THE WATERWHEEL

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Water Kidz

WATER RESEARCH COMMISSION

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Editorial offices:
Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa.
Tel (012) 330-0340. Fax (012) 331-2565.
WRC Internet address: http://www.wrc.org.za
Editor: Lani van Vuuren, E-mail: laniv@wrc.org.za; **Editorial Secretary**: Mmatsie Masekoa , E-mail: mmatsiem@wrc.org.za;
Layout: Drinie van Rensburg, E-mail: drinievr@wrc.org.za

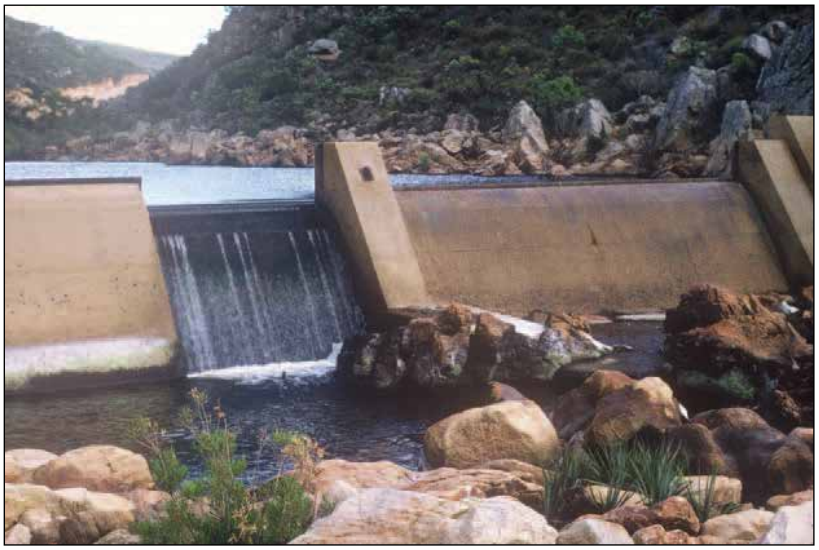
WATER Kidz

Dams in South Africa

In South Africa we depend mostly on rivers, dams and underground water for our water supply. The country does not get a lot of rain, less than 500 mm a year. In fact, South Africa is one of the 30 driest countries in the world. To make sure that we have enough water to drink, to grow food and for industries, the government builds dams to store water.

A typical dam is a wall of solid material (like concrete, earth and rocks) built across a river to block the flow of the river. In times of excess flow water is stored behind the dam wall in what is known as a reservoir.

These dams make sure that communities don't run out of water in times of drought. About half of South Africa's annual rainfall is stored in dams. Dams can also prevent flooding when there is an overabundance of water. We have more than 500 government dams in South Africa, with a total capacity of 37 000 million square metres (m^3) – that's the same as about 15 million Olympic-sized swimming pools!



There are different types of dams:
Arch dam: The curved shape of these dams holds back the water in the reservoir.
Buttress dam: These dams can be flat or curved, but they always have a series of supports of buttresses on the downstream side to brace the dam.
Embankment dam: Massive dams made of earth and rock. They rely on their weight to resist the force of the water.
Gravity dam: Massive dams that resist the thrust of the water entirely by their own weight. Usually made of concrete.

THE BIGGEST DAM IN SOUTH AFRICA

The Gariep Dam, in the Free State, is the biggest dam ever built in South Africa. Constructed in 1972, it stores water from the Orange River in a 100 km-long dam with a surface area of 374 km^2.

The dam can store about 5 500 million cubic metres (m^3) of water. The dam is a combined gravity and arch dam, built entirely of concrete. The dam wall is 88 m high and contains about 1,73 million m^3 of concrete. Gariep Dam is a double curvature structure, which means it is shaped like an egg shell.

The dam forms part of the Orange River Project, one of the largest African irrigation projects, which was started in 1966. Its purpose is to provide water for the irrigation of 22 400 hectares of land for agricultural use and, at the same time, to provide drinking water for the cities of Bloemfontein and Port Elizabeth.

DAMS AND THE ENVIRONMENT

Dams are not always a good thing. If they are not planned properly they can have devastating effects on rivers and freshwater ecosystems. It is very important that dam sites are chosen that will have the least impact on the environment. Dams can change the hydrology of the river and disturb the seasonal fluctuations. Dams also change daily flows by releasing water as a reaction to demands for irrigation, energy and so on. Furthermore, the transport of sediment along the river can be disrupted. This affects the morphology of the riverbed, downstream flood plains and even coastal deltas, and in turn impacts on the ecosystems in these areas.

Migratory fish species are said to be particularly vulnerable to dams, which block access to their spawning or feeding sites. These days, new dams include fish ladder structures built in the river to allow fish to get safely through the dam to the other side of the river.

For these reasons, the South African government requires that an environmental impact assessment be undertaken before any dam project, and the an environmental management plan is drawn up to ensure the least damage to the environment and surrounding communities.

DAM FACTS AND FIGURES

- According to the World Commission on Dams there are an estimated 48 000 dams worldwide over 15 m high. About half of these are in China.
- There are about 1 500 dams under construction worldwide at present.
- It takes about four years to build one dam.
- The highest dam in the world is the Rogun Dam in Tajikistan which is 335 m high.
- The Three Gorges Dam, which is being built in China, will be the largest concrete dam in the world. When it is completed in 2009, the dam will stretch almost two kilometres across the Yangtze River and soar 183 m above the valley floor. The reservoir will be 563 km long.

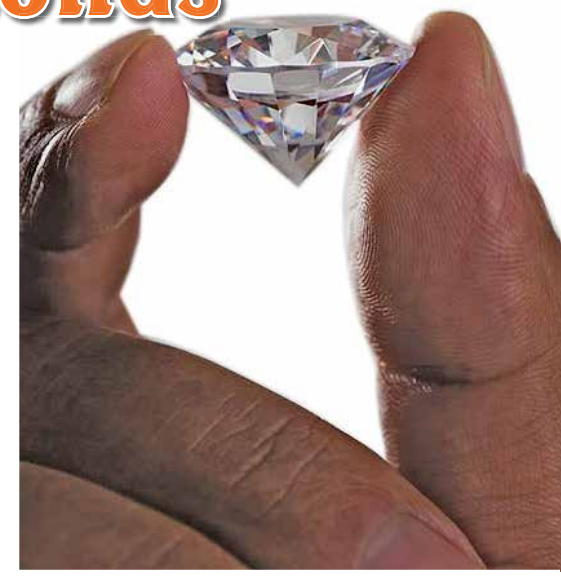
Source: World Wildlife Fund

WATER WORDS

Ecosystem: An interconnected and symbiotic grouping of animals, plants, fungi and micro-organisms.
Flood plain: Area bordering a river which is flooded when the river rises over its normal banks.
Hydrology: Science that deals with the transportation and distribution of water in the atmosphere, on and beneath the earth's surface.
Sediment: Material deposited by water.

WATER Kidz

The Orange – River of Diamonds



Known as the Gariep or 'the Great River' by the indigenous Nama people, the Orange River when viewed for the first time, is said to be an impressive sight.

At more than 2 000 kilometres long, the Orange River is the longest river in South Africa. The river is a political and geographical divide, separating Namibia from South Africa and the massive sand dunes of the lower Namib Desert from the swept-rock moonscape of northwestern Namaqualand. The Orange River basin is the largest of all the so-called international river basins in southern Africa, both in terms of physical size, and in terms of volume of water (mean annual rainfall) involved. The river has a total catchment area of about 1 000 000 square kilometres of which almost 600 000 square kilometres is inside South Africa, with the remainder in Lesotho, Botswana and Namibia.

Along with its main tributary, the Vaal, the river conveys nearly 23% of the total surface water of South Africa.

The Orange River catchment varies dramatically both in climate and topography from east to west. To the east, at the source of the Orange River high in the Lesotho Highlands, the precipitation, some of which occurs as snow, can exceed 2 000 millimetres a year in places which, together with the relatively shallow soil cover and low evaporation results in significant run-off.

As the river progresses towards the west, the lush pastures of Lesotho are gradually transformed into harsh but impressive desert areas where only the most drought resistant plants can grow. It is reported that the desert areas of the lower Orange basin are among the driest in the world with an average rainfall of less than 50 millimetres a year and annual potential evaporation of more than 3 000 millimetres in some areas. The river eventually connects with the Atlantic Ocean at Oranjemund. There are many deposits of alluvial diamonds along the Orange River. In fact, the first diamond discovery in Africa was made on the banks of the river in 1867.

Courtesy of SA Tourism

Arguably the most dramatic point on the river occurs at the Augrabies Falls where the mighty Orange plunges 56 metres in a deafening and breathtaking explosion of power. Legend has it that the biggest cache of diamonds in the world lies in the swirlhole eroded into the granite at the foot of the waterfall by the thundering waters. The name of the falls is derived from the Nama name meaning 'Place of Big Noise'.

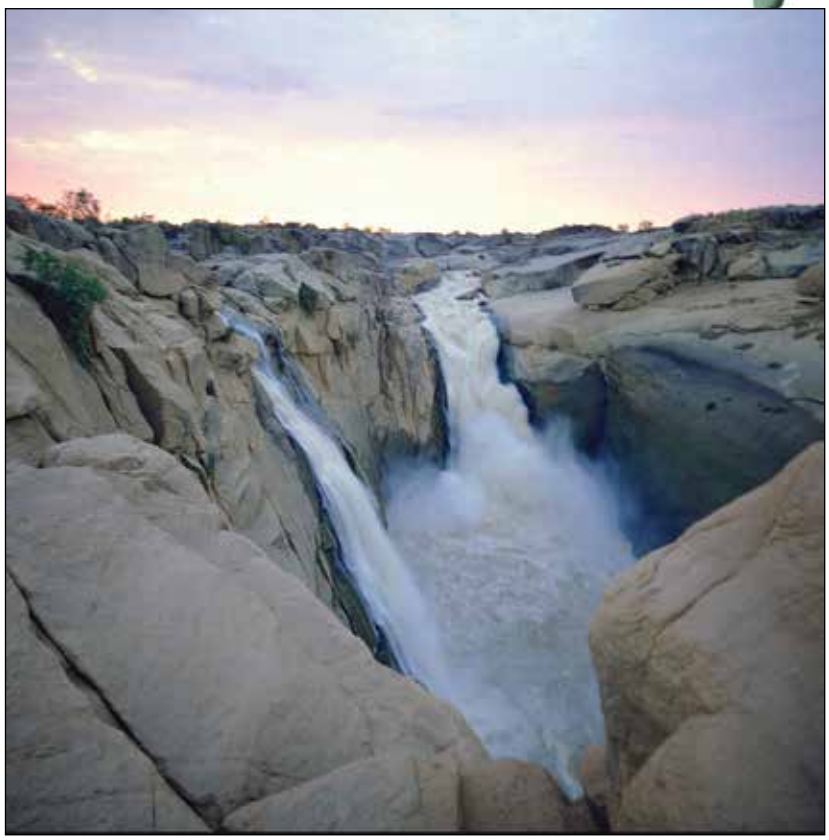
The Orange River is the most developed of all the rivers in southern Africa. Historically, the average runoff from the total basin was more than 12 000 million cubic metres a year, but extensive developments over the

decades have resulted in the runoff reaching the river mouth being much less. The first time the Orange was dammed was in 1929, when Buchuberg Dam was built.

Today, there are at least 29 dams in the basin with a storage capacity of more than 12 million cubic metres. The largest of these is the Gariep Dam with a storage capacity of 5 600 million cubic metres (also South Africa's largest dam), and the Vanderkloof Dam, with a storage capacity of 3 200 million cubic metres. More recently the Katse and Mohale dams have been constructed as part of the Lesotho Highlands Water Project to bring much needed water to Gauteng.

