words. Make a sentence with the secret word.





PHOTOCOPIABLE

THE WORD SEARCH PUZZLE : ADVANCED

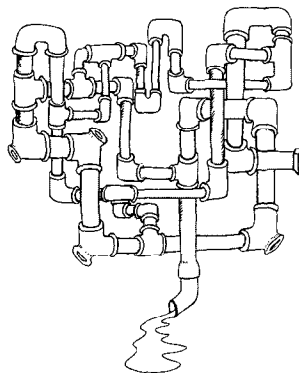
1. Hidden in the block below are the following words. Once you have found a word, draw a line around it.



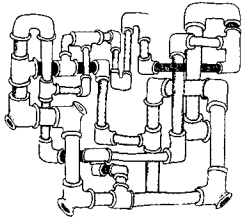
TOILETPAPER	LITTER
BLOCKAGES	BRICKS
SEWAGE	OIL
SEWER	WATER
PIPES	CHEMICALS
PLUGHOLES	TRASH
DRAINS ✓	GERMS
MANHOLES	PUMPS
NEWSPAPER	AVOID
OVERFLOW	BROKEN
ODOUR	REPAIR
POLLUTION	OPEN
RATEPAYERS	PHONE
GREASE	SMELLS
RUBBISH	SAND

B R I C K S O V E R F L O W N S
 O L T T S M E L L S H E I N N M
 A V O I D R U B B I S H G I O A
 P T I C H E M I C A L S A H E N
 O R L T K H A N E T O R R I L H
 L E E T P A A R P E D E R M O O
 L I T T E R G A S E W A G E D L
 U Y P U M P S E B E E D I S O E
 T R A S H C E A S A N D R D U S
 I P P E D O P E N R E P A I R D
 O H E O W N I I N T H W A T E R
 N O R A T E P A Y E R S E T O I
 L N E W S P A P E R B R O K E N
 G E R M S E T P L U G H O L E S

2. Make sure that you understand what each word means.
3. Choose five of the words and write a paragraph which includes all five.
4. Starting at the top, and working from left to right along each row, write down all the letters left in the puzzle. These 56 letters do not belong in any of the words you have identified. See if you can work out the secret message that can be found in these letters.
5. Discuss the secret message in small groups. Think of ways in which this message can be spread to other people in your school and family.



sewage &
sanitation



infosheet

GOOD HYGIENE - GOOD HEALTH



it's a fact!
Gastro-enteritis
is one of the 3
main causes of
death in South
African
children under the
age of 5.

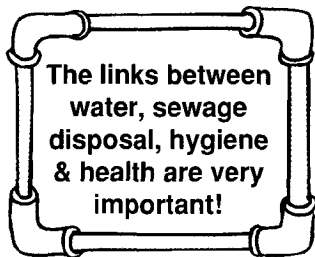
We all need water for life, but it is important to know that water can also be a carrier of disease. Water is especially dangerous when it is **contaminated** with human faeces. Faeces contain bacteria called *E. coli*. When *E. coli* counts in streams, rivers or dams become very high, this indicates faecal pollution. This means that there is an increased possibility that disease-causing micro-organisms which are also known as **pathogenic bacteria** may be present in the water.



it's a fact!
some disease
organisms can
live for up to 3
years in human
faeces

Diseases that are carried in water are known as waterborne diseases, for example cholera, typhoid and dysentery. When drinking water becomes contaminated with urine and faeces, these diseases are able to spread quickly and much further: When whole communities get sick with the same disease, the outbreak is known as an epidemic.

People who have waterborne diseases usually suffer from diarrhoea. This means that they have 'runny tummies' (pass frequent watery stools). Sometimes they also vomit and have swollen stomachs that cramp. Diarrhoea causes the body to lose a lot of fluid (water and dissolved salts) in a short period of time. This leads to dehydration and makes a person feel weak and tired. **Dehydration** can and must be treated immediately or else it will lead to death, especially in babies and young children. Waterborne diseases can often be prevented through improved sewage disposal and hygiene practices.



The links between
water, sewage
disposal, hygiene
& health are very
important!



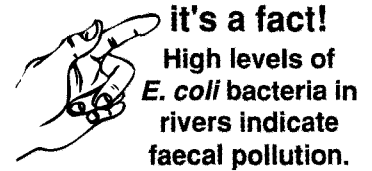
Types of hygiene include:



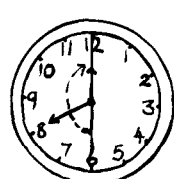

- *Personal hygiene* - such as washing hands after using the toilet
- *Household hygiene* - such as keeping flies away from food
- *Community hygiene* - such as reporting overflowing sewers immediately
- *Environmental hygiene* - such as treating sewage before putting it back into the rivers.



WATERBORNE DISEASES

1. Ask the learners if they know of anyone who has become sick as a result of drinking or swimming in dirty (polluted) water. Discuss the examples given.
2. Ask learners to visit their local library or clinic to find out more about the following diseases and their symptoms:
 - gastroenteritis -typhoid
 - polio -dysentery
 - cholera -yellow jaundice
3. Ask learners to prepare the **rehydration** drink described below. This activity also provides an opportunity of finding different ways to measure 1 litre.

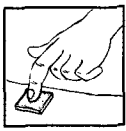


step 1	step 2	step 3
<p>Boil 1 litre of water and let it cool.</p>  <p style="text-align: center;">Add 2 teaspoons of sugar...</p>  <p style="text-align: center;">and ½ teaspoon of salt.</p> 	 <p style="text-align: center;">Stir well</p>	  <p style="text-align: center;">Give the patient 1 teaspoon every half hour.</p>

Take Note!
Before giving someone the rehydration drink, taste it! It should be no more salty than tears.

An easy **rehydration** treatment can be prepared at home and given to the sick person. The drink replaces water and salt and provides the body with sugar for energy. If available add half a cup of orange juice or a little mashed banana. This helps replace the potassium that the sick person has lost.

4. Using the Coliform Bacteria Water Test kit, which can be purchased from Share - Net or Umgeni Water (see Support Sheets), test a local stream, river or dam for *E. coli* bacteria. This is a very simple test that will indicate the level of faecal pollution in the water. Discuss the findings and ask the learners to decide whether the water is safe to use or to swim in.



PHOTOCOPIABLE

activity



Hello Learners! I am a nurse from one of Durban's busy clinics.

Today we are going to learn about

Making Sensible Connections

for good health. First, study the facts and the actions below and then draw lines to join the facts and the actions that go together. Don't be surprised if each fact has more than one action! Discuss your choices in small groups.

its a fact

action



Germs can enter the body through the soles of the feet.

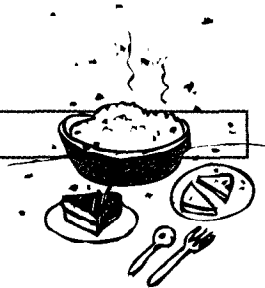
Always wash your hands with soap and water after using the toilet - even if they don't feel dirty



The faeces of babies and small children are just as dangerous as the faeces of adults.

Keep your food and water covered at all times.

Avoid playing in places where people urinate and defecate on the ground.



Flies spread diseases.

Clean the yard of all dog faeces everyday.

Always wash your hands with soap and water after changing the nappy.

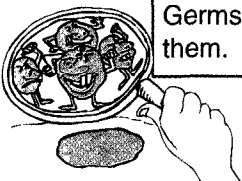
If you use a pit-latrine, always put the toilet lid down and close the toilet door when you have finished.



The shigella dysentery virus can live for up to 17 days on a toilet seat!

Clean toilets everyday.

If you trample on faeces, wash your feet with soap and water straight away.



Germs are so small that we can't even see them.

Help small children to learn to use the toilet.

Always put dirty nappies into a special nappy bucket.

Animal faeces contain many disease-causing bacteria



Never drink water straight from a river - even if it looks clean. Boil it first.

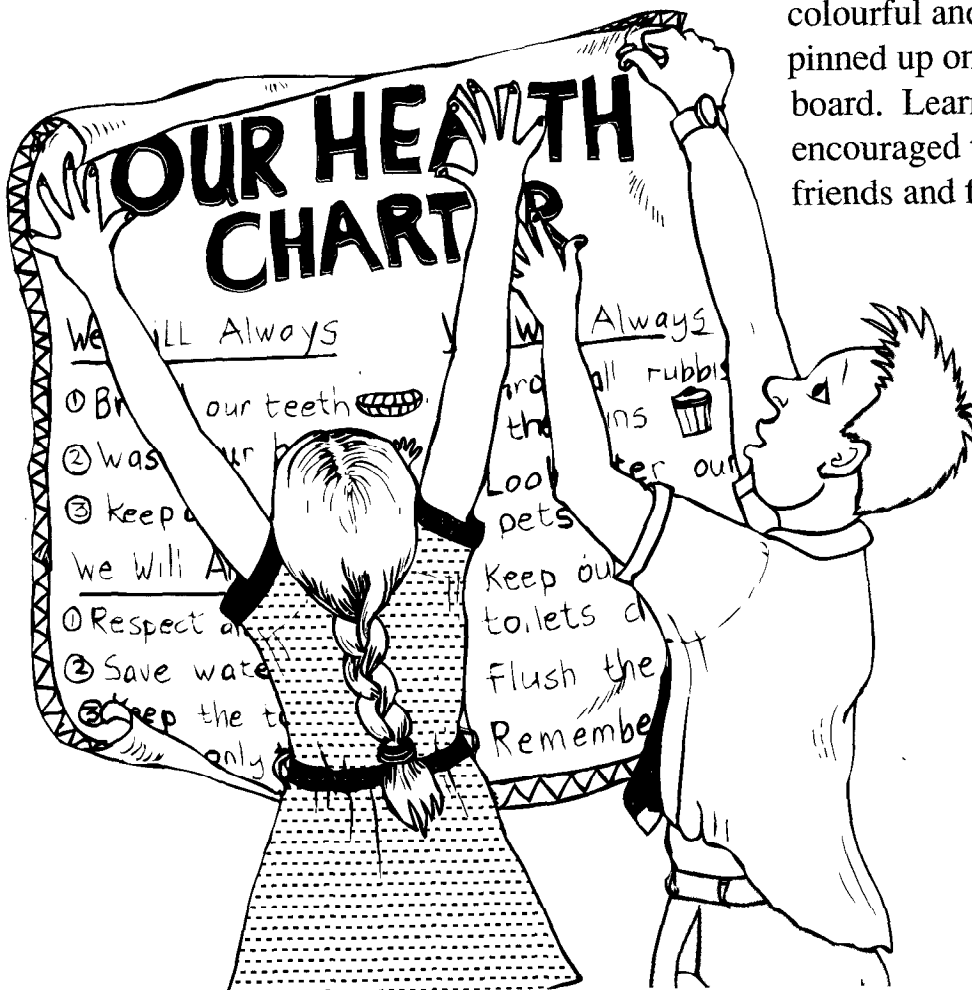


HYGIENE PLEDGES FOR HEALTH AND HAPPINESS

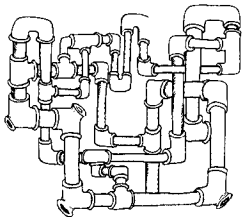
- Discuss with the class the concepts of health and **hygiene**.
- Ask the learners to draw up a:
 - Personal Hygiene Charter
 - Household Hygiene Charter
 - School Hygiene Charter

It may be useful to have the learners first discuss their ideas in groups and to then share their ideas with the whole class.