The Gariep Dam forms the central structure of the original Orange River Project which involves the supply of water to parts of the Vaal, Fish and Sundays catchments as well as to irrigation along the Orange River itself.

Another major construction is the Orange-Fish tunnel which diverts water from the Gariep Dam towards the Eastern Cape with a maximum capacity of 54 cubic metres a second. The main purpose of the tunnel is to divert water to the Eastern Cape for irrigation, urban and industrial use. At 82,45 metres long, this is the longest tunnel in the world. The Orange-Fish tunnel, which is 405 metres below ground level at its deepest point, took 12 years to construct, and was officially opened by then Prime Minister BJ Vorster on 22 August 1975. The tunnel has a diameter of 5,3 metres, large enough for a train to drive through.



Courtesy of SA Tourism

Development in the Orange River Basin, it seems, has still not come to an end. In August 2005, the Namibian government and South Africa's Department of Water Affairs & Forestry announced that the possibility of building a dam on the Lower Orange River is being studied. In the same month, Lesotho and South Africa announced that the second phase of the LHWP is under investigation.

Courtesy of SA Tourism

WHAT'S IN A NAME?

Contrary to popular belief, the Orange River was not named after the reddish orange colour of its silt-laden water. It was, in fact, named in 1779 by Colonel Robert Gordon, the commander of the garrison of the Dutch East India Company during a reconnaissance into the interior, in honour of the Dutch Royal House of Orange.

WATER Kidz

Groundwater – More Valuable Than Gold

Water can be found all around us. In streams, rivers and dams and even in the air. Water can also be found under the ground. Groundwater is an important part of the water cycle.

Groundwater comes from rain, snow, sleet and hail that soak into the ground. The water moves down into the ground because of gravity, passing between particles of soil, sand, gravel, or rock, until it reaches a depth where the ground is filled, or saturated, with water.

The area that is filled with water is called the saturated zone and the top of this zone is called the water table. The water table may be very near the ground's surface or it may be hundreds of metres below.

Although groundwater exists everywhere under the ground, some parts of the saturated zone contain more water than others. An aquifer is an underground formation of permeable rock or loose material which can produce useful quantities of water when tapped by a well. These aquifers may be small, only a few hectares in area, or very large, underlying thousands of square kilometres of the earth's surface.

Even if groundwater isn't used by people it may still play an important role in the local environment and sustain rural livelihoods in that way.

GROUNDWATER IN SOUTH AFRICA

Groundwater, despite its relatively small contribution to bulk water supply (13%), represents an important and strategic water resource in South Africa. Owing to the lack of perennial streams in the semi-desert to desert parts, two-thirds of South Africa's surface area is largely dependent on groundwater. In these water-scarce areas, groundwater is more valuable than gold.

Although irrigation is the largest user, the supply to more than 300 towns and smaller settlements is also extremely important. Groundwater has also become a strategic resource for village water supply in the wetter parts of the country, because of its cost-effectiveness in a widely scattered small-scale-user situation.

DID YOU KNOW?

About 22% of the world's available freshwater is stored underground.

Over about 90% of the surface of South Africa, groundwater occurs in hard rock. Groundwater in these rocks is contained in fractures and in dolomite and limestone, in dissolved openings called fissures.

Hard rock aquifers are known as secondary aquifers because the groundwater occurs in openings which were formed after the rock was formed. Over the remainder of the country groundwater occurs in primary aquifers. These comprise porous sediments and groundwater is contained in the spaces between sand grains.

Primary aquifers are found in river (alluvial) sediments, in coastal sand deposits, and in the Kalahari deposits.

GROUNDWATER POLLUTION

Just because water is underground doesn't mean it can't be polluted. Groundwater can be contaminated in all sorts of ways. Pollutants dumped on the ground or in landfills may leach into the soil, and work their way

GROUNDWATER WORDS

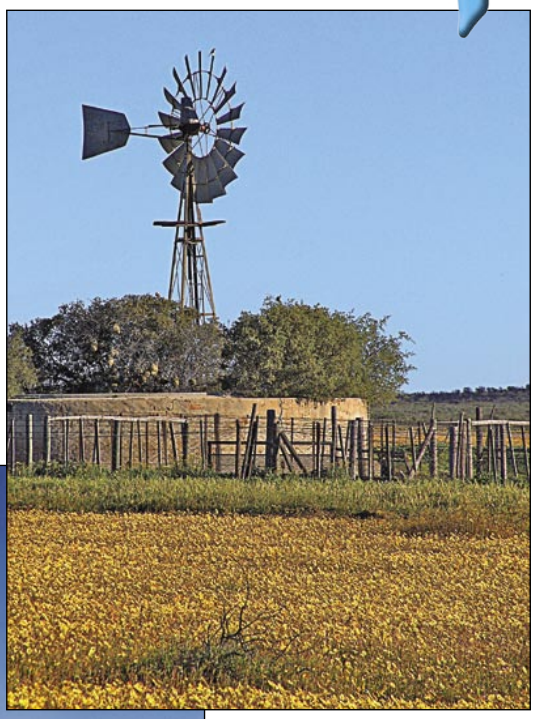
Aquifer: A geologic formation(s) that bears water. A geological formation or structure that stores and/or transmits water, such as wells and springs.
Baseflow: Streamflow coming from groundwater seepage into a stream.
Groundwater: Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.
Recharge: Water added to an aquifer. For instance, rainfall that seeps into the ground.
Water table: The top of the water surface in the saturated part of an aquifer.

down into aquifers. Pollutants include substances that occur as a liquid (such as oil); or can be dissolved in water (such as nitrate) or are small enough to pass through the pores in soil (such as bacteria).

Movement of water within the aquifer is then likely to spread the pollutant over a wide area, making the groundwater unusable. Typical contamination sources include on-site sanitation (such as unlined latrines); waste disposal sites; burial sites; and animal husbandry.

OVER-ABSTRACTION

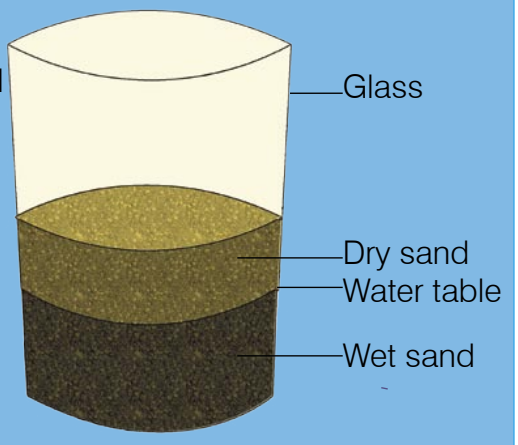
While groundwater is an abundant resource it does not mean we should waste it. The maximum quantity of groundwater that can be developed economically is estimated at about 6 000 million m^3 a year.



Some groundwater resources take a long time to replenish. If too much groundwater is extracted too fast, it may become depleted. Therefore, it is important to decide how much water can be extracted from an aquifer before it is developed.

MAKE A GROUNDWATER MODEL

Take a glass or clear plastic container and fill it with sand. Pour some water into the sand. This shows how water collects under the ground. Pour some water into the sand. What happens to the level of the water? We call this top level of the water the water table. Take a drinking straw and put it down into the wet sand. The straw is like a borehole. Suck up some water. What happens to the water table now?



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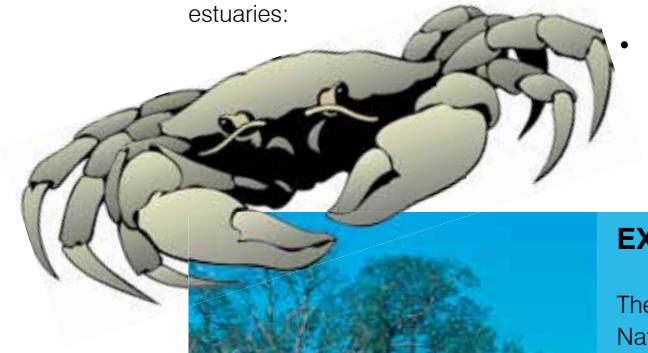
NURSERIES OF THE ENVIRONMENT

Estuaries, the places where rivers meet the sea, are among the most productive yet threatened habitats in South Africa.

Estuaries and the lands surrounding them are places of transition from land to sea, and from freshwater to saltwater. Although influenced by the tides, estuaries are protected from the full force of ocean waves, winds and storms by the reefs, barrier islands, or fingers of land, mud or sand that surround them.

Due to regional differences in geology, biology, hydrology and land use, each estuary is unique, though all have fundamental properties in common. South Africa has more than 250 estuaries.

There are several different types of estuaries:



- **Permanently open estuaries**: Usually quite large systems with a perennial river and/or strong tidal exchange with the sea. For example, the Breede and Swartkops estuaries.
- **Temporarily closed/open estuaries:** These estuaries are often closed for many months of the year and sometimes for more than a year at a time. For example, the Van Stadens and Mhlanga estuaries.
- **River mouths:** All rivers flowing into the sea have a river mouth. However, estuaries under this category are usually permanently open to the sea. For example, the Orange and Thukela estuaries.
- **Estuarine lakes:** These estuaries occur where a coastal lake is connected to the sea by a channel of varying length and width. For example, St Lucia and Kosi estuaries.
- **Estuarine bays:** These estuaries have wide mouths with strong tidal exchange resulting in a continuously open mouth, and the regular replacement of sea water in the lower and middle reaches. For example, Durban Bay and Knysna.

The Durban harbour is an example of an estuarine bay.

EXAMPLE OF AN ESTUARY: ST LUCIA

The Greater St Lucia Wetland Park on the KwaZulu-Natal coast is a United Nations World Heritage Site. Like many tidal estuaries, Greater St Lucia has diverse wildlife reflecting the concentration of diverse ecosystems. Among the animals to be found there are the white-backed and pink-backed pelican, flamingos, fish eagles, and some 530 other bird species. Two sea turtle species use the beaches for laying eggs. It is also home to the largest population of hippopotamus in South African parks.

The estuary is the largest in Africa and boasts, among other attractions, the world's largest forested sand dunes. It is the only park on the continent where you can find hippopotamus, crocodiles and sharks all in the same area.

Swamps along the border of the lake, and 'sponge' areas are fed by water seeping through the dunes. These provide critical refuge to freshwater life when the lake salinity (salt content) is particularly high.

For centuries, people have come to the St. Lucia Estuary for the food, materials, and beauty that it and the surrounding wetlands offer. To this day, thousands of Zulu people harvest ncema grass (*Juncus kraussii*) each spring, which they use to make sleeping and sitting mats.

DID YOU KNOW?

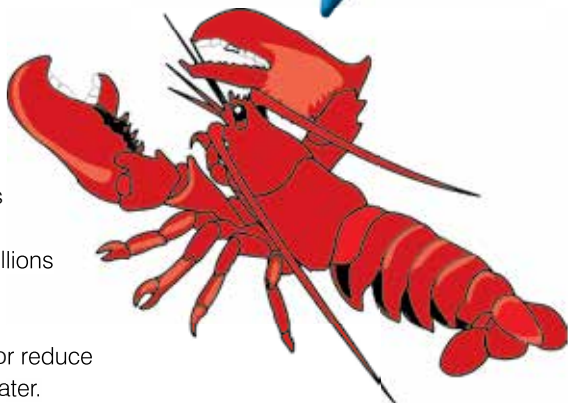
Estuaries are among the most productive natural systems on earth due to the mixing of nutrients from land and sea.

WHY ARE ESTUARIES IMPORTANT?

Estuaries are focal points for community and business activities along the coast as they provide us with a range of opportunities and benefits. They are an important location for cultural and recreational activities for coastal residents and visiting tourists.

Not only do estuaries enhance the quality of life for households, but they also provide numerous opportunities for jobs and income generation. Many businesses rely on estuaries to perform functions which have economic value, such as providing a nursery for marine fish and crustaceans (like certain types of crabs and prawns), for transport or for a place to provide facilities for tourists which, in turn, helps to support business and jobs in the coastal region (think of places like Durban, Knysna and Kosi)

Estuaries are often called the nurseries of the sea. More than 100 species of fishes, prawns and crabs in South African off-shore waters use estuaries as nurseries and/or feeding grounds.



The lifecycle of most of these species involves egg production at sea, often close inshore and near an estuary mouth. Eggs and larvae develop at sea, but the larvae and juveniles migrate to estuaries in great numbers. In fish, this migration takes place mainly during late winter, spring and early summer when millions of juveniles swim into estuaries.

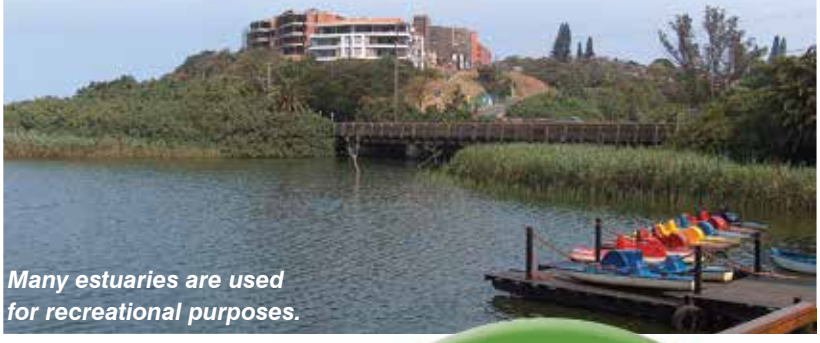
Estuaries also have the ability to control or reduce flooding, while improving the quality of water.

WHAT THREATENS ESTUARIES?

Because estuaries are so beautiful and useful to us, many people live around them and make use of them. Unfortunately, as more people flock to the shore, we are upsetting the natural balance of estuaries and threatening their health.

We endanger our estuaries by polluting the water and building on the lands surrounding them. These activities can contribute to unsafe drinking water, beach closings, declines in fisheries, loss of habitat, fish kills and a host of other human health and natural resource problems.

Development can damage or even destroy estuaries. In the past, many people thought estuaries were wasted land and many estuaries where filled in and built on. Today, we are much more aware of the important role estuaries play in the environment and many people are working to save these areas.

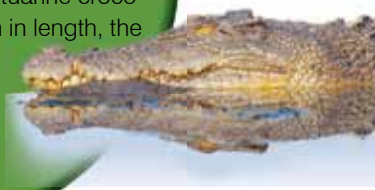


Many estuaries are used for recreational purposes.

More than 100 species of fishes, crabs and prawns in South Africa use estuaries as nurseries and/or feeding grounds.

INTERESTING FACT

The largest reptile in the world is found in estuaries. It is called the estuarine or saltwater crocodile, and can be found throughout the tropical regions of Asia and the Pacific. The Bhitarkanika Wildlife Sanctuary in Orissa State, India, houses four protected estuarine crocodiles measuring more than 6 m in length, the largest being over 7 m long. There are several unauthenticated reports of specimens up to 10 m in length.



WATER Kidz

Saving SA from Alien Invasion

The future of South Africa's natural resources is threatened by the invasion of aliens. No, not little green space men, but rather species from other parts of the world that are taking over our ecosystems, using up the country's scarce water resources.

Invasive alien plants constitute one of the greatest single threats to conservation in South Africa. Some of these invaders arrived by accident, however, the majority were introduced deliberately by people who thought it a good idea at the time. Many alien species were imported for commercial reasons (such as forestry) or as ornamental garden plants.

Cape fynbos is severely threatened by alien species such as Australian acacias, which were originally introduced into the country for timber, bark products, and to stabilise sand dunes.

Today, there are more than 700 alien plant species in southern Africa, originating from places such as Asia, South America and Australia. About 10% of these are considered invasive plants. This is because of their aggressive qualities, and their capacity to invade natural habitats and overwhelm some, or even all of the indigenous vegetation.

Invasive plants have specific traits that make them especially good competitors. Sometimes it can be as simple as having the ability to grow and reproduce more rapidly than native species. Other plants can directly or indirectly prevent other plants from growing nearby. Local herbivores might also find these alien plants inedible.

Invasive alien plants come in many shapes and sizes. They may be trees, shrubs, small herbaceous plants or waterweeds. These plants have been declared undesirable and may not be grown on any public or private property. What they have in common is the ability to spread and reproduce rapidly and to resist all but the most determined attempts to control them.

Invasive alien plant species found in South Africa include chromolaena, lantana, pereskia, American bramble, sesbania, syringa, bugweed, prickly pear, and water hyacinth. These plants have already taken over more than 10 million hectares of South Africa.

Why do we need to worry about invasive alien plants? Of most concern in South Africa is the fact that most of these species consume vast amounts of water. Experts maintain that more than 7% of all water runoff is lost to alien plants. That's some 3,3 billion cubic metres of water (equivalent to the mean annual runoff of the Vaal River).

WHAT CAN YOU DO?

- Plant indigenous plant species (nurseries can help you identify which species are local).
- Familiarise yourself with the pervasive alien plants plaguing your area and learn how to identify them.
- Don't bring foreign plants into the country.
- Join a volunteer clearing group, and adopt a piece of land to keep it clear from alien plants.
- Encourage your municipality, school, church and others to work with the Working for Water programme.

Courtesy of SA Tourism

Many rivers are dams are clogged with exotic water lettuce, water hyacinth, Kariba weed or parrot's feather.

WORDS

Alien: This refers to a species which does not occur naturally in an area (in other words, it is not indigenous), but has been introduced by people. Also referred to as 'exotic' species.
Biodiversity: Biodiversity refers to the variability of all living organisms – including animal and plant species – of the genes of all these organisms, and of the terrestrial, aquatic and marine ecosystems of which they are part. Biodiversity makes up the structure of the ecosystems and habitats that support essential living resources, including wildlife, fisheries and forests.
Indigenous: An indigenous plant or animal is one which occurs naturally in the place in which it is currently found.
Invader: A few alien species reproduce and spread, unassisted by man, into areas where they are not wanted. For a species to become an invader it has to a) arrive, b) survive and c) thrive.

In addition, invasive alien plants can cause flooding and erosion, which destroys riverbanks and leads to the siltation of dams and estuaries, and consequent poorer water quality. These species can also fuel wild fires, making fire management difficult.

To combat this invasion, the government, under the leadership of the Department of Water Affairs & Forestry, established Working for Water. The organisation employs especially underprivileged people to literally hack and cut their way through alien plants. Since its inception, Working for Water has invested more than R25-billion to clear invasive alien vegetation and establish programmes in more than 300 areas. At the same time it has created thousands of jobs. About 52% of the people employed by Working for Water are women, mostly single moms.

WEBSITES

- www.dwaf.gov.za/wfw
- www.sanbi.org.za
- http://en.wikipedia.org/wiki/Alien_%28biology%29

The first Jacaranda tree was imported to Pretoria from Brazil in 1888. Today some 70 000 of the trees grace parks, gardens and streets.

Working for Water was established 11 years ago to help clear South Africa of invasive alien plants while creating much needed employment.

WATER Kidz

Ecological Reserve – Keeping SA's Lifeblood Pumping

Courtesy of SA Tourism

South African water law dictates that we reserve water for future generations and to keep our aquatic ecosystems alive.

It is well known that without water we cannot survive. Our bodies are up to 60% water, and each day we must drink water to replenish our systems and stay healthy.

Just like the human body needs water to survive and function, so rivers and other water resources (wetland, estuaries and underground water) need to retain a certain amount of water.

People need water for all sorts of things, not only for drinking, but also for washing, cooking, and growing food. We also need water to power our industries, and create electricity and mine precious metals and minerals. But in the process of using water, people can damage rivers, wetlands, lakes and other watery places. Damaged ecosystems do not work very well and may fail us when we need them most.

Because South Africa is a semi-arid country (the country is among the 30 driest countries in the world), we have to take care of the little water we have. The South African Bill of Rights states that everyone has the right to sufficient food and water and to an environment that is not harmful to their health or well-being. One way of protecting water is through the creation of special laws.

NATIONAL WATER ACT

The National Water Act, which was promulgated in 1998, emphasises that all aspects of water on earth are connected, and that we have to manage water resources within that connected cycle. (Can you still remember how the water cycle works? Water falls from the sky as rain, runs off the landscape, filters into the soil, flows to the sea in rivers, is stored in dams, evaporates into the sky and rains back onto the earth.)

The Act recognises that water belongs to the whole nation and is administered by the government for the good of the people. This legislation protects the rights of all people to have water for their basic needs, but also takes into account the needs of aquatic (watery) ecosystems.

How does it do this? By ensuring that a little bit of all water resources are reserved for future generations. South Africa is the first country in the world to legislate this concept and provide this Reserve as right of law.

RESOURCES

Watermark – The Lasting Impression of the Ecological Reserve (WRC Report No TT307/07)
Some for All, Forever – Water Ecosystems and People (WRC Report No TT 176/02)
These booklets are available from the Water Research Commission at no charge. To order, contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za and quote the WRC Report number.

Courtesy of SA Tourism

Rivers do not only provide water, but also 'products' such as fish, medicinal plants and reeds used for basket weaving.

THE RESERVE

The Reserve consists of two parts – the Basic Human Needs Reserve and the Ecological Reserve:

- The **Basic Human Needs Reserve** is the water allocated for human consumption before any other water can be assigned. It provides for the essential needs of individuals and includes water for drinking, food preparation and personal hygiene. The Reserves ensures that people are never overlooked in favour of ecosystems or industrial use. At present, this amount is calculated as a minimum of 25 litres per person per day.

Kathy Eales

We all have a responsibility to ensure that our water ecosystems are protected from pollution and overuse.

- The **Ecological Reserve** relates to the water required to protect and sustain the aquatic ecosystems in order to secure ecologically sustainable development and water use.

In this way, the National Water Act protects the rights of water ecosystems because they provide people with many free services necessary to life – water supply, waste processing and dilution, natural products (reeds, fish, and medicinal plants), nature conservation, flood control, recreation and places for beauty and religious rituals.

This does not mean we are not allowed to use the resources. We must use water and water ecosystems for social and economic development. We must use water and water ecosystems for poverty alleviation. But we need to leave enough water in an ecosystem so that the ecosystem remains alive.

Rivers clean themselves naturally. They provide habitats for a wide range of plants, animals and microbes. When a river is used by many people, the number and kind of plants, animals and habitats change. Feeding processes change. The structure and function of the river change. The health of the river suffers.

The Reserve provides that all rivers, regardless of their health, need:

- Enough water to maintain their structure and to provide habitats for plants and animals;

Courtesy of SA Tourism

THE SOUTH AFRICAN BILL OF RIGHTS (Chapter 2 of the Constitution) STATES THAT:

"Everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

- prevent pollution and ecological degradation;
- promote conservation; and
- secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

- Water in the right season so that plants and animals can complete their life cycles;
- Variability of flow so that the groups of animals that thrive in either wetter or drier conditions can be maintained;
- Enough water in severe droughts so that rivers that usually flow all year continue to do so, and seasonal rivers do not dry up for longer than they would naturally.

We all need to work together to ensure we have the water ecosystems we want.

WATER Kidz

TRANSBOUNDARY WATERS: We all live downstream

Rivers know no boundaries. Their paths have been carved out through valleys and mountains over centuries, without thought of the political systems of the countries through which they flow or the international rules used to manage them.