The final charters can be written up as colourful and attractive posters and pinned up on the classroom notice board. Learners should also be encouraged to share their pledges with friends and family.



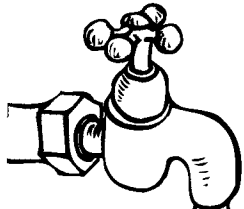
- Pin up your personal hygiene pledge in your bedroom.
- Pin up your household hygiene pledge in your kitchen.
- Pin up your school hygiene pledge in the school toilets.



infosheet

SANITATION SAVES: PREVENTION IS BETTER THAN CURE!

Diseases spread quickly in crowded places. In cities like Durban it is important to dispose of urine and faeces responsibly so that people can stay healthy. Using toilets is the best way of doing this, but they must be used correctly and kept clean.



did you know
the smelly,
pan-closet toilets
of old were
sometimes
known as
thunderboxes!

Many homes are linked to Durban's **waterborne sewerage**. Sewage from houses flow into sewage treatment works where it is 'cleaned-up' and the **pathogenic bacteria** killed. The treated **sewage effluent** is then **discharged** into rivers or the sea.

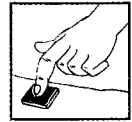
Durban, like many South African cities, is having to cope with a rapid increase in informal settlements. In these areas, dry toilets such as pit latrines or chemical toilets are often used instead of flush toilets.



it's a fact!

the faeces of
babies and young
children is just as
dangerous as the
faeces of adults!



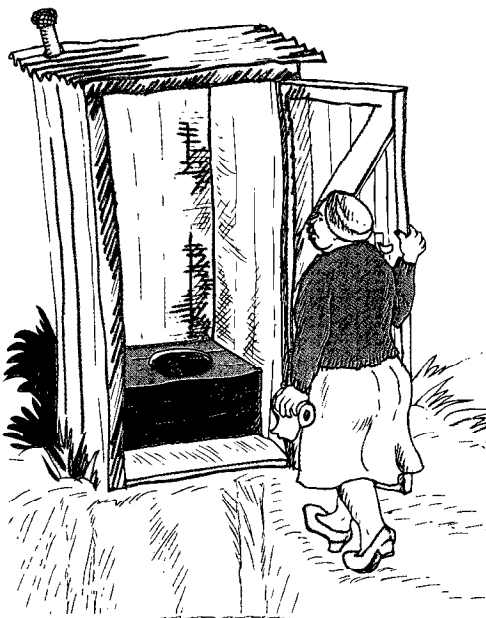


PHOTOCOPIABLE

PEARLS OF WISDOM FOR PIT-LATRINES

Pit-latrines can be a safe and healthy way of disposing of human faeces and urine, if they are built far away from bore-holes and river beds.

REMEMBER: PIT-LATRINES ONLY WORK PROPERLY IF LOOKED AFTER IN THE CORRECT WAY.



- Label a clean piece of paper "Pearls of Wisdom for Pit-Latrines".
- Make 2 columns and give them the headings: DO NOT and DO.
- Cut the blocks out.
- Read through the blocks. Each block should start with either the words 'Do' or 'Do not'. Glue the blocks into the correct column
- Discuss your final lists in small groups
- Prepare interesting and colourful posters using the information on how to look after pit-latrines at home or at school.

...ensure that the toilet door is always closed.

...throw old engine oil into the pit.

...remove the fly screen from the vent pipe.

...ensure good ventilation to the pit-latrine at all times.

...keep the area around the pit-latrine clean. This will stop the spread of disease and keep flies away.

...check that the vent pipe is open to the pit.

...use a disinfectant to wipe the seat regularly. This will kill any harmful bacteria on the seat.

...throw stones, clothes, food-stuffs, plastic, etc. into the pit.

...pour any disinfectants (Jik, Jeyes Fluid, Sanpic, Dettol, Lime etc.) into the pit. These will kill the bacteria and cause the pit to start smelling.

...keep a lid on the opening of the pit. This stops flies laying their eggs and spreading disease. It also prevents small children falling into the pit.

...allow any water to enter the pit. It could cause the sides of the pit to collapse and the ground around the pit will become waterlogged and the pit will not drain.



SCHOOL TOILET AUDIT

1. Ask the learners to complete an **audit** of the school toilets. They can work in small groups. An example of an audit sheet is provided, but classes should preferably be encouraged to develop their own.

Ask the learners to discuss their findings with other groups. The groups must provide reasons for why they are satisfied or dissatisfied with what the audit has revealed. Each learner should then summarise and comment on the findings of the audit in a written paragraph.

A summary of the audit can be presented to the school at assembly, and the other classes encouraged to discuss and plan suitable actions.

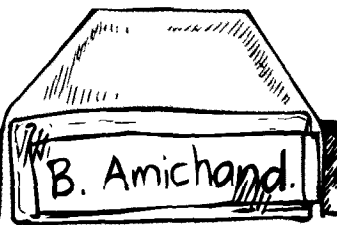
2. If the state of the school toilets is found to be unsatisfactory, ask the learners to plan ways in which the toilets can be made more pleasant to use. The following questions may be useful:

- what needs to be done?
- what will it cost?
- what can we do?
- when can we do it?
- who can do what?
- how can we start?

3. Ask the learners to develop their own pledge on using the toilets responsibly. Learners may wish to extend this beyond the toilets to include the school kitchen or home economics room and the science laboratory.



paint educational
murals in the school
toilets



AUDIT OF SCHOOL TOILETS

TOILETS

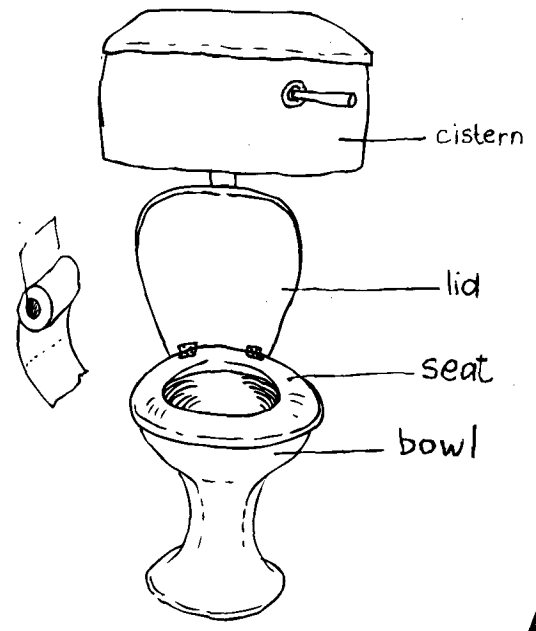
- are they pleasant to use? _____
- what is the condition of the seat? _____
- the cistern? _____
- the bowl? _____
- the floor? _____
- how clean are the toilets? _____
- do the toilets flush properly? _____
- do the toilet doors close/lock? _____
- is there a regular supply of water to the toilet? _____
- is toilet paper provided? _____
- are sanitary bins provided? _____
- number of boys' toilets _____
- number of boys in school? _____
- number of girls' toilets _____
- number of girls in school _____

WASH-HAND BASINS

- are they pleasant to use? _____
- what is the condition of the basin? _____
- the taps? _____
- is the basin clean? _____
- is there a supply of soap? _____
- is there a regular supply of water to the basins? _____
- are rubbish bins provided? _____
- are the rubbish bins used? _____
- are hand towels provided? _____
- are hand towels changed every day? _____

CLEANING / MAINTENANCE

- who is responsible for cleaning the toilets and hand basins? _____
- who is responsible for maintaining and fixing the toilets and hand basins? _____
- To whom do toilet users report dirty, blocked or broken toilets and basins? _____



activity



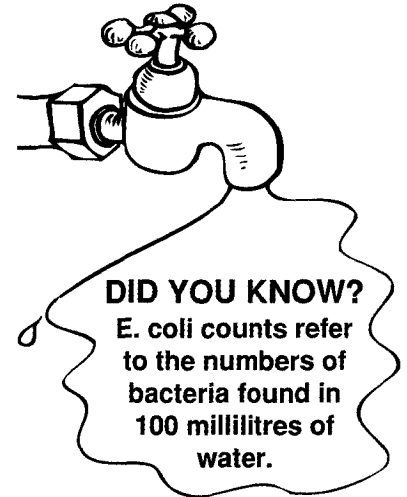
MEDIA WATCH: SEWAGE AND COMMUNITY HEALTH

- Ask learners to collect newspaper articles related to **sewage**, water **pollution**, community health and **waterborne** diseases. Discuss these articles with the whole class.
- Hand out photocopies of the newspaper articles *Durban's 'river of sewage'* and *Durban Deep in the Quagmire*. Ask learners to read them carefully and to answer the following questions. They can work individually or in small groups.



Questions:

1. Use a dictionary and write down the meanings of the underlined words.
2. What does Dr. Robinson mean when he claims that the Cato Manor river is an 'open sewer'? Support your answer with information on *E. coli* counts from the articles.
3. The '*river of sewage*' article tells us that the committee members 'sat in silence' during Dr Robinson's speech. What do you think the writer of the article is trying to say when he gives us this information?
4. What are the costs of the shigella dysentery epidemic? Are all the costs measured in rands and cents?
5. In the '*river of sewage*' article, Dr. Robinson says that the problem must be tackled at its source. What does he mean by this? Support your answer with information on the Cato Manor informal area.
6. Dr Robinson stresses the need to speed up the sewage provision to informal areas. What solutions does he offer
for the long term?
for the short term?