Around the world, there are more than 260 river and lake systems shared by more than one country. Known as transboundary or international river systems, the basins from which these rivers and lakes draw their water are home to about 40% of the world's population. Less is known of the aquifers (underground reservoirs of water) shared between countries, however, to date, around 300 transboundary aquifers have been recorded.

While most transboundary rivers systems are shared between just two countries, there are many rivers where this number is much higher. There are 13 river systems worldwide that are shared between five to eight countries. Five river systems, the Congo, Nile, Rhine and Zambezi, are shared between nine to eleven countries. The river that flows through the most countries is the Danube, which passes through the territory of 18 countries.

This is significant because it means that the way we treat our water might also affect the water supplies of our neighbours.

Many people have spoken of so-called 'water wars' – conflicts over limited and shared water supplies – that might occur between countries in future as water resources become scarcer, and such shared waters might well hold potential for conflict. However, history has shown that transboundary waters are more likely to be catalysts of peace rather than conflict. Over the last 60 years, there have been more than 300 international water agreements, compared to less than 40 conflicts over water. We need to continue to nurture the opportunities for cooperation that transboundary water management can provide.

TRANSBOUNDARY WATERS IN AFRICA

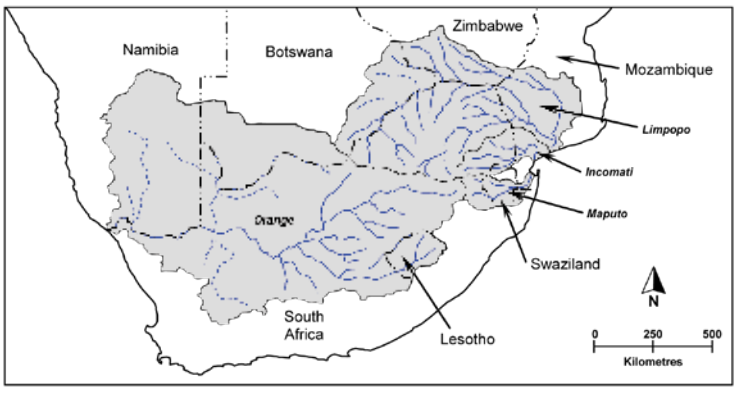
In Africa, transboundary river systems provide 93% of the renewable surface water. There are 63 river systems that cross international borders, quite considerable when considering there are only 53 countries in Africa. The continent boasts a number of large river systems shared by quite a number of countries, for

SOUTHERN AFRICAN SHARED RIVER BASINS

	Area of Basin in Country	
Countries	**km²**	**%**
Incomati		
South Africa	29 200	62,47
Mozambique	14 600	31,20
Swaziland	3 000	6,33
Limpopo		
South Africa	183 500	44,25
Mozambique	87 200	21,02
Botswana	81 500	19,65
Zimbabwe	62 600	15,08
Maputo		
South Africa	18 500	60,31
Swaziland	10 600	34,71
Mozambique	1 500	4,98
Orange		
South Africa	563 900	59,65
Namibia	240 200	25,40
Botswana	121 400	12,85
Lesotho	19 900	2,10

Source: Atlas of International Freshwater Agreements

Right: The positions of the four river basins that South Africa shares with its six neighbours.



FACTS AND FIGURES ABOUT TRANSBOUNDARY WATERS

- Over 90% of people in the world live in countries that share river basins.
- About 40% of the world's people live in river and lake basins that are shared between two or more countries.
- There are about 300 transboundary aquifer systems in the world on which more than two billion people depend for water.
- There are 263 transboundary river and lake basins that cover nearly one half of the Earth's land surface.
- The Danube is the river system shared by most countries (18).
- More than 3 600 treaties have been identified relating to international water resources dating from AD 805 to 1984. The majority of these treaties are concerned with some aspect of navigation.

example, the Nile, which is shared between ten countries (Burundi, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Uganda, Tanzania, and the Democratic Republic of Congo).

South Africa shares four major river systems with neighbouring countries:

- The Orange-Senqu system is shared with Lesotho and Namibia
- The Limpopo River is shared with Botswana, Zimbabwe and Mozambique
- The Incomati system is shared with Swaziland
- The Usutu/Pongola-Maputo system is shared with Mozambique and Swaziland.

South Africa has signed and ratified the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses, which promotes the principles of equitable and reasonable utilisation and the obligation not to cause significant harm (to downstream users). It also prescribes to the Southern African Development Community Protocol on Shared River Courses.

The management of internationally shared surface and groundwater resources is considered so important to South Africa that it has been taken up in the country's national laws (namely the National Water Act). This Act gives international requirements a priority that is second only to the basic human needs and the Ecological Reserve. This means that no infrastructure may be developed in any transboundary waters without considering the needs (or without the involvement) of the other countries involved.

WHAT IS TRANSBOUNDARY WATER?

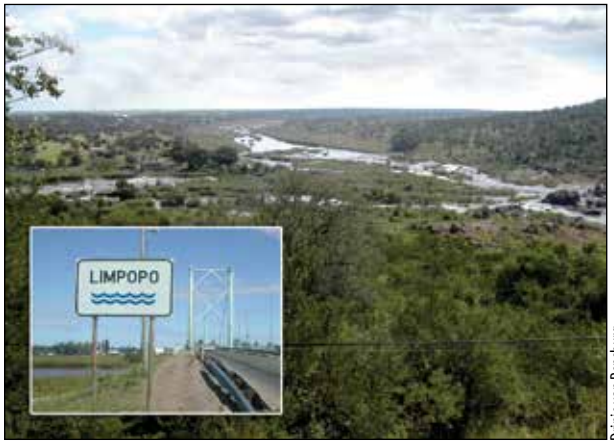
Transboundary water refers to lakes, rivers, and aquifers (groundwater) which are shared between more than one country.

WORLD WATER DAY

The theme 'Shared Water – Shared Opportunities' was selected as the theme for World Water Day in 2009, which is celebrated on 22 March. Special focus was placed on transboundary waters. Nurturing the opportunities for cooperation in transboundary water management can help build mutual respect, understanding and trust among countries and promote peace, security and sustainable economic growth. For more information on World Water Day Visit: www.unwater.org/worldwaterday/ or for South African National Water Week activities, Visit: www.dwaf.gov.za

Drinie van Rensburg

The Limpopo River forms the border between South Africa and Botswana.



Drinie van Rensburg

The Limpopo River flood plains near Xai-Xai in Mozambique and a bridge across the river.

Drinie van Rensburg

The Platjan border post between South Africa and Botswana.

Drinie van Rensburg

The Limpopo River mouth in Mozambique.

WATER Kidz

EXPLORING WATER CULTURE

Amanzi. Metsi. Water. Whatever you call it, water is the symbol of life and healing. On 22 March we celebrate World Water Day, and internationally the theme is 'Water and Culture'. This offers us the chance to look at what important role water plays in our societies.

As South Africans we are blessed to have people of many cultures and religions living together. In each of these cultures and religions, water, in its many forms, including rivers, lakes, rain and snow, plays a plays a part in how people live and what they believe.

For the San, water is the ancient symbol of life. In ancient San culture, people acquired good or bad rain-bringing abilities at birth. This ability was reactivated when the person died.

In Limpopo, in the Lobedu Mountains, surrounded by the sacred Modjadji cycads, lives the legendary Queen Modjadji or Rain Queen. Her history can be traced back 400 years to Zimbabwe. Legendary leaders, from King Shaka of the Zulus to former president Nelson Mandela, have paid homage to this leader of the Balobedu, who is said to have power over drought and rain.

In other parts of the country there are lakes and rivers that are legend to be home to water nymphs, mythical serpents and spirits, and people often make pilgrimages to offer sacrifices to appease the gods. Lake Fundudzi, in former Venda, is one such a sacred lake. Believed to be the resting place of the god of fertility, symbolised by a serpent, the lake is so revered that strangers are not allowed to touch the water. Offerings of sorghum beer are made to the lake often.

Some 22 000 thousand years ago, a meteorite hit the earth at a place 40 km north of Pretoria. The result was the Tswaing crater, or 'place of salt'. A giant serpent known to the locals as Kokwana, 'the old woman', is said to inhabit the waters of this lake.

NEW WATER GAME ON THE NET

UNICEF'S Voices of Youth programme has launched *Water Alert!*, a new interactive game that young people can play online, or through a CD version. This educational tool on water, environment and sanitation is intended to engage young people in an adventure of strategy and survival that explores real-life situations.

The object of the game is to ensure that the people in a drought-challenged village, who are facing the threat of a flood, have water that is safe to drink and a clean and healthy school environment. To play the game, your computer needs to have the Flash program installed.

To access the game, go to www.unicef.org/voy/explore/wes/explore_1818.html

Every year, hundreds of faithful worshippers flock to Ngome, a village in KwaZulu-Natal where the waters of seven streams meet to form the Isikhwebezi River. The waters of this

WATER ON THE WEB

Don't forget to check out the Water Research Commission's Education link on the web, www.wrc.org.za, where you will find lots of information on water to help you with school projects.

No matter our culture, water is the tie that binds us all.

river is said to have healing powers, and the area itself is known to be a haven for medicinal plants used by sangomas or traditional healers.

Water is also central to many religions practiced in South Africa. Almost all Christian churches or sects have an initiation ritual involving the use of water. Baptism has its origins in the symbolism of the Israelites being led by Moses out of slavery in Egypt through the Red Sea and from the baptism of Jesus by John the Baptist in Jordan.

Islam ascribes the most sacred qualities of water as a life-giving, sustaining and purifying source. It is the origin of all life on earth, the substance from which Allah created man. Water is important for cleansing and purifying, and Muslims must be ritually pure before approaching Allah in prayer.

Water is imbued with powers of spiritual purification for Hindus, for whom morning cleansing with water is a traditional every day obligation. All temples have historically been located near a water source, and followers must bathe before entering the temple. Many pilgrimage sites are found on river banks.

In Judaism, ritual washing is intended to restore or maintain a state of ritual purity and its origins can be found in the Torah. These ablutions can be washing the hands, the hands and the feet, or total immersion which must done in 'living water', i.e. the sea, a river, a spring or in a mikveh.

So let us make water the tie that binds us all.

The San believed some people were born with rain-making abilities

WATER IN A WORD

Did you know that there are over 6 000 different languages in the world? This means that there are more than 6 000 ways to say WATER? Can you find these words in the block by searching horizontally (sideways) and vertically (down)?

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

Nero (Greek)
Maim (Hebrew)
Agua (Spanish)
Vtan (Iceland)
Paani (Hindi)
Metsi (Setswana)
Madi (Venda)
Vesi (Finnish)
Wasser (German)
Biyo (Somali)
Meetse (Sepedi)
Mati (Tsonga)
Uji (Albanian)
Wai (Maori)
Amanzi (Zulu)
Mul (Korean)
L'eau (France)
Shouei (Chinese)

WATER PROVERBS

Cultures all over the world have proverbs where water is the central theme. Can you think of water proverbs in your culture? Here are some to get you started:

- Any water in the desert will do. (Saudi Arabia)
- Heaven is dark and yet out of it streams clear water. (Afghanistan)
- Words are mere bubbles of water; deeds are drops of gold. (Tibet)
- You cannot separate water by beating it with a fork. (India)
- We do not know the worth of water until the well runs dry. (France)
- The heart of a wise man lies quiet like limpid water. (Cameroon)
- The horse that arrives early gets good drinking water. (Zulu)
- Dirty water cannot be washed. (Togo)

The sacred Lake Fundudzi is said to be home to a fertility god.

All photographs courtesy of SA Tourism

WATER Kidz

MIGRATORY BIRDS – Nature's long-distance adventurers

With long-haul flights these days we can travel almost anywhere. But imagine you had to cross a continent on your own steam? Many of our feathered friends – some no bigger than mice – do exactly that.