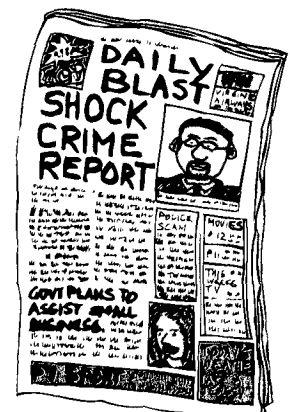


What do you think is the biggest question that Durban Metro has to answer when deciding on solutions?

7. Dr Robinson is worried that increases in *E. coli* counts in the sea may discourage tourists from visiting Durban. Why is the tourist industry important?

Explain what might happen if tourists stopped coming to Durban, using an example from your own knowledge or experience of the tourist industry.

8. Suggest any other ideas of your own which you feel may help to reduce the shigella dysentery epidemic in Cato Crest.



Plan to fight deadly dysentery

Durban's 'river of sewage'

Some of Durban's rivers are no better than open sewers, breeding grounds for killer diseases. ALAN COOPER reports.

Durban civic leaders, shocked at the mounting toll of the deadly dysentery epidemic gripping the province and city, are considering plans to speed up sewage provision to the **informal areas**.

Records show that thousands of people have been referred to city hospitals and hundreds have already died from shigella, a particularly **virulent** strain of dysentery since the epidemic caught the public eye late last year.

The decision to act follows an urgent appeal to the metro council's executive committee from top city health officer Dr Andrew Robinson, who told them Durban's Cato Manor River was effectively an "open sewer".

Committee members sat in silence as the acting deputy city

"Tests on the Cato Manor River have shown that it is to all intents and purposes a sewer."

DR ANDREW ROBINSON
City Health official

medical officer of health spelled out the enormous cost to the province of shigella dysentery epidemic and other diarrhoea-related diseases.

"It costs us R 125 million a year in KwaZulu-Natal to treat shigella cases and another R 940 million a year to tackle other diarrhoeal diseases.

And that doesn't take into account the huge human cost. How do you calculate the loss of a child, of a **breadwinner**?" he asked.

The main symptom of the disease was blood in stools. Other symptoms included, **nausea**,

fever, vomiting and cramps.

Dr Robinson said the conflict in Zaire could have serious implications for KwaZulu-Natal as refugees brought together, drug-resistant strains of the disease.

"It doesn't matter how many hospitals you build: it won't do a thing to prevent the disease. For that you have to tackle it at its **source**".

"Tests on the Cato Manor River have shown that it is to all intents and purposes a sewer. It's no use giving people houses if they're going to have no proper sewage infrastructure, no sanitation," he said.

The incidence of shigella and other similar diseases could be cut by as much as 30%, the moment effective sanitation was implemented.

"Can the city afford to wait 10 years before the basic infrastructure is in place? I'm asking you to **accelerate** that

process so we can take the next developmental step".

"Ancient Greek and Roman cities had this **infrastructure** thousands of years ago."

Exco chairman Margaret Winter described the figures revealed by Dr Robinson as "shocking" and said other senior officials would be called to brief the committee on the **feasibility** of speeding up sewage provision to informal areas.

Durban deep in the quagmire

Durban health officials say run-off from home-built pit toilets and river banks is one of the main causes of pollution in Durban's rivers.

The health and environmental pressures in these areas are staggering.

In Cato Crest an estimated 4 070 shack dwellings are served by a mere 200 informal 'rough' construction ground toilets. This means one toilet facility for about 100 people.

"It is essential that the sanitation plans for Durban be brought forward", said Dr Robinson. "We must cut the red tape and get on with the task. Linking the informal settlements to a sewage system is not an impossible task. It just needs commitment."

This week Dr Robinson shocked Durban civic leaders with a hard-hitting report on the deteriorating health scenario.

He said that, while a proper latrine system connected to a sewage network was the ideal, this would take time and money.

One of the suggestions put forward for a short-term solution was to introduce portable chemical

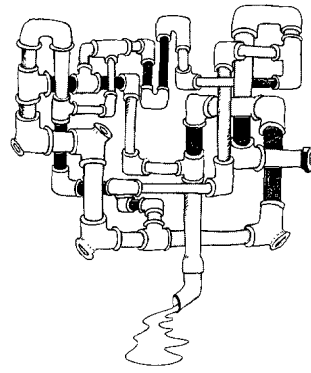
toilets to high risk areas. These could be installed and serviced at a cost of R70 a week.

Said Dr Robinson: "Although this may sound like a large expenditure, it is small compared to the amount spent on treating disease associated with poor sanitation."

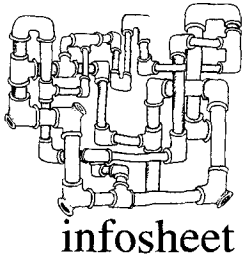
The accepted counts for *E. coli*, the bacterial strain that causes diarrhoeal-related disease, is zero for drinking water and a maximum of 120 for **recreational** water. Recent monitoring showed that the Cato Manor rivers running through Cato Crest had a count of 37 000. The Umgeni River count was 1 500 while rivers in Chatsworth had a count of 13 000.

Latest CSIR reports on 20 strategic beach points showed that the levels of *E. coli* in sea water was still within acceptable limits, although there was a dramatic rise in pollution near river mouths.

"But if the situation deteriorates further, those *E. coli* counts will rise," said Dr Robinson. "For our burgeoning tourist industry it could be very bad news."



sewage
tomorrow



REDUCE, RE-USE, RECYCLE: THE FUTURE STARTS TODAY

Durban is the
4th fastest
growing city in
the world!

More people mean more **sewage**. More industry means more sewage. To be prepared for the future, Durban Metro's Department of Wastewater Management is having to decide how to expand sewage treatment works and where to build new ones. But these developments are expensive. The big question is - who will pay for them?

Perhaps an even bigger question than the money, however treated, is the question about whether nature can cope with bigger loads of sewage being discharged into the rivers and seas. This is a very real worry nowadays, because more and more **non-biodegradable** chemicals are being found in sewage. These **pollutants** cannot be broken down at treatment works and are therefore discharged into the rivers and sea. Many of these chemicals are very harmful to people, animals and plants.

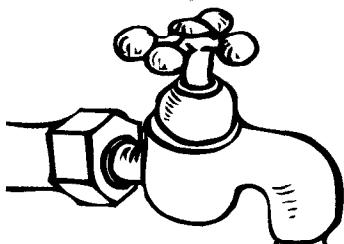
Golf-courses,
parks and farms
can make use of
recycled water.

Re-using and recycling sewage seems to be the way to go in the future. There are also many ways to reduce the amount of water that flows down the sewage drains at our homes, schools and offices. And the good news is that it saves you money too!

Water is a
limited
resource: if
everyone saves
a little we can
all save a lot.

Durban's
Southern
Treatment
Works supplies
a
paper-mill
with 8
megalitres of
recycled sewage
water everyday!





Did you know?
Coal fired power stations need water to generate electricity. Every time a 100 Watt light bulb is left on unnecessarily for 12 hours, almost 3 litres of water is wasted.

WAYS TO SAVE WATER

Treating sewage is expensive! It is important not to pour unnecessary amounts of clean water down the sewage drains. Hold a discussion with learners about ways to save water. The ideas below may be of help for facilitating the discussion. This page can be photocopied (enlarged if possible), coloured in and pinned up on the classroom noticeboard.

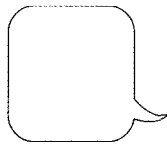
An average bath uses 91 litres and a shower 27 litres

HOW YOU CAN SAVE WATER

Use bathwater for watering the garden.



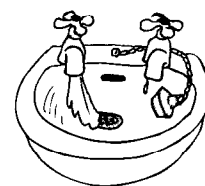
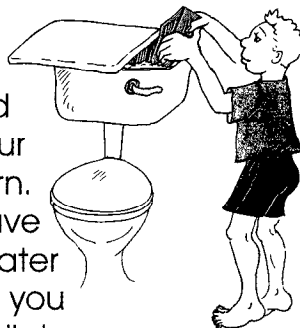
Mend any leaking taps.



Use electrical equipment responsibly.

warning
Remember that washing your hands with soap and water after using the toilet is important. Don't stop doing this to save water.

Wrap a brick in plastic and put it in your toilet cistern. This can save a litre of water every time you flush the toilet.



Turn off the tap while you brush your teeth.

Run shallow baths or have quick showers.



Only run washing machines or dishwashers when there is a full load.

Wash dishes all at once, not one at a time.



INVESTIGATING WATER USE AT SCHOOL: A WATER AUDIT

- Ask learners to guess how much water they use at school each day.
- Learners will need to estimate how much water comes out of the tap each time it is opened. This can be demonstrated by putting a large bowl in the sink and turning on the taps fully for 5 seconds. Then switch off the tap and measure the amount of water in the bowl using 1 litre cooldrink bottles or a measuring jug. Multiply the volume by 12 to give the amount of water flowing in 1 minute. Ask learners to enter the figures on their water log (see example below).
- For a period of 5 days ask learners to time how long they run the taps at school each time they use water. Each time toilets are flushed, learners should record that 10 litres of water is used. At the end of each day they should add up how much water they used in a day.
- At the end of 5 days, ask learners to work out the average amount of water they used each day. To do this they will have to add up their daily totals and divide the answer by 5.
- Learners can also work out the average volume of water used by the class by adding together their personal totals and dividing the answer by the numbers of learners in the class.

Don't throw
the water away
- use it!

Ask learners to discuss their findings. They should also be asked to compare their original 'guesstimate' with the daily average they have worked out. Learners

personal water use totals with the class average.

- Ask learners to plan ways to reduce the amount of water they use each day.

Nandi Majibiko 24/7/97.