The annual migration of birds within and across continents remains one of the world's greatest natural wonders. Every year, a special two-day celebration is held worldwide in honour of the estimated 50 million birds (around 19% of the world's total bird species) that take flight every year to travel hundreds or even thousands of kilometres.

The Day is organised by the Convention on the Conservation of Migratory Species of Wild Animals and the African –Eurasian Migratory Waterbird Agreement – two treaties that represent various countries. This year, World Migratory Bird Day was held on 11 and 12 May. The day is celebrated in over 65 countries, including South Africa.

The Barn Swallow is an annual visitor to South Africa.

The migration of birds is a natural process, whereby different birds fly over long distances to find the best places to live and raise their young. There are many different migration patterns. Most birds migrate from breeding areas in the north in summer, to the south where they can sit out the cold northern winter. However, some birds breed in southern parts of Africa and migrate to northern wintering grounds, or horizontally to enjoy the milder coastal climates in winter.

In South Africa more than 100 migratory bird species have been recorded, including species that fly across the continent as well as those that migrate longer distances between our country and northern Europe and Asia. One of the most important threats to our birds is mining.

The survival of at least 15 of the migratory bird species in South Africa is being threatened. One of these is the Blue Swallow, which is listed as Critically Endangered.

There are many reasons why migratory birds should be conserved. Their

World Migratory Bird Day

Multimedia resources

To learn more about South African birds:

- www.birdlife.org.za
- www.witsbirdclub.org.za (South Africa's oldest bird club)
- www.sanparks.co.za/groups/birders/ (for bird watching in South Africa's national parks)

World Migratory Bird Day

To learn more about migratory birds:

- www.worldmigratorybirdday.org
- www.youtube.com/watch?v=bTvqXVFQLIs
- www.unep-aewa.org/
- www.migraction.net/

beauty and behaviour are a source of joy and inspiration for millions of people. In almost all cultures, flocks of birds have announced the arrival of spring for centuries, and the yearly rebirth of nature associated with it. In ancient times, the social acceptance of birds as messengers of life was accompanied by the knowledge that migration had an important role to play in the functioning of nature and its processes.

Migratory birds are specially engineered to fly fast and across long distances. However, their journey is often an exhausting one during which they push themselves to their limits. The Red Knot, for example, which is just under a ruler-length long (24 cm), breeds in Siberia and overwinters on the west coast of Africa, some even going down to South Africa. During its migration the bird loses about half its body weight of 220 g.

Migratory birds therefore rarely fly to their destination non-stop but interrupt their journey frequently. Similar to human transport systems of harbours, airports and roads, migratory birds depend on these international networks of natural sites for food, safety, breeding and moulting, as well as stopover areas which act as refuelling stations between breeding and non-breeding areas.

Unfortunately, human activities have resulted in the destruction of many of these resting spots. If we don't step in and protect what is left, we could lose some of our travelling feathered friends to extinction within the next few decades. The main message of this year's World Migratory Bird Day was that we as countries, organisations and communities, need to work together to ensure that migratory birds can continue to travel, refuel and reach their destinations. ❑

SA Bird of the year 2013: The elusive white-winged flufftail

The South African Bird of the Year for 2013 is about the size of a sparrow, is rarely seen and so secretive that more than 130 years after its discovery in South Africa very little remains known about it.

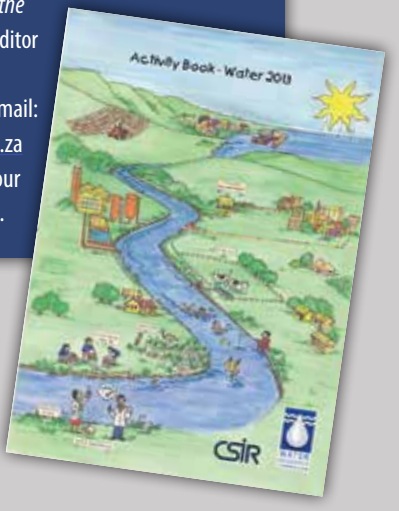
The critically-endangered white-winged flufftail is endemic to Africa, and travels between Ethiopia and South Africa. The little bird favours high-altitude wetlands, and it is speculated that the white-winged flufftail migrates between these two countries, arriving at suitable habitat within South Africa in summer. However, this has not been proved.

The bird is ground breeding, and has very specific habitat requirements regarding altitude, grass type, water level and temperature. There are only a handful of sites in the country where the white-winged flufftail can be found. **(Source: BirdLife SA & Middelpunt Wetland Trust)**

- To learn more about the white-winged flufftail and its wetlands habitat Visit: http://www.birdlife.org.za/events/bird-of-the-year or Watch: http://www.youtube.com/watch?v=m0rEbNf80Io

CSIR-WRC Activity Book back by popular demand

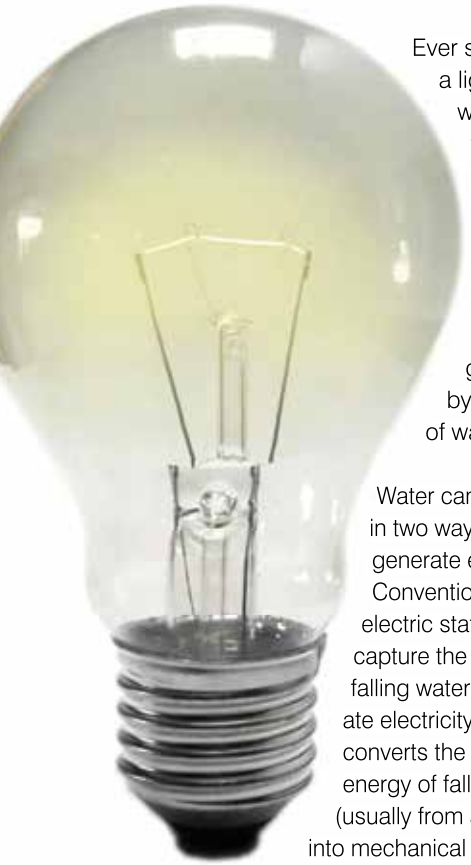
The Water Research Commission (WRC) has republished the popular CSIR WRC Water Activity Book. Suitable for children ages 7 to 14, the book contains various water-related activities, including water word search games, water snakes and ladders, among others. It is a useful tool to have in the classroom to explain, for example, water pollution and the impact of alien invasive plants. To get your free Activity Book, contact *the Water Wheel* Editor at Fax: (012) 331-2565 or Email: laniv@wrc.org.za and provide your postal address.



A couple of Southern African birds that take part in the annual migration to the Northern Hemisphere.

WATER Kidz

The Power of Water



Ever switch on a light and wonder where the electricity came from? It might have just been generated by the power of water.

Water can be used in two ways to generate electricity. Conventional hydroelectric stations capture the energy of falling water to generate electricity. A turbine converts the kinetic energy of falling water (usually from a dam) into mechanical energy. Then a generator converts the mechanical energy from the turbine into electrical energy. The electricity generated is fed on to the transmission lines that link up with the national electricity grid. Once the water has run through the turbines it is discharged back into the river below the power station to continue its course.

On the other hand, pumped storage schemes reuse water to generate power. The schemes use off-peak energy to pump water into an elevated dam from a lower dam from which it can be released to generate electricity when required. When the energy is needed, the water is released from the top dam to flow through the power station to the bottom dam.

The amount of electricity a hydropower plant produces depends mainly on how far the water falls (i.e. the further the water falls, the more power it has, this is usually dependent on the size of the dam); and the amount of water falling (more water falling through the turbine will produce more power, the amount of water available depends on the amount of water flowing in the river).

While hydropower stations are considered more environment-friendly than coal-fired stations, there is some debate whether they should really be actively pursued. This is because most hydropower stations involve the construction of a dam, which can be disruptive to the surrounding environment and to communities who might be displaced.

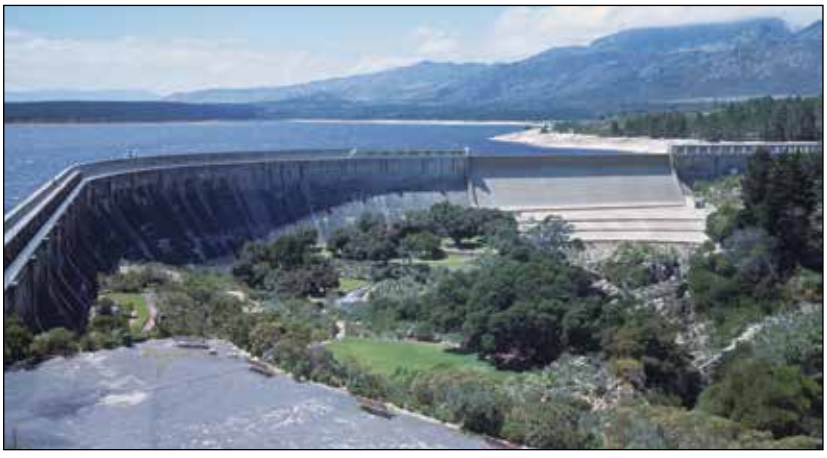
Because of its limited water resources and erratic rainfall, South Africa does not have much potential for large hydropower stations. Whereas, worldwide, about 20% of all electricity is generated by hydropower, in South Africa it varies between 2% and 4%. The country's largest power producer, Eskom, operates six hydropower schemes at present.

There are two hydropower stations on the Orange River. The Gariep

THE BASIC COMPONENTS OF A CONVENTIONAL HYDROPOWER UNIT

Dam: Most hydropower plants rely on a dam that holds back water, creating a large reservoir.
Intake: Gates on the dam open and gravity pulls the water through the penstock, a pipeline that leads to the turbine. Water builds up pressure as it flows through this pipe.
Turbine: The water strikes and turns the large blades of a turbine, which is attached to a generator above it by way of a shaft.
Generators: As the turbine blades turn, so do a series of magnets inside the generator. Giant magnets rotate past copper coils, producing alternating current (AC) by moving electrons.
Transformer: The transformer inside the powerhouse takes the AC and converts it to higher-voltage current.
Outflow: Used water is carried through pipelines, called tailraces, and re-enters the river downstream.

Source: www.howstuffworks.com

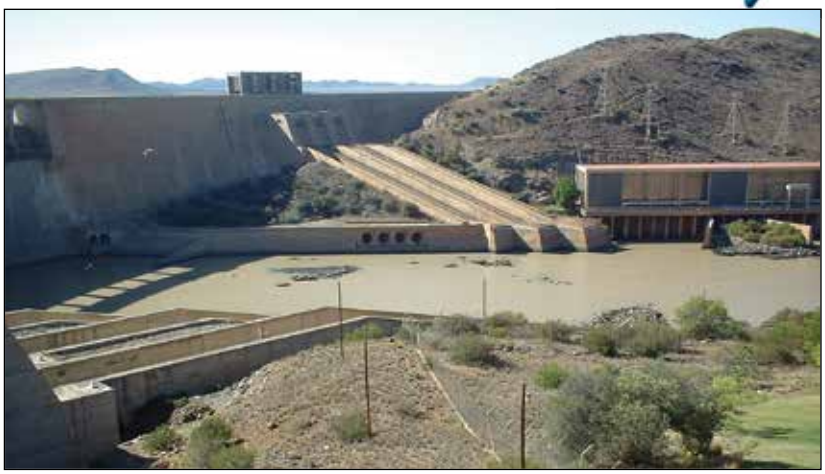


The Steenbras Dam forms part of the Palmiet Pumped Storage Scheme, in the Western Cape.

(formerly known as Hendrik Verwoerd) hydropower station started feeding into Eskom's transmission system in 1971. Vanderkloof, a similar hydropower station, was commissioned in 1977.

Eskom also operates four smaller hydropower stations, namely Colley Wobbles (Mbashe River), First Falls and Second Falls (Umtata River), and Ncora (Ncora River). The Eastern Cape (particularly the area of the former Transkei) and parts of KwaZulu-Natal have been identified as having the most potential for the future development of hydropower in South Africa.

In addition, there are two pumped storage schemes at present. The Drakensberg Pumped Storage Scheme not only supplies the country with 1 000 MW of electricity during peak periods, it also assists in supplementing the Vaal Dam with water transferred from the Tugela River in KwaZulu-Natal. Completed in 1988, the 400 MW Palmiet Pumped Storage Scheme is situated about 50 km from Cape Town. This scheme is also used to pump water from the Palmiet River catchment into the Steenbras Dam to supplement Cape Town's water supply. At present, Eskom is also developing a third pumped storage scheme at Braamhoek, in the Klein Drakensberg (for more details, see the article elsewhere in this issue).



The Gariep Dam is also used for hydropower.

There are also a number of independently-operated hydropower stations in South Africa, for example, the 2,5 MW Friedenheim mini-hydropower plant situated on the Crocodile River, near Nelspruit, Mpumalanga. This plant has been operational since 1998 to provide power for the Friedenheim Irrigation Board while excess power is sold to Mbombela Municipality.

The Bethlehem Hydropower Project is currently under construction. The project comprises two generation facilities: a 2,2 MW run-of-river site located on the As River, midway between Bethlehem and Clarens; and a 1,7 MW facility at the existing concrete wall of the Saulspoort Dam, in Bethlehem. The first electricity is expected to be delivered later this year.

HYDROELECTRIC FIRSTS IN SOUTH AFRICA

- The first hydropower plant on the Orange River was constructed near Kakamas, in the Northern Cape.
- The Sabie River Gorge power station was the first hydropower station to be erected by Eskom. It started commercial operations in 1927, and was built mainly to support mines in the area. The plant closed in 1964.
- The hydroelectric power station at the Vanderkloof Dam was the first power station in South Africa situated entirely underground.
- The Friedenheim Hydro Power plant is recognised as the first independent power producer in South Africa.

TABLE 1
Eskom's hydropower & pumped storage schemes

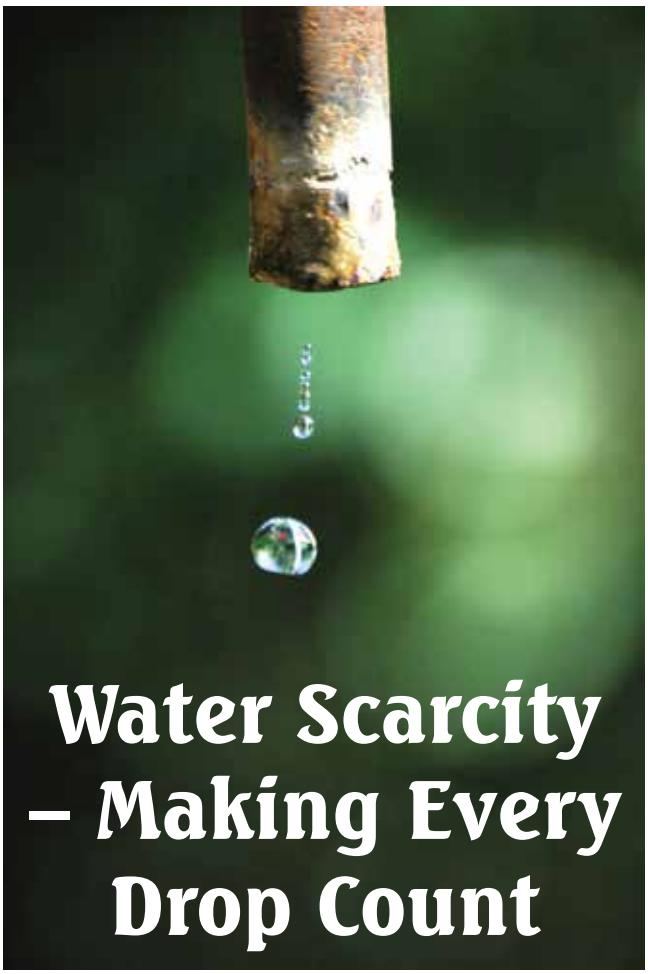
Hydroelectric Stations	Area	Total Capacity
Colley Wobbles	Mbashe River	42 MW
First Falls	Umtata River	6 MW
Gariep	Orange River	360 MW
Ncora	Ncora River	2 MW
Second Falls	Umtata	11 MW
Vanderkloof	Orange River	240 MW
Pumped Storage		
Drakensberg	Bergville, KZN	1 000 MW
Palmiet	Grabouw, Western Cape	400 MW

Source: Eskom

HYDRO-ELECTRIC WEBSITES

- http://www.dme.gov.za/energy/renew_hydro.stm
- http://assets.panda.org/downloads/africahydropowerreport2006.pdf
- www.eskom.co.za
- http://mp2mas26.eskom.co.za/heritage/main.htm
- http://people.howstuffworks.com/hydropower-plant.htm

WATER Kidz



Water Scarcity – Making Every Drop Count

Every year, International Water Day is celebrated on 22 March. In 2007, the theme was 'Coping with Water Scarcity'.

When we think of water scarcity, we usually think of drought, especially in a country such as South Africa, which remains one of the 30 driest countries in the world. But the lack of rain is only one reason why people might not have enough water.

WHAT IS THE DIFFERENCE BETWEEN WATER SCARCITY AND DROUGHT?

While arid and drought-stricken areas suffer the most, people everywhere can be affected by water scarcity, even those living in areas with plenty of rainfall or freshwater. Water scarcity occurs when the ways in which we use and distribute water cannot fully meet the demand from households, farms, industry and the environment.

Global water use is increasing at more than twice the rate of population growth and more people than ever are learning first hand about coping with water scarcity. While three-quarters of the Earth is covered by water, only a small fraction of it is available as freshwater. In addition, this water is spread unevenly, in other words, some areas might have more freshwater while others have less.

WHAT CAUSES WATER SCARCITY?

Anything that causes water shortages, contaminates freshwater supplies, damages the facilities that carry water to people, or keeps significant numbers of people from receiving clean water can lead to water scarcity. Major factors include drought, a lack of water near people's homes, high water tariffs, and the overuse of lakes, waterways and aquifers. Other causes range from flooding to poorly-placed dams.

Even climate change is said to increase water scarcity in some areas. Many experts point to the rising level of the Earth's seas, the rapid melting of glaciers, the frequency and ferocity of hurricanes, floods and drought as consequences of climate change. All of these can threaten the amount or safety of a community's water supply, as they destroy crops, contaminate freshwater bodies and damage water facilities.

In South Africa, a number of factors, ranging from poverty and a subsequent lack of access to potable water to increased demand for water from industry and mining, are stressing the water system. This poses a challenge to public health, agriculture (food production), and the environment. This is in addition to the country's physical water scarcity (i.e. South Africa generally receives less than 500 mm of rain a year compared to the world average of 860 mm a year).

Through various programmes, the government, mainly through the

Courtesy SA Tourism

South Africa, with its erratic rainfall, is prone to water scarcity.

The exponential growth of cities around the world can lead to water scarcity.

Department of Water Affairs & Forestry, has made much progress in bringing clean water to even the country's poorest citizens. These initiatives include the Masimbambane and Water Reallocation programmes, which aims to make water available to communities for domestic (such as drinking) and productive (such as farming) purposes. The country remains on track to meet the United Nations Millennium Development Goals of halving the proportion of people without access to safe water by 2015.

At the same time, stricter regulations have been instituted for issuing permits to use water. Other issues being addressed include increasing urbanisation, industry and the continued need for irrigation.

WEBSITES

- www.worldwaterday07.org
- www.unwater.org
- www.unesco.org/water/wwap/wwdr2/

SHOULD PEOPLE MOVE TO URBAN AREAS TO GET BETTER ACCESS TO WATER?

Living in a town or city is no guarantee of access to water. Many people, especially the poor who come from rural areas, end up living in informal townships where they often have to share communal standpipes. Those who don't have access to piped water often have to purchase water from private vendors at a high price. Water supplies are also threatened by urban pollution such as sewage spills, stormwater runoff and wastewater from industries.

WHY SHOULD PEOPLE GET INVOLVED IN THIS ISSUE?

Water scarcity already affects every continent and more than 40% of the people on our planet. The situation is being made more acute by population growth, urbanisation and the increases in domestic and industrial water use by people who live in more developed areas. Water is intricately linked to every aspect of our lives. We need to improve the use of the world's water and to protect the environment.

WHAT CAN I DO?

Actively support government, non-governmental organisations, private foundations and companies which make it a priority to conserve, recycle and protect water resources, and deliver affordable water to people at every level of the community. Do your part to use water more efficiently, reduce pollution and protect the environment. Support funding initiatives that help to make these objectives possible. Everyone needs water and everyone needs to take responsibility.

HELP FOR TEACHERS

In support for learning and teaching about water and water-related issues, the Water Research Commission and Share-Net (a project of the Wildlife and Environment Society of South Africa) have developed a series of lesson plans on water.

These lesson plan packs, from Grade R to Grade 10, are linked to the national curriculum. Each pack contains five lessons, with each lesson focusing on a different learning area – these can either be used as they are, or adapted to suit the local context. Each lesson is concluded with a rubric of criteria to assess the learners. Learning Outcomes and Assessment Standards covered during each lesson are given in the summary at the beginning of the pack.

The lesson packs can be downloaded from www.envirolearn.org.za or www.wrc.org.za. Alternatively, contact Share-Net at Tel: (033) 330-3931; Fax: (033) 330-4576; E-mail: sharenet@future.net.co.za

WATER Kidz

Stop Killing our Rivers and Streams

Our rivers and streams are the lifeblood of our country. Without them we have no water to drink, no water for our factories and power plants, no water to grow our food, and no water for our environment.

Yet we are slowly killing our rivers by polluting them. What is water pollution? Water pollution is any substance introduced into a river, stream, lake or ocean that harms the natural resources found in those environments (such as plants and animals).

Lakes and rivers can naturally clean up a certain amount of pollution by dispersing it harmlessly. For example, if you were to pour a cup of black ink into a river, the ink would quickly disappear into the river's much larger volume of clean water. The ink would still be there in the river, but in such a low concentration that you would not be able to see it.

Abandoned and closed mines produce a large quantity of polluting chemicals. Many dangerous metals, including iron, aluminium, lead, mercury, chromium and cadium come out of old mine workings and pollute water resources.

At such low levels, the chemicals in the ink does probably not present any real problem. However, if you poured many litres of ink into a river every few seconds through a pipe, the river would quickly turn black. The chemicals in the ink could very quickly have an effect on the quality of the water. This, in turn, could affect the health of all the plants, animals and humans whose lives depend on the river.

This means that water pollution is all about quantities: how much of a polluting substance is released and how big a volume of water it is released into. A small quantity of a toxic chemical may have little impact if it is spilled into the ocean from a ship. But the same amount of the same chemical can have a much bigger impact pumped into a lake or river, where there is less clean water to disperse it.

There are two different ways in which pollution can occur. If pollution comes from a single location, such as a discharge pipe attached to a factory, it is known as **point-source pollution**. Unfortunately, a great deal of water pollution happens not from one single source but from many different scattered sources. This is called **non-point-source pollution**.

When point-source pollution enters the environment, the place most affected is usually the area immediately around the source. This is less likely to happen with nonpoint-source pollution which, by definition, enters the environment from many different places at once.

WHERE DOES POLLUTION COME FROM?

It must be remembered that water is part of a deeply interconnected system. This means what we pour on the ground ends up in our water, and what we spew into the sky ends up in our water. By depleting and polluting rivers, lakes and wetlands, we are destroying ecosystems that play an essential role in filtering and assuring freshwater resources.