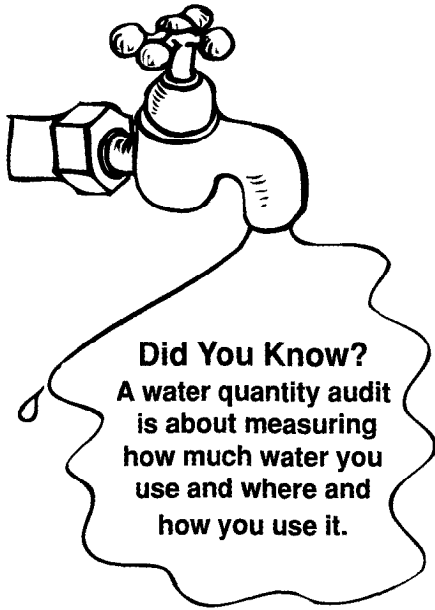
Water Log: Date:

should also compare their

Amount of water flowing from tap in 5 seconds: _____ litres
 Amount of water flowing from tap in 1 minute (60 seconds): _____ litres

Time of day	Activity	Time taken	Amount of Water Used
7:30	<i>toilet</i>	—	10 l
7:35	<i>washed hands</i>	60 seconds	12 l
10:00	<i>Drink of water</i>	45 seconds	8 l

Total for Day _____ litres/day



Did You Know?
A water quantity audit is about measuring how much water you use and where and how you use it.

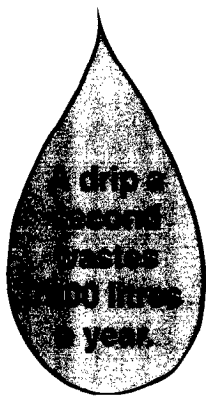
Alternatively, a thorough water quantity **audit** of the school could be undertaken. This is a very exciting exercise which more and more South African schools are doing.

Remember to get the support of other staff and the principal.

A very useful booklet put out by the National Water Conservation Campaign, called *Water Audit*, provides detailed guidance about how to do a water quantity audit. It is obtainable through Umgeni Water or the Durban Environmental Education Centre (see support sheets for contact details).

The following steps can be followed:

1. Ask learners to identify all the things they do at school that use water.
2. Ask learners to identify all other activities at school that uses water eg. watering sports fields.
3. Ask learners to estimate and record how much water each activity uses.
4. Ask learners, teachers and non-teaching staff to count and record why, how often and for how long they use water in a day.
5. Ask learners to work out the total amount of water used in the school per day.
6. Repeat this exercise for a week and ask learners to work out a weekly water-use total for the school.
7. Ask learners to discuss their findings. They should also identify which activities use the most water.
8. Encourage and support learners to set up a Water Action Campaign.



it's a fact!

A primary school in Mitchell's Plain, Western Cape, has worked out that closing the taps of self-flushing urinals after school hours will save them R 6000 per year!





TOILET TECHNOLOGY

With the population growing and the increases in industry, managing sewage in the future is going to be a real challenge! Water pollution has to be controlled. We are probably going to have to re-think how we treat sewage and dispose of the effluent. This will be necessary if we want to keep our communities and our natural environment healthy.

More and more interesting technologies are being put forward for consideration. Some work better than others. One interesting South African innovation is the 'EnviroLoo'. Photocopy the attached newspaper article and ask learners to read it through carefully and answer the following questions. They can work individually or in small groups.

New SA-made 'EnviroLoo' has good export prospects

Reinie Booysen

CONSIDERING the number of bone-dry territories around the world, a new SA-made product must have great prospects as an export item: a toilet that uses no water, gives off no odor, uses no chemicals and provides first-class compost every few years.

It is the result of 15 years' research by retired dentist Brian la Trobe on the problem of raw sewage stabilisation, in association with the municipality of Grahamstown and the Water Research Commission.

La Trobe sees his 'dry compost sanitation system', called the "EnviroLoo", as the perfect solution for the water and sewage problems in dry regions. He said it was gaining acceptability in SA, and his company, Enviro Options, was drawing foreign interest.

Orders were coming in from Botswana, Angola, Ghana and Mozambique and pilot projects were under way in Brazil, Mauritius and the US states of Texas and Arizona. Officials from Israel and China have also been to SA to see the system, said LA Trobe. So far almost 600 units have been installed in SA.

Business Day 13 January 1997

1. Remembering what you know about South Africa's rainfall, why do you think the 'EnviroLoo' could be of great benefit to our country?
2. *Composting toilets* such as the 'EnviroLoo' are claimed to be economical, hygienic and environmentally friendly. Other existing non-flush toilet alternatives in South Africa today include *chemical toilets, pit latrines or buckets*.
Do a comparative study of these 4 toilets. Find out how each operate, the cost of developing them, the cost of maintaining them, and how they are kept free of germs and other unpleasant smells. Also include any other interesting advantages and disadvantages of each. Most importantly, be sure to investigate their impact on nearby soils and water. You can ask your local Council, or Durban Metro's Department of Wastewater Management to help you access relevant information.
3. Explain the term 'pilot project'. It may be useful to use a dictionary.
4. Do you know of any other interesting ideas to do with sewage treatment in the future? Share these with the class.





CELEBRATING WATER DAY, WATER WEEK AND RIVER DAY

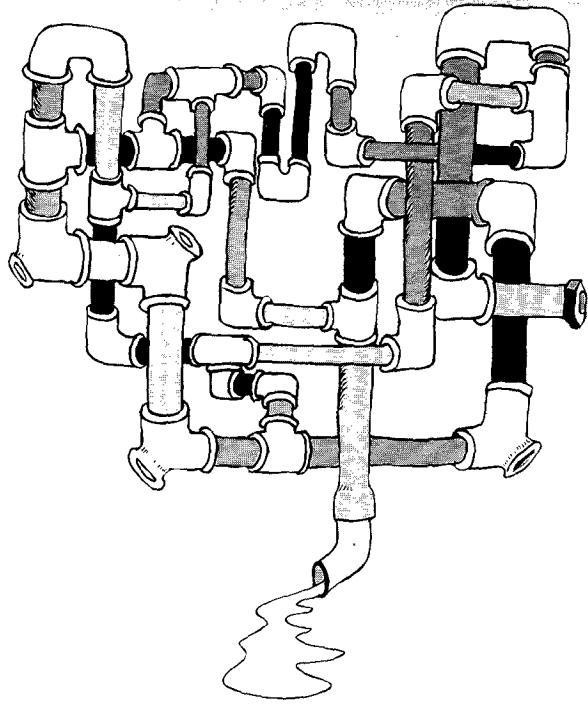
The United Nations General Assembly has chosen 22 March each year as World Water Day. South Africa's Department of Water Affairs and Forestry has chosen the week in which this day falls as National Water Week for our country. The last day of the week is River Day. Each year the department chooses a specific theme for Water Week, and they also produce free posters and other resource materials. To find out what the theme is and to ask for their resource materials write to



*The Department of Water Affairs and Forestry
Communications Division
Private Bag X313
Pretoria
0001
Tel: 012-3387500*



Water Week, Water Day and River Day are good opportunities for focusing attention on sewage in your school. This is the time when the whole school can take part in sewage-related activities. Use Water Week to launch an ongoing project related to responsible sewage disposal.



(for teachers' eyes only!)

MATHS: DOWN THE DRAIN PAGE E8

1. 1 millilitre = *ml* = 1 big raindrop
 1 litre = *l* = 4 cups of water
 1 kilolitre = *kl* = 5 full baths of water
 1 megalitre = *Me* = a 25 m x 25 m school swimming pool

2. 1000 *ml* = 1 *l*
 1000 *l* = 1 *kl*
 1000 *kl* = 1 *Me*
 1000 000 *l* = 1 *Me*
 1000 000 000 *ml* = 1 *Me*

- 3.a) 1 *l* = 1000 *ml*
 c) A teaspoon holds 5 *ml*
 e) A *kl* equals 1000 *l*
 g) A full bath holds 100 *l*
 i) 100 *Me* = 100 000 *kl*
- b) 1 *Me* = 1000 *kl*
 d) A teacup holds 250 *ml*
 f) A bucket holds 5 *l*
 h) A *Me* is 1000 000 bigger than a litre

- 4.a) R 0,23
 b) R 0,11

5. It stands for 20 *Me*

- 6.a) 200 *Me* per day
 c) 40 *Me* per day
 e) 10 *Me* per day
- b) 60 *Me* per day
 d) 50 *Me* per day

- 7.a) 200 000 *kl* per day
 c) 40 000 *kl* per day
 e) 10 000 *kl* per day
- b) 60 000 *kl* per day
 d) 50 000 *kl* per day

- 8.a) 200 000 000 *l* per day
 c) 40 000 000 *l* per day
 e) 10 000 000 *l* per day
- b) 60 000 000 *l* per day
 d) 50 000 000 *l* per day

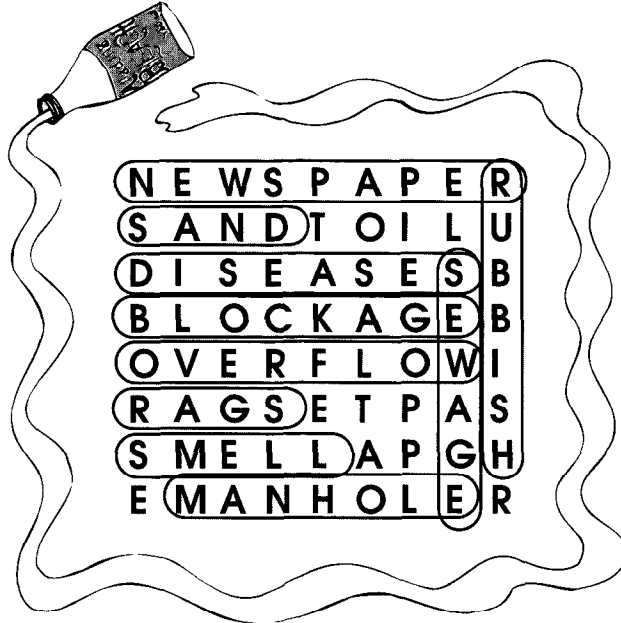
- 9.a) R 22000,00
 c) R 9200,00
 e) R 2300,00
 g) R 18 834 000,00 or 18 million 834 thousand Rand per year
- b) R 66 00,00
 d) R 11500,00
 f) R 51600,00

(for teachers' eyes only!)

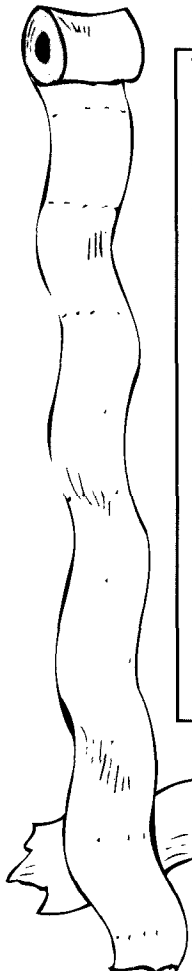
THE WORD SEARCH PUZZLE - Beginners p H.4

- BLOCKAGE✓
- OVERFLOW✓
- SEWAGE✓
- SAND✓
- RAGS✓
- NEWSPAPER✓
- RUBBISH✓
- MANHOLE✓
- DISEASES✓
- SMELL✓

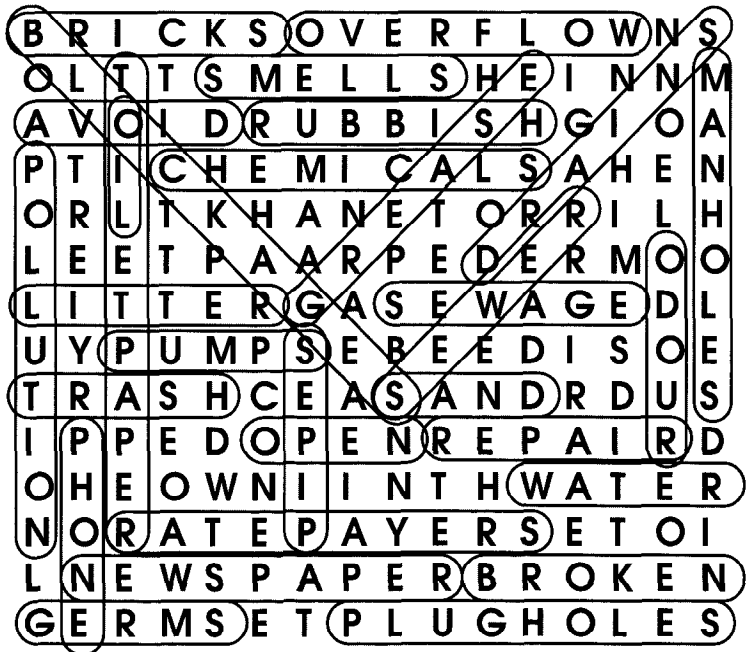
TOILET PAPER



THE WORD SEARCH PUZZLE - Advanced p H.5



- | | |
|--------------|------------|
| TOILETPAPER✓ | LITTER✓ |
| BLOCKAGES✓ | BRICKS✓ |
| SEWAGE✓ | OIL✓ |
| SEWER✓ | WATER✓ |
| PIPES✓ | CHEMICALS✓ |
| PLUGHOLES✓ | TRASH✓ |
| DRAINS✓ | GERMS✓ |
| MANHOLES✓ | PUMPS✓ |
| NEWSPAPER✓ | AVOID✓ |
| OVERFLOW✓ | BROKEN✓ |
| ODOUR✓ | REPAIR✓ |
| POLLUTION✓ | OPEN✓ |
| RATEPAYERS✓ | PHONE✓ |
| GREASE✓ | SMELLS✓ |
| RUBBISH✓ | SAND✓ |



NOTHING OTHER THAN TOILET PAPER MAY BE DISCARDED DOWN IN THE TOILET

CRITICAL CROSS-FIELD OUTCOMES

These outcomes are designed by the South African Qualifications Authority (SAQA) and apply to all the learning areas.

Learners should be able to successfully demonstrate their ability to:

1. Communicate effectively using visual, mathematical and / or language skills in the modes of oral and / or written presentation.
2. Identify and solve problems by using creative and critical thinking.
3. Organise and manage themselves and their activities responsibly and effectively.
4. Work effectively with others in a team, group, organisation and community.
5. Collect, analyse, organise and critically evaluate information.
6. Use science and technology effectively and critically, showing responsibility towards the environment and the health of others.
7. Understand that the world is a set of related systems. This means that problem-solving contexts do not exist in isolation.
8. Show awareness of the importance of effective learning strategies, responsible citizenship, cultural sensitivity, education and career opportunities and entrepreneurial abilities.



TECHNOLOGY

Learners will be able to:

1. Understand and apply the Technological Process to solve problems and satisfy needs and wants.
2. Apply a range of technological knowledge and skills ethically and responsibly.
3. Access process, and use data for technological purposes.
4. Select and evaluate products and systems.
5. Demonstrate an understanding of how different societies create and adapt technological solutions to particular problems.
6. Demonstrate an understanding of the impact of technology.
7. Demonstrate an understanding of how technology might reflect different biases and create responsible and ethical strategies to address them.

ARTS AND CULTURE

Learners will be able to:

1. Apply knowledge, techniques and skills to create and be critically involved in arts and culture processes and products.
2. Use the creative processes of the arts and culture and develop and apply social and interactive skills.
3. Reflect on and engage critically with the arts experience and works.
4. Demonstrate an understanding of the origins, functions and dynamic nature of culture.
5. Experience and analyse the role of the mass media in popular culture and its impact on multiple forms of communication and expression in the arts.
6. Use art skills and cultural expressions to make an economic contribution to self and society.
7. Demonstrate an ability to access arts and cultural processes to develop self esteem and promote healing.
8. Acknowledge, understand and promote historically marginalised arts and cultural forms and practices.

SPECIFIC OUTCOMES

MATHEMATICAL LITERACY, MATHEMATICS AND MATHEMATICAL SCIENCES

Learners will be able to:

1. Demonstrate understanding about ways of working with numbers.
2. Manipulate number patterns in different ways.
3. Demonstrate understanding of the historical development of mathematics in various social and cultural contexts.
4. Critically analyse how mathematical relationships are used in social, political and economic relations.
5. Measure with competence and confidence in a variety of contexts.
6. Use data from various contexts to make informed judgements.
7. Describe and represent experiences with shape, space, time and motion using all available senses.
8. Analyse natural forms, cultural products and processes as representations of shape, space and time.
9. Use mathematical language to communicate mathematical ideas, concepts, generalisations and thought processes.
10. Use various logical processes to formulate, test and justify conjectures.

LIFE ORIENTATION

Learners will be able to:

1. Understand and accept themselves as unique and worthwhile beings.
2. Use skills and display attitudes and values that improve relationships in family, group and community.
3. Respect the rights of people to hold personal beliefs and values.
4. Demonstrate value and respect for human rights as reflected in *Ubuntu* and other similar philosophies.
5. Practice acquired life and decision making skills.
6. Access career and other opportunities and set goals that will enable them to make the best use of their potential and talents.
7. Demonstrate the values and attitudes necessary for a healthy and balanced lifestyle.
8. Evaluate and participate in activities that demonstrate effective human movement and development.

SPECIFIC OUTCOMES

ECONOMIC AND MANAGEMENT SCIENCES

Learners will be able to:

1. Engage in entrepreneurial activities.
2. Demonstrate personal role in economic environment.
3. Demonstrate the principles of supply and demand and the practices of production.
4. Demonstrate managerial expertise and administrative proficiency.
5. Critically analyse economic and financial data to make decisions.
6. Evaluate different economic systems from various perspectives.
7. Demonstrate actions which advance sustained economic growth, reconstruction and development in South Africa.
8. Evaluate the interrelationships between economic and other environments.

HUMAN AND SOCIAL SCIENCES

Learners will be able to :

1. Demonstrate a critical understanding of how South African society has changed and developed.
2. Demonstrate a critical understanding of patterns of social development.
3. Participate actively in promoting a just, democratic and equitable society.
4. Make sound judgements about the development, utilisation and management of resources.
5. Critically understand the role of technology in society.
6. Demonstrate an understanding of the interrelationships between society and the natural environment.
7. Address social and environment issues in order to promote development and social justice.
8. Analyse forms and processes of organisation.
9. Use a range of skills and techniques in the Human and Social Sciences context.

SPECIFIC OUTCOMES

LANGUAGES, LITERACY AND COMMUNICATION

Learners will be able to:

1. Make and negotiate meaning and understanding.
2. Show critical awareness of language usage.
3. Respond to the aesthetic, affective, cultural and social values in texts.
4. Access, process and use information from a variety of sources and situations.
5. Understand, know and apply language structures and conventions in context.
6. Use language for learning.
7. Use appropriate communication strategies for specific purposes and situations.

NATURAL SCIENCES

Learners will be able to:

1. Use process skills to investigate phenomena related to the Natural Sciences.
2. Demonstrate an understanding of concepts and principles, and acquire knowledge in the Natural Sciences.
3. Apply scientific knowledge and skills to problems in innovative ways.
4. Demonstrate an understanding of how scientific knowledge and skills contribute to the management, development and utilisation of natural and other resources.
5. Use scientific knowledge and skills to support responsible decision making.
6. Demonstrate knowledge and understanding of the relationship between science and culture.
7. Demonstrate an understanding of the changing and contested nature of knowledge in the Natural Sciences.
8. Demonstrate an understanding of ethical issues, bias and inequities related to the Natural Sciences.
9. Demonstrate an understanding of the interaction between the Natural Sciences and socio-economic development.

SPECIFIC OUTCOMES

**Metro Wastewater Management
Department
Education and Public Liason Division
PO Box 1038
Durban
4000**

Tel. 031 - 3024667

Services offered include:

- Educational Programmes for schools
- Resource Guide for Teachers (Outcome Based)
- Education & Awareness Campaign for Communities
- Video
- Leaflets and Posters
- Working Model showing the difference between Stormwater & Sewerage systems
- Organised visits to the Sewage Treatment Works
- Technical Library - Reference Material for Teachers Only

**Umgeni Water
External Educational Services
PO Box 9
Pietermaritzburg
3200**

Tel. 0331 - 3411111

Umgeni Water is responsible for supplying water to all people living in the Umgeni and other catchments. The External Educational Services of Umgeni Water is dedicated to education about water and related issues. Services offered include:

- A range of resources for teaching and learning about water. If you would like a catalogue of these materials, write to or telephone Umgeni Water.
- A twice-yearly newsletter called 'On Stream'. This is available at no charge. To receive this newsletter, write to Umgeni Water.
- 'Tailor-made' workshops for teachers in the Pietermaritzburg / Durban area. The workshops can be linked to the curriculum, and include guidance on how to use simple water test kits, and health education.

**Natal Parks Board
PO Box 662
Pietermaritzburg
3200
Tel. 0331 - 471961**

**Share-Net
PO Box 394
Howick
3290**

Tel. 0332 - 303931

Share-Net produce a range of low-cost resource materials for teaching and learning about the environment. Materials include simple field-guides, teacher's guides, picture-building games and information sheets. Contact them for a free copy of their Resources Guide which describes all the materials.