Water pollution has many different causes and this is one of the reasons why it is such a difficult problem to solve. Disposing of sewage is a major problem. Human waste landing up in river systems due to communities lacking toilet facilities, leaking faulty sewerage pipelines and overflowing sewage treatment works can lead to

DID YOU KNOW?

- According to Guinness World Records, the worst **river pollution** in the world occurred in November 1986 when firefighters tackling a blaze at the Sandoz chemical works in Basel, Switzerland, flushed 30 tons of agricultural chemicals into the Rhine River, western Europe's most important waterway, killing about 500 000 fish.
- Every year, **200 to 500 million tons** of heavy metals, solvents, toxic sludge and other wastes accumulate in water resources from industry.
- More than 80% of the world's **hazardous waste** is produced in the US and other industrial countries.
- About two million tons of waste is dumped every day into rivers, lakes and streams. One litre of wastewater pollutes **eight litres** of freshwater.

water-related illnesses such as cholera and diarrhoea.

Wastewater for industries and mines is another source of pollution. Factories and mines are point sources of water pollution, but quite a lot of water is polluted by ordinary people from nonpoint sources. Virtually everyone pours chemicals of one sort or another down their drains and toilets. Even detergents used in washing machines and dishwashers eventually end up in our rivers. So do the pesticides we use in our gardens.

Harmful substances spilled into rivers can build up in the environment and aquatic life, for example, fish.

A lot of toxic pollution also enters wastewater from highway runoff and city sidewalks. Highways and typically covered with a cocktail of toxic chemicals – everything from spilled fuel and brake fluids to bits of worn tyres and exhaust emissions. When it rains, these chemicals wash into drains and rivers.

WHY DOES POLLUTION MATTER?

Some people believe pollution is an inescapable result of human activity: they argue that if we want to have cities, mines, factories and cars some degree of pollution is almost certain to result. Fortunately, not everyone agrees with this view. One reason people have woken up to the problem of pollution is that it brings costs of its own that undermine any economic benefits that come about by polluting. It affects our health, destroys our environments, and makes the water so much more expensive to treat for drinking purposes.

We need to make a choice: either we live with smelly rivers, and poisoned fish that we cannot eat, or we do our part to keep the environment clean so the plants, animals and people who depend on it remain healthy.

Lani van Vuuren

South Africa is a water-scarce country, thus it is exteremely important that we safeguard all the water resources we have against pollution.

Kathy Eales

Solid and human wastes polluting our river systems can cause serious health hazards and outbreaks of diseases such as cholera and diarrhoea.

When it rains, chemicals and other polluting substances from city roads and sidewalks wash into drains and rivers.

STOP RIVER POLLUTION – HOW YOU CAN HELP

- Do not litter.
- Reduce your use of pesticides and fertilisers and look for safer alternatives to control weeds and bugs.
- Take part in local river clean-up campaigns.
- Always throw unwanted fishing line in a trash can, not in the water.
- Do not use toilets and stormwater drains to dispose of trash of any kind.
- Notify your parents or the authorities if you see someone dumping trash in a river or stream.

WATER Kidz

How big are your ECOLOGICAL FEET?

We all have a role to play in minimising the degradation of our natural resources.

Your ecological footprint has nothing to do with the size of your shoes. It is actually a measure of a person's demand on Earth's natural resources, including water.

The size of your ecological footprint depends on how much biologically productive land and water you require to live your life. You can reduce this footprint by not wasting electricity and water, cycling or walking to places close by rather than driving, and eating locally-produced rather than imported food.

To calculate your ecological footprint, take the following quiz.

Water use

The amount of water used often depends on whether you have running water in your home, a tap in your yard, or whether you carry water from a river or dam. The way that you use water in your home can sometimes be very wasteful.

When you wash, do you use:

a	A bucket	b	A shower	c	A bath

Your score: a) 0 points, b) 5 points, c) 20 points

Re-using water

South Africa is a water-scarce country. It is believed that if no immediate action is taken by the year 2025 we will have insufficient water for use in our homes, for agriculture and for industry. By using water carefully, you can help to conserve our water sources.

When you have finished washing at home:

a	Does your water run straight down the drain?	b	Do you use the water on your plants?

Your score: a) 20 points, b) -10 point

Energy use

Whether you use electricity, coal or paraffin for energy in your home, you are polluting the air – which causes acid rain, global warming and health problems. You can conserve energy by using energy-saving devices (such as energy-saving light bulbs), and solar-powered energy systems.

In your home do you have at least one energy-saving method?

a	Yes	b	No

Your score: a) -10 points, b) 20 points

Indigenous plants

By growing indigenous plants in your garden, you can contribute to biodiversity because you will attract indigenous insects, birds and other animals. Indigenous plants have many advantages over alien plants, for example, they require less water.

Excluding your home-grown fruit and vegetables, in your garden at home are:

a	Most of the plants indigenous	b	More than half of the plants indigenous	c	Less than half of the plants indigenous	d	None of the plants indigenous

Your score: a) -10 points, b) 0 points, c) 10 points, d) 20 points

Animal-based products

Producing animal products (beef, chicken, pork, eggs, fish, diary, etc) puts much more pressure on the environment than producing vegetables. Many people eat more meat than their bodies need. People who eat a lot of meat have more impact on the environment than those who eat less meat or no meat at all.

How often do you yeat animal products?

a	Never	b	A few times a week	c	Once a day	d	Small amounts at every meal	e	A large part of every meal

Your score: a) -10 points, b) 0 points, c) 5 points, d) 10 points, e) 20 points

Poisons in the garden

Poisons – more correctly known as biocides – are often used to kill rats, insects and weeds. Many of the ingredients in these biocides may cause allergies, trigger cancer growth and cause genetic defects. Frequently we don't actually need to kill in the first place! For example, the flat spider on the wall won't hurt you at all (and it helps ridding the home of other pests, such as flies). But if we really do need to kill, we need to decide upon which option of removal is the most evnvironmentally friendly.

In your home, when you have a problem with household pests do you:

a	Use the strongest insecticide or other poison and use until the problem is solved	b	Buy specially-designed environmentally-friendly products	c	First attempt to solve the problem with a less destructive alternative

Your score: a) 20 points, b) 0 points, c) -10 points

www.sxc.hu

Did you know that it takes about 2 400 litres of water (to grow the grain to feed the cow and to sustain the cow) to produce a 150 g hamburger patty?

Locally-grown food

Much of the energy cost of food production is spent transporting food from harvest to market, and for processing, packaging and storage. Growing food yourself or buying locally-grown, in-season, unprocessed food can therefore reduce energy consumption. Buying food from local farmers can greatly reduce your ecological footprint.

How much of the food that you eat is locally grown, unprocessed and in-season?

a	Most	b	About three-quarters	c	About half	d	About a quarter	e	Very little

Your score: a) -10 points, b) 0 points, c) 5 points, d) 10 points, e) 20 points

Travel

Poisonous gases and substances released by cars and other motor vehicles include nitrogen oxides, hydrocarbons and lead which contribute to acid rain, smog, health problems and global warming.

How do you get to work/school/university?

a	On foot	b	Bicycle	c	By taxi/train/bus	d	By car

Your score: a) -10 points, b) 0 points, c) 5 points, d) 20 points

Re-use

Re-use of some of your waste helps to reduce the impact on the environment; reduces the amount of waste that goes into landfill sites (rubbish dumps) and reduces the amount of raw materials required.

At home do you re-use waste materials such as plastic, paper, glass and tins:

a	Never	b	Sometimes	c	Often

Your score: a) 20 points, b) 5 points, c) -10 points

Consumer choices

Some goods available in supermarkets pollute the environment more than others – a roll-on deodorant is better than a spray containing CFCs (which break down the ozone layer); a brightly coloured toilet cleaning liquid is not necessary as that colour doesn't clean the toilet.

When you shop do you choose the least polluting product?

a	Always	b	Often – depending on price, brand or what you have seen on television	c	Sometimes – depending on price, brand or what you have seen on television	d	Never think about such things

Your score: a) -10 points, b) 0 points, c) 5 points, d) 20 points

Recycling

Recycling some of your waste helps to reduce the impact on the environment, reduces the amount of waste that goes into landfill sites (rubbish dumps), and reduces the amount of raw materials required.

At home do you recycle waste materials such as plastic, paper, glass and tins:

a	Never	b	Sometimes	c	Often

Your score: a) 20 points, b) 5 points, c) -10 points

Reducing

You can reduce your eco-footprint by shopping carefully. Buy in bulk to reduce packaging; buy refills (e.g. deodorants); choose well-made articles that will last well and those with recycled content; and avoid over-packaged products.

When you buy products do you:

a	Always think of the amount you will throw away	b	Often try – but take into consideration price and brand	c	Sometimes – depending on the price and brand	d	Never think of how goods are packaged or how long they will last

Your score: a) -10 points, b) 0 points, c) 5 points, d) 20 points

WHAT YOUR SCORE SAYS ABOUT YOU

Add you all your points. How big is your ecological footprint?

Score less than 50: Green footprint (you have a tiny ecological footprint)

Score between 51 and 110: Yellow footprint (you have a small ecological footprint)

Score between 111 and 180: Blue footprint (you have a medium ecological footprint)

Score between 181 and 200: Orange footprint (you have a large ecological footprint)

Score over 200: Red footprint (you have a huge ecological footprint)

SOURCE

This activity is taken from the lesson plans developed by the Water Research Commission in partnership with Share-Net (A project of the Wildlife and Environment Society of South Africa). To download the full lesson (free of charge) go to: www.wrc.org.za/downloads/education/school%20lesson%20plans/Grade10_Activity5.pdf

WATER Kidz

Ready, Steady, Monitor!

On 18 October World Water Monitoring Day (WWMD) is celebrated in countries all over the globe, including South Africa.

WWMD is an international education and outreach programme, which was initiated by the Water Environment Federation (WEF) and the International Water Association (IWA). The programme builds public awareness and involvement in protecting water resources around the world by engaging ordinary people, and especially school children, to conduct basic monitoring of their local water bodies.

The organisers have made available an easy-to-use kit, which enables everyone, from children to adults, to sample local water bodies for a core set of water quality parameters, including temperature, acidity (pH), clarity (turbidity) and dissolved oxygen. Following the monitoring period (18 September to 18 October) results are collected, analysed and shared with participating communities through the WWMD website (www.worldwatermonitoringday.org). The timeframe for monitoring was selected to foster consistency in monitoring dates across the world.

The coordinators of this special programme hope to expand participation to a million people in 100 countries by 2012. Last year, more than 46 000 people from Argentina to Zimbabwe visited their local streams, rivers, lakes and other water bodies in celebration of WWMD. This represented an increase of 61% over participation in 2006. The organisers hope to attract even more participants this year.

In addition to the core set of water quality parameters, some groups also tested for the presence of certain macroinvertebrates such as dragonflies, mayflies and scuds. Samples were taken in a range of settings – agricultural, commercial, residential and industrial. Some participants acted as individuals, while many took part with schools, universities, civic, environmental and faith-based groups.

Data was reported from 43 countries, with sites in the US accounting for about 63% of the 3 544 monitored worldwide. After the US, Taiwan (444) and Spain (343) led global WWMD efforts in the number of sites monitored.

The Department of Water Affairs (DWA) leads WMD activities in South Africa. Every year, DWA engages with selected schools that are participating in the 2020 Vision Programme and equip them with monitoring kits to determine the physical and microbiological quality of their tap water.

This will be done in cooperation with the responsible water service authorities since the municipality will be benefiting by having access to additional water quality information.

Yuven Gounden

On 18 October, groups around the world will come together to monitor the quality of their water resources.

In addition, the department reports that 18 October has also been set up as D-day for water service authorities to have water sampling programmes in place as is required by the Water Services Act. "It is the legislated duty of water service authorities to have sampling programmes in place in order to ensure that the quality of drinking water supplied to the public by means of formal reticulation, complies with the National Standard," DWAF said in a statement.