**SWAP
EEPUS: Faculty of Education
University of Stellenbosch
Private Bag X 1
Matieland
7602**

Tel. 021 - 8082292

The Schools Water Awareness Project is supported by EEPUS, with a number of satellites countrywide. Although primarily school-based, SWAP endeavours to develop strong community links.

**KwaZulu-Natal Dep. of
Education and Culture
Durban Environmental Education Centre
49 Lambert Rd.
Morningside
Durban
4001**

Tel. 031 - 234029

Supports Environmental Education in the greater Durban Area.

Shell Educational Services

PO Box 2231

Cape Town

8000

Tel. 021 - 4084112

Shell education services produce a range of resource materials for teaching many subjects, e.g. science, geography and maths. Write off for their free colour catalogue.

Global Rivers Environmental Education Network (GREEN)

National Coordinator: Dr D Schreuder

EEPUS: Faculty of Education

Private Bag X 1

Matieland

7602

Tel. 021 - 8082292

GREEN is an international network for sharing water quality monitoring information ideas.

**Department of Water Affairs and Forestry
Communications Division**

Private Bag X 313

Pretoria

0001

Tel. 012 - 3387500

This department organises Water Day, Water Week and River Day. They also produce free resources such as posters and booklets which follow the theme chosen for Water Week.

**Department of Environmental Affairs and
Tourism**

Communications Division

Private Bag X 447

Pretoria

0001

Tel. 012 - 31039111

EnviroTeach

The Communications Group

PO Box 7870

Johannesburg

2000

Tel. 011 - 8352221

The Wildlife Society of Southern Africa

Environmental Clubs Programme

PO Box 394

Howick

3290

Tel. 0332 - 303931 or 011 - 4863294/5

The Wildlife Society's Environmental Clubs have many benefits for their members, including two full colour educational magazines *African Wildlife* (for older children and adults) and *Toktokkie* (for younger children). Both of these magazines are full of interesting information to help you in your teaching. If you would like to know more about the benefits of being a member of the Wildlife Society's Environmental Clubs, write or telephone for more information.

The National Parks Board

Custos

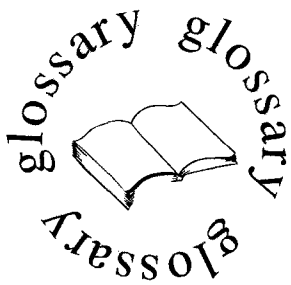
PO Box 787

Pretoria

0001

Tel. 012 - 3439770

This organisation is in charge of all our National Parks, e.g. Kruger National Park, Addo National Park and Karoo National Park. They produce two free magazines, *Custos* and *Young Custos*. Write off and have your name added to their mailing list. Like *Skipper* and *Conserva*, the magazines deal with many issues, including water, that will be of interest to you as a teacher.



AERATION: The mixing or agitation of liquid sewage in order to add in just the right amount of oxygen or air. This helps the 'good' bacteria to break down the pathogens (bacteria that are harmful to humans) more effectively.

AEROBIC SLUDGE DIGESTION: The breakdown of suspended and dissolved matter in the presence of oxygen.

ALGAL BLOOM: The growth of many tiny water plants (algae) in a river or sea, increasingly as a result of unnatural fertilisation of the water by phosphorus and nitrogen. This can lead to the death of plants and animals when the bloom uses up most of the available oxygen.

ANAEROBIC SLUDGE DIGESTION: The breakdown of organic matter brought about by micro-organisms in the absence of oxygen.

AQUATIC: An aquatic plant or animal is one that grows or lives in or near water.

AUDIT: An investigation of an issue using a choice of criteria. These could include financial criteria, environmental criteria or a combination of various criteria.

BACTERIA: Organisms, each of which are made up of a single cell. They can only be seen with a microscope. Many bacteria are essential for human life, but a small percentage (about 2%) are harmful to us. *E. coli*, found in human faeces, is an example of a harmful disease-causing or pathogenic bacteria.

BIODEGRADABLE MATTER: That which can be broken down by natural processes, usually involving bacteria and fungi. Examples include faeces and toilet paper.

BIOLOGICAL PROCESSES: These occur where living organisms perform natural activities. An example is the breakdown of organic solids found in sewage by micro-organisms.

CHOLERA: A serious disease caused by a certain bacterium. It often leads to death. Cholera epidemics arise when people come into contact with water or food contaminated by the faeces of infected people. The supply of enough purified water and the hygienic disposal of sewage help to prevent cholera outbreaks.



COCKTAILS: A mixture of liquids.

CONTAMINATED: Polluted or infected by filth or germs.

DECOMPOSE: To rot or break down into smaller elements.

DEHYDRATE: Too much fluid lost from the body due to fever, vomiting and diarrhoea, etc. This can lead to the failure of normal body functions.

DIARRHOEA: Diarrhoea refers to a 'runny tummy', or the frequent passing of very liquid stools (faeces). Large amounts of water are lost when a person has diarrhoea. This can lead to dehydration which is particularly dangerous in young children.

DIFFUSERS: The short chimney-like structures under the sea through which sewage effluent is discharged. The diffusers are positioned to ensure that the effluent is well spread.

DISCHARGE: The process of releasing the 'cleaned up' or treated sewage also known as sewage effluent, into a river or sea.

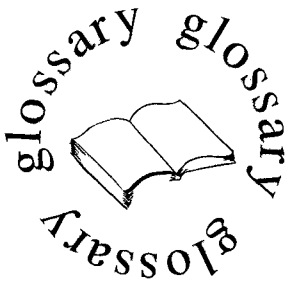
DOMESTIC: Originating out of the home or household.

ELBOW GREASE: A way of saying that a job needs to be done with a good deal of hard work.

FAECES: Human waste from the bowels. Also known as stools.

FERTILISERS: Substances that help plants to grow.

FIELD- GUIDE: A 'hands-on' booklet developed to provide learners with locally relevant information on a specific subject area. Field guides are very useful 'out of doors' during educational excursions.



GASTROENTIRITIS: This is the inflammation of the lining of the stomach which can have many different causes including viral or bacterial infection. Persistent vomiting and diarrhoea may result in severe dehydration, which, in babies and young children, can easily lead to death. Admission to hospital is essential.

HAZARDOUS: Dangerous. Hazardous waste is of risk to people and their environment.

HEAVY METALS: For example mercury and lead. Any metal heavier than water, e.g. mercury and lead. Even small quantities of heavy metals can lead to poisoning.

HYGIENE: The principles and practices necessary for good health.

INCINERATION: The process of destroying solids through burning at very high temperatures.

INDUSTRIAL REVOLUTION: During the late 18th and early 19th Century, there was a sudden increase in mechanical inventions. This led to a rapid increase in the numbers of industries, attracting many people to the cities. Industrialisation and urbanisation resulted in large increases in the amount of sewage discharged into the sewers and rivers.

INSOLUBLE: Matter that will not dissolve in water, for example cooking oil.

MECHANICAL PROCESSES: These involve the use of machinery. For example, the screening of sewage at a treatment works is a mechanical process.

METROPOLITAN: The areas falling under the control of a single local authority. It is usually associated with larger cities, eg. Greater Durban Metropolitan Area.

MICRO-ORGANISMS: Microscopic plants or animals, invisible or barely visible to the naked eye. Examples are some algae, bacteria, fungi, protozoa and viruses.



MONITOR: Checkup to ensure that required standards are being maintained.

MUTATION: A change in the genetic material of an organism. This often leads to harmful side effects such as incomplete foetal development.

NIGHT SOIL: A term describing human faeces deposited in toilets using the bucket system.

NON-BIODEGRADABLE: Materials that cannot be broken down by natural processes, e.g. hard plastics.

NON-RENEWABLE: Resources that, once used, cannot be renewed, e.g. petrol.

NUTRIENTS: Substances that are necessary for growth and life. Nutrients in sewage refer mostly to nitrogen and phosphorus.

ORGANIC: Matter which comes from or off living organisms.

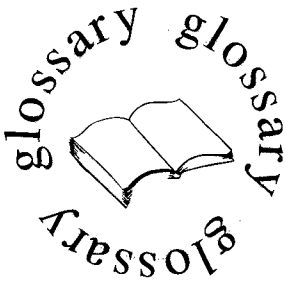
OUTFALL PIPES: Sewage disposal pipes through which 'cleaned up' or treated sewage is discharged into rivers and seas.

PATHOGENIC BACTERIA: Any bacteria that cause disease. Also see bacteria in glossary.

PESTICIDES: Poisonous chemicals produced to kill off pests, including a wide range of insects and other vermin such as rats and mice.

PHOSPHORUS: A chemical element that occurs naturally in human waste and is present in some detergents and fertilizers. Phosphorus is a nutrient that should be controlled in effluent discharge so that algal blooms (eutrophication) can be prevented.

PHYSICAL PROCESSES: These use the principles of physics. For example, gravity is largely responsible for the settling of heavy organic solids in the settling tanks at the sewage treatment works.



POLLUTER-PAYS PRINCIPLE: The system of charging users, especially industry, for both the quantity and quality of sewage discharged into the sewerage system.

POLLUTION: Damage caused to the environment by substances released into it. These substances are known as pollutants.

RECYCLING: Method of removing and re-using certain types of materials.

REGULATIONS: Rules or laws laid down by local, provincial and national authorities.

REHYDRATE: The process of reintroducing fluid into the body after it has been dehydrated.

RENEWABLE: Resources which, if used wisely, can be used again. Water that is well managed is a renewable resource.

SEDIMENTS: Matter that settles to the bottom of a liquid.

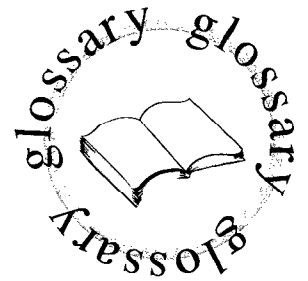
SEWAGE: Waste products and water that are flushed down the drain, toilet or sink. Sewage includes domestic and industrial waste. Because it often contains human waste (faeces and urine), sewage contains many disease-causing organisms. In very populated places, such as towns and cities, it is essential that sewage gets treated before it is discharged into nature.

SEWAGE EFFLUENT: The 'cleaned up' sewage, or final liquid by-product of the sewage treatment process which flows out of a sewage works into a river or sea.

SEWAGE TREATMENT WORKS: A man made centre to where all waterborne sewage is piped for treatment. Here the dirty, contaminated water is 'cleaned-up' before being released back into nature.

SEWERAGE: The system of pipes (usually underground), pumps and treatment works used for effective disposal and cleansing of sewage.

SURVEY: Gaining information through investigation and the asking of questions.



SLUDGE: The solids - heavy organic matter - resulting from the sewage treatment process. This material is separated from the liquid effluent, treated separately and disposed of.

SOLUBLE: Matter that will dissolve in water, e.g. salt.

SOLVENT: A solvent is a substance, usually liquid, in which other substances are able to dissolve. For example, when sugar is added to tea, the water is the solvent.

TOXIC: Poisonous. Toxic chemicals are a source of water pollution.

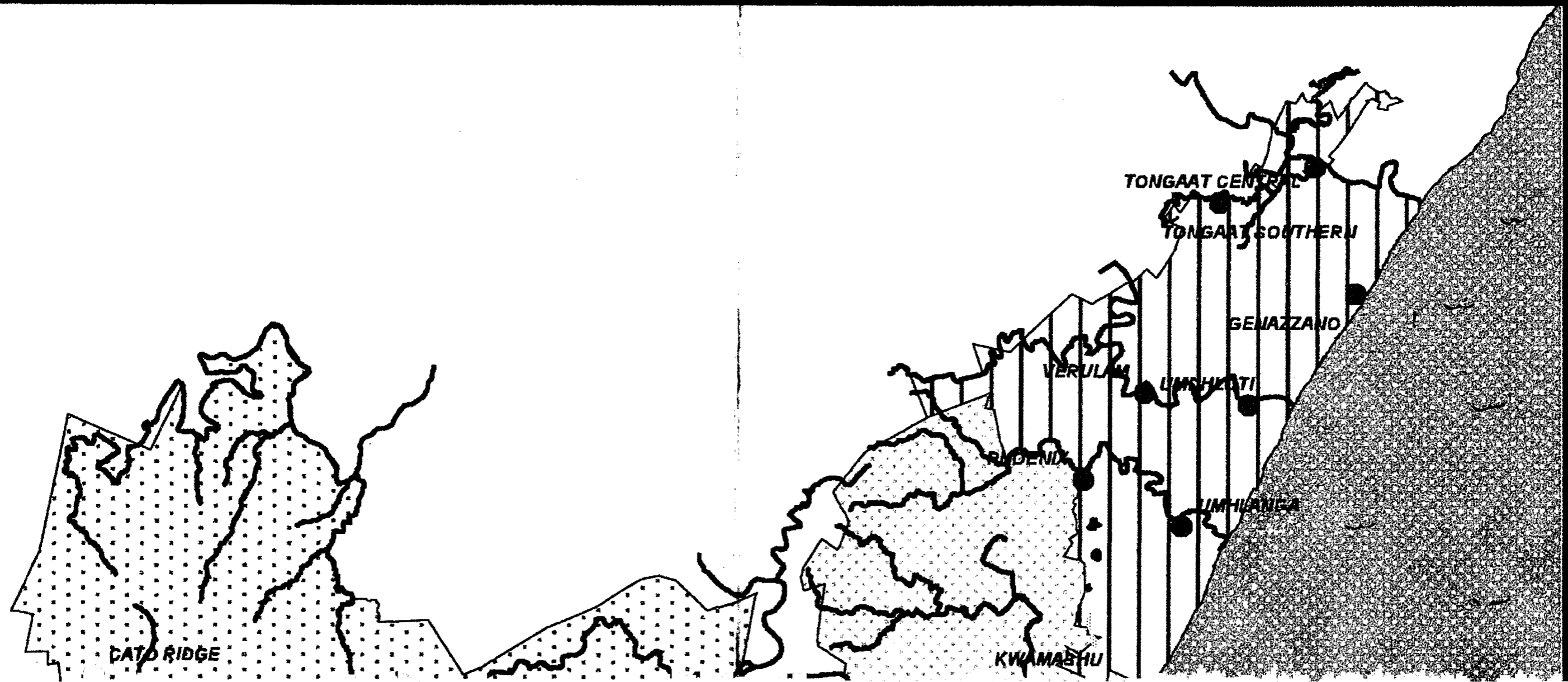
URINE: The fluid people pass when going to the toilet. It contains waste products that the body no longer needs.

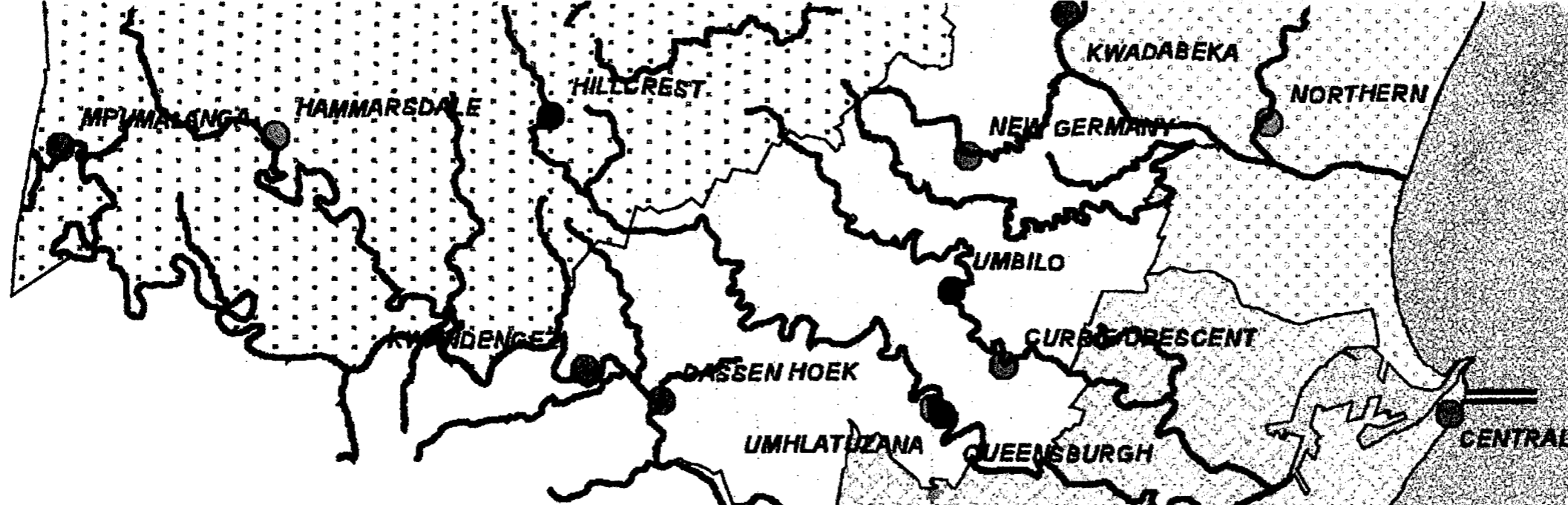
WATERBORNE: Carried in water.

WETLAND: Marshes, bogs, swamps, vleis and sponges are examples of wetlands. Wetlands are difficult to define because of their great variation in size and location. The most important features of wetlands are: waterlogged soils covered with a shallow layer of water, unique soil types and plants that are especially adapted to waterlogged soils.

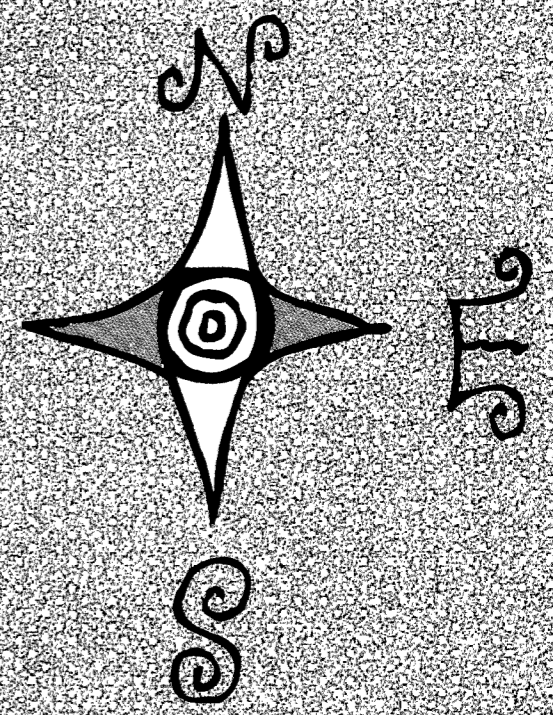
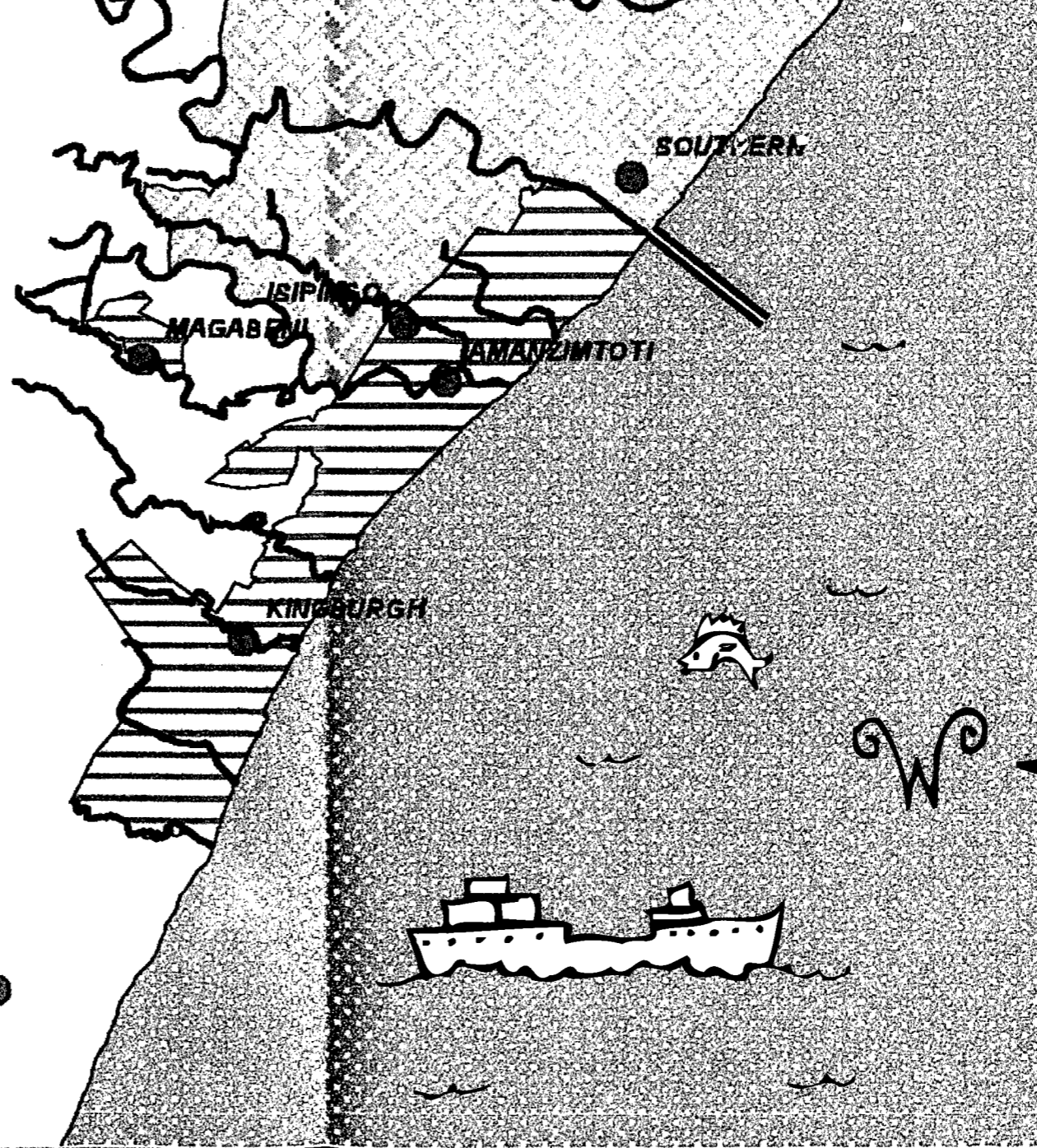
TYPHOID: A bacterial infection from food or water contaminated with human faeces. The bacteria responsible are also found in dairy products and undercooked meat. Prevention of typhoid depends on good sanitation and proper hygiene among food handlers.

DURBAN METRO SEWERAGE MAP

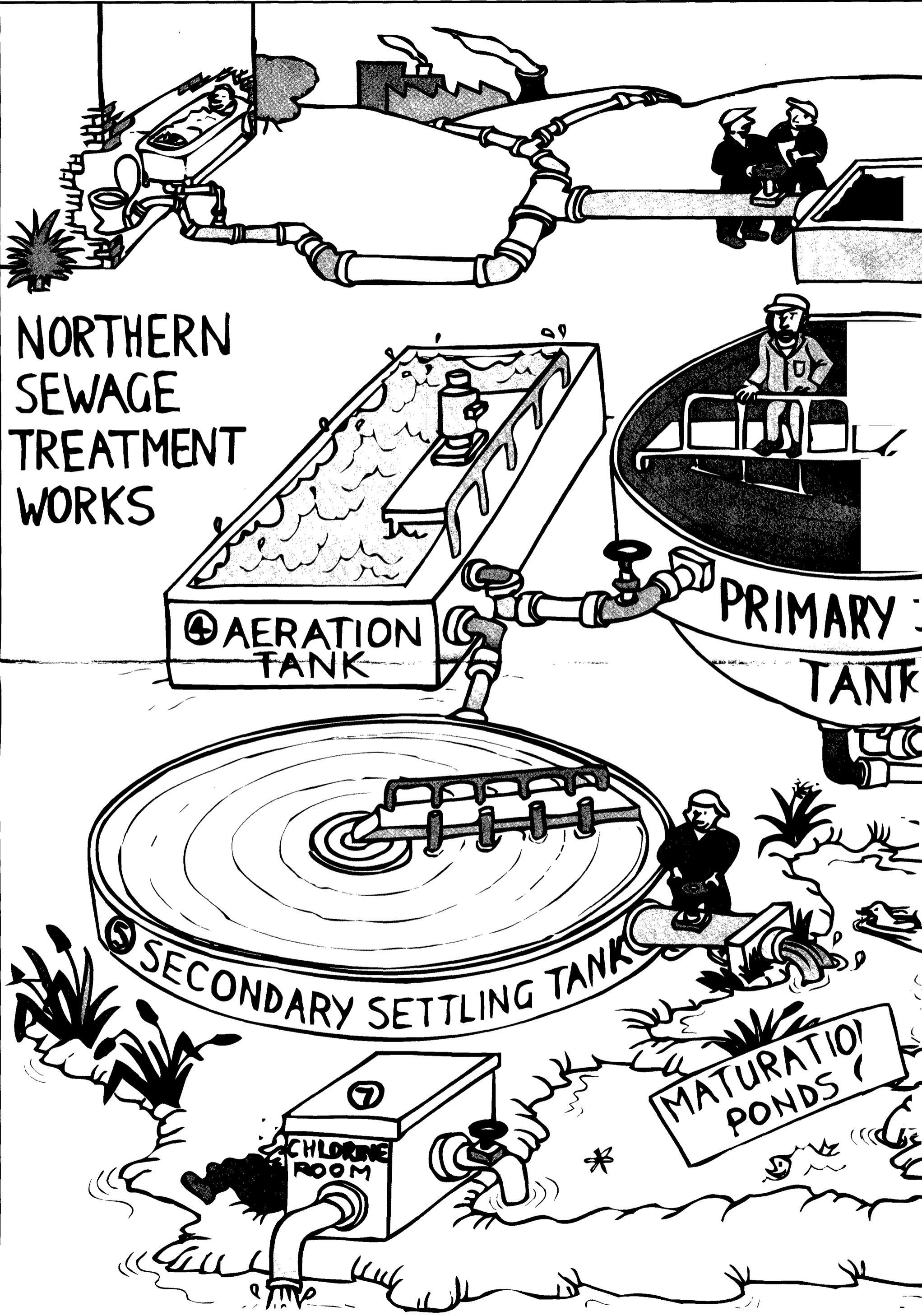




	NORTH
	OUTER WEST
	NORTH CENTRAL
	INNER WEST
	SOUTH CENTRAL
	SOUTH
	SEWAGE TREATMENT WORKS
	MARINE OUTFALL PIPES



NORTHERN SEWAGE TREATMENT WORKS



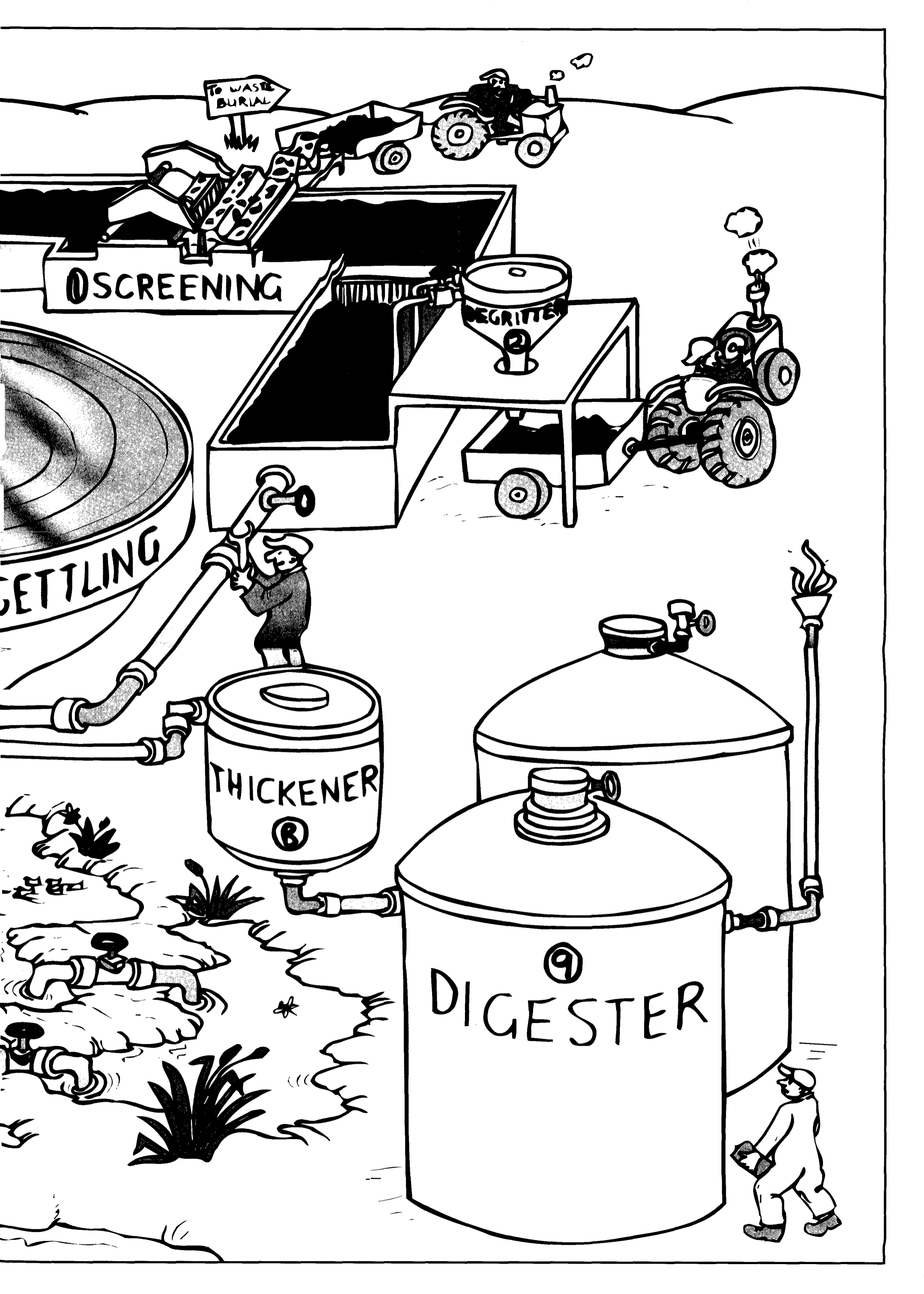
④ AERATION
TANK

PRIMARY
TANK

⑤ SECONDARY SETTLING TANK

⑦ CHLORINE
ROOM

MATURATION
PONDS



TO WASTE BURIAL

1 SCREENING

2 DEGRITTER

SETTLING

3 THICKENER

4 DIGESTER