SOUTH AFRICA'S RIVER HEALTH PROGRAMME

South Africa has had a national programme in place since 1994 to assess the health of its rivers, namely the River Health Programme (RHP). The RHP, which is a collaborative effort between the Department of Water Affairs & Forestry, the Department of Environmental Affairs & Tourism, and the Water Research Commission (WRC), assesses the biological and habitat integrity of rivers. This is done through the evaluation of, among others, fish, aquatic invertebrates and riparian vegetation.

This assessment enables reports on the ecological state of the river system to be produced in an objective and scientifically sound manner. Information from the RHP assists with identification of those areas where unacceptable ecological deterioration is taking place. In addition, this programme reflects the effectiveness of existing river management policies, strategies and actions

Apart from the two national government departments and the WRC, a variety of organisations within each province implement the River Health Programme at a local level. The following state-of-the-river reports have been completed to date, and can be downloaded from the RHP website (www.csir.co.za/rhp): Gouritz water management area; Mokolo River; Olifants, Doring and Sandveld rivers; Greater Cape Town rivers; Crocodile (West) Marico water management area; Buffalo River System; Berg River System, Free State region; Diep, Hout Bay, Lourens and Palmiet river system; Umgeni River, Letaba and Luvuvhu rivers, and Crocodile Sabie-Sand & Olifants rivers.

WATER QUALITY PARAMETERS

Dissolved oxygen: Aquatic organisms such as zooplankton, invertebrates and fish require sufficient levels of dissolved oxygen (DO) to survive. The amount of DO in the water is a factor in determining the species and abundance of organisms that can live in a river, stream or estuary.

Temperature: Temperature is a critical factor in determining where aquatic organisms live and how well they thrive there. Growth rates of aquatic plants and cold-blooded animals generally increase with temperature, up to the thermal optimum. Shifts in temperature cause variation in, for example, phytoplankton abundance and species composition. Temperature also affects the solubility of oxygen in the water, which is critical for the survival of aquatic organisms. As water temperature increases, the solubility of oxygen decreases.

Acidity (pH): Solutions with a pH less than 7 are acidic, and those with pH greater than 7 are basic (alkaline). Knowledge of pH is important because most aquatic organisms are adapted to live in pHs between 5.0 and 9.0.

Turbidity: Turbidity is a measure of the ability for light to transmit down through the water column. As suspended solids increase in the water, the amount of light travelling through the water column is reduced. This can influence the populations of organisms that are directly dependent upon light (phytoplankton and aquatic plants) and those, in turn that are dependent upon them as a food source. Suspended solids include particles of algae, sediment, debris or solid waste. Turbidity affects fish and other aquatic life by: a) limiting photosynthetic processes and increasing respiration, oxygen use and the amount of carbon dioxide produced; b) clogging of fish gills and feeding apparatus of bottom dwelling animals by suspended particles; and/or obscuring vision of fish as they hunt food and smothering bottom-dwelling animals.


USGS
science for a changing world
The heat of the sun provides energy to make the water cycle work.
The sun evaporates water from the oceans into water vapor.
This invisible vapor rises into the atmosphere, where the air is colder.
The water vapor condenses into clouds.
Volcanoes emit steam, which forms clouds.
Air currents move clouds all around the Earth.
Water drops form in clouds, and the drops then fall to Earth as precipitation (rain and snow).
In cold climates, precipitation builds up as snow, ice, and glaciers.
Snow can melt and become runoff, which flows into rivers, the oceans, and into the ground.
Some ice evaporates directly into the air, skipping the melting phase (sublimation).
SUBLIMATION
ICE AND SNOW
PRECIPITATION
VOLCANIC STEAM
SNOWMELT
RUNOFF
FOG AND DEW
STREAMFLOW
SPRING
RUNOFF
LAKES
INFILTRATION
SEEPAGE
RECHARGE
UN WATER
World Water Day
2013
United Nations International Year of Water Cooperation
GROUNDWATER STO
U.S. Department of the Interior
U.S. Geological Survey

You may think that every drop of rain that falls from the sky, or each glass of water that you drink is brand new, but in fact it has always been here and is a constant part of The Water Cycle!

THE ATMOSPHERE

CONDENSATION

EVAPOTRANSPIRATION

EVAPORATION

RUNOFF

H_2O

THE OCEANS

PLANT UPTAKE

GROUNDWATER FLOW

Rainfall on land flows downhill as runoff, providing water to lakes, rivers, and the oceans.

Some rain soaks into the ground, as infiltration, and if deep enough, recharges groundwater.

Water from lakes and rivers can also seep into the ground.

Water moves underground because of gravity and pressure.

Groundwater close to the land surface is taken up by plants.

Some groundwater seeps into rivers and lakes and can flow to the surface as springs.

Plants take up groundwater and evapotranspire, or evaporate, it from their leaves.

Some groundwater goes very deep into the ground and stays there for a long time.

Groundwater flows into the oceans, keeping the water cycle going.

General Information Product 146
http://ga.water.usgs.gov/edu/watercycle.html

WATER Kidz

Riding the Water Cycle

There is water all around us. In fact, between two thirds and three-quarters of the Earth is made of water. There is also water in the air, under the ground and in ice caps and glaciers in the very cold parts of our planet.

The Earth never gets new water, and water never disappears. This means the same water you brush your teeth with was used millions of years ago by a mother dinosaur to give her baby a bath. This is because water never stands still and is constantly recycled. We call this the water cycle.

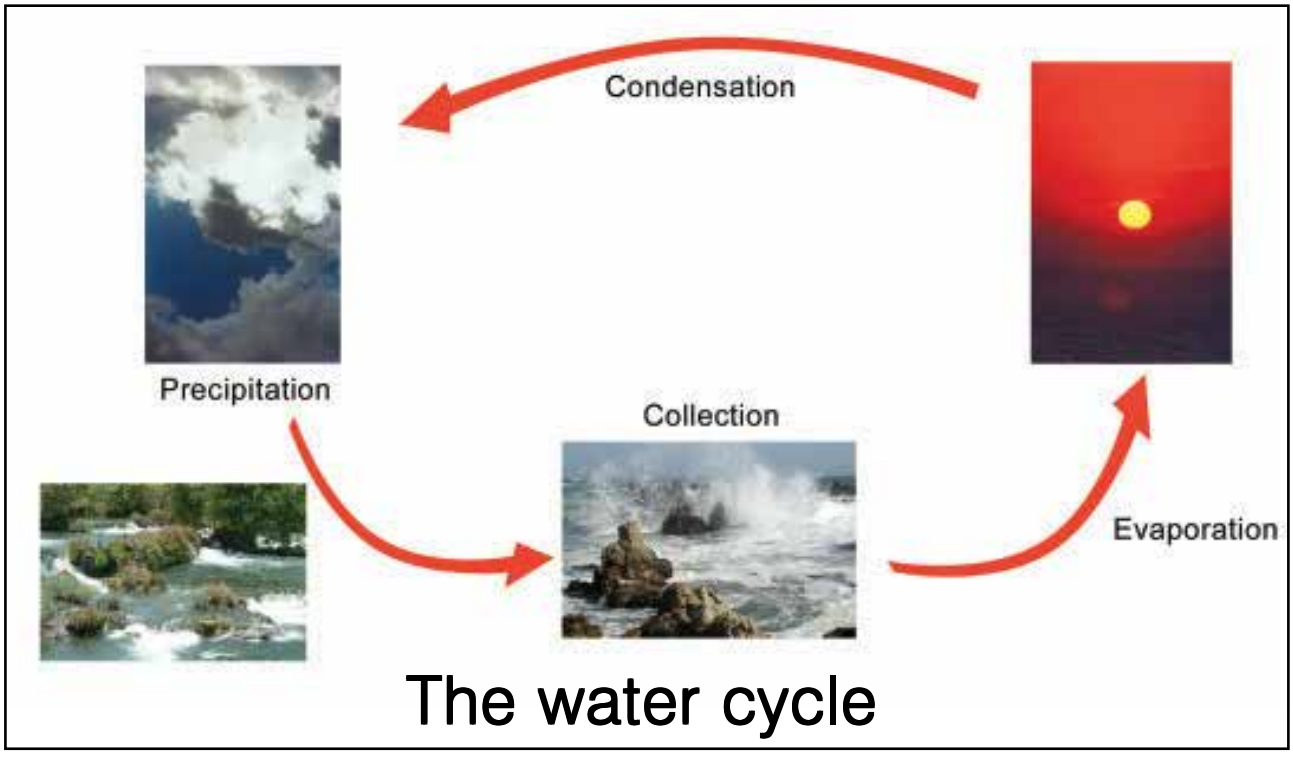
HOW DOES THE WATER CYCLE WORK?

The water cycle is made up of different parts. The water cycle starts with **evaporation**. That is when the sun heats up water in rivers or lakes or the ocean and turns it into vapour or steam. This vapour or steam then leaves the river or lake or the ocean and goes into the air. We also get **transpiration** which is when plants lose water out of their leaves.

When the water vapour or steam is up in the air it gets cold and changes back into liquid form. This forms clouds. This process is called **condensation**. Take a cold glass of water and hold it against the mouth of a boiling kettle. Do you see the water droplets forming on the outside of the glass? That is condensation.

The last step in the water cycle is **precipitation**. This is when water falls back to the earth (for example, when it rains, snows or hails). As more water fall to the ground we get **surface runoff** which is when some of the rain runs into streams and rivers and returns to the oceans.

Some of the water **infiltrates** the soil and is evaporated directly; some of it moves through the roots of plants and is transpired by the leaves. Other water **percolates** or seeps deeper into the ground into layers or rocks or soil underground that hold the water (these are called aquifers).



The water cycle

BUILD YOUR OWN WATER CYCLE

You will need:

1. A jar
2. Small plants
3. A bottle cap or a shell filled with water
4. Soil
5. Sand
6. Small stones

1. Fill the jar by first placing the small stones, then the sand, then the soil.
2. Then add the plants in the soil and add the bottle cap or shell of water in the jar.
3. Put the lid on the jar and place it in the sun.
4. Now watch how the water cycle works.

WATER WORDS

Condensation: The process of water vapour in the air turning into liquid water. Water drops on the outside of a cold glass of water are condensed water.

Evaporation: The opposite of condensation. It is the process of liquid water becoming vapour.

Freshwater: Water that contains less than 1 000 mg per litre of dissolved solids.

Glacier: Huge mass of ice, formed on land by the compaction and recrystallisation of snow.

Transpiration: The process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface, such as leaf pores.

Water cycle: The cyclic transfer of water vapour from the Earth's surface via evapotranspiration into the atmosphere, from the atmosphere via precipitation back to earth, and through runoff into streams, rivers and lakes, and ultimately into the oceans.

DID YOU KNOW?

- The Nile is the longest river in the world. Its main source is Lake Victoria, in east central Africa. From its farthest stream in Burundi, in eastern Africa, it extends 6 695 km in length.
- The Amazon in South America is the largest river in the world. This is because it flows through the Amazon rain forest – the largest and wettest rainforest on earth. In fact, the Amazon basin holds two-thirds of all the flowing water in the world. The river is fed by 1 000 tributary rivers, many of which are more than 1 600 km long.
- The largest freshwater flood in the world occurred 18 000 years ago in the Altay Mountains of Siberia, Russia. An ice-dam blocking a lake broke, allowing water to pour out. The lake was estimated to be 120 km long and 760 m deep.

Source: Guinness Book of Records

WATER WORD SCRAMBLE:

Put the letters in the right order:

All living things need _____ (**tawer**) to live.

When water evaporates it travels up in the air, gets cold and turns into liquid form to make _____ (**sdclou**).

When water freezes we call it _____ (**cei**).

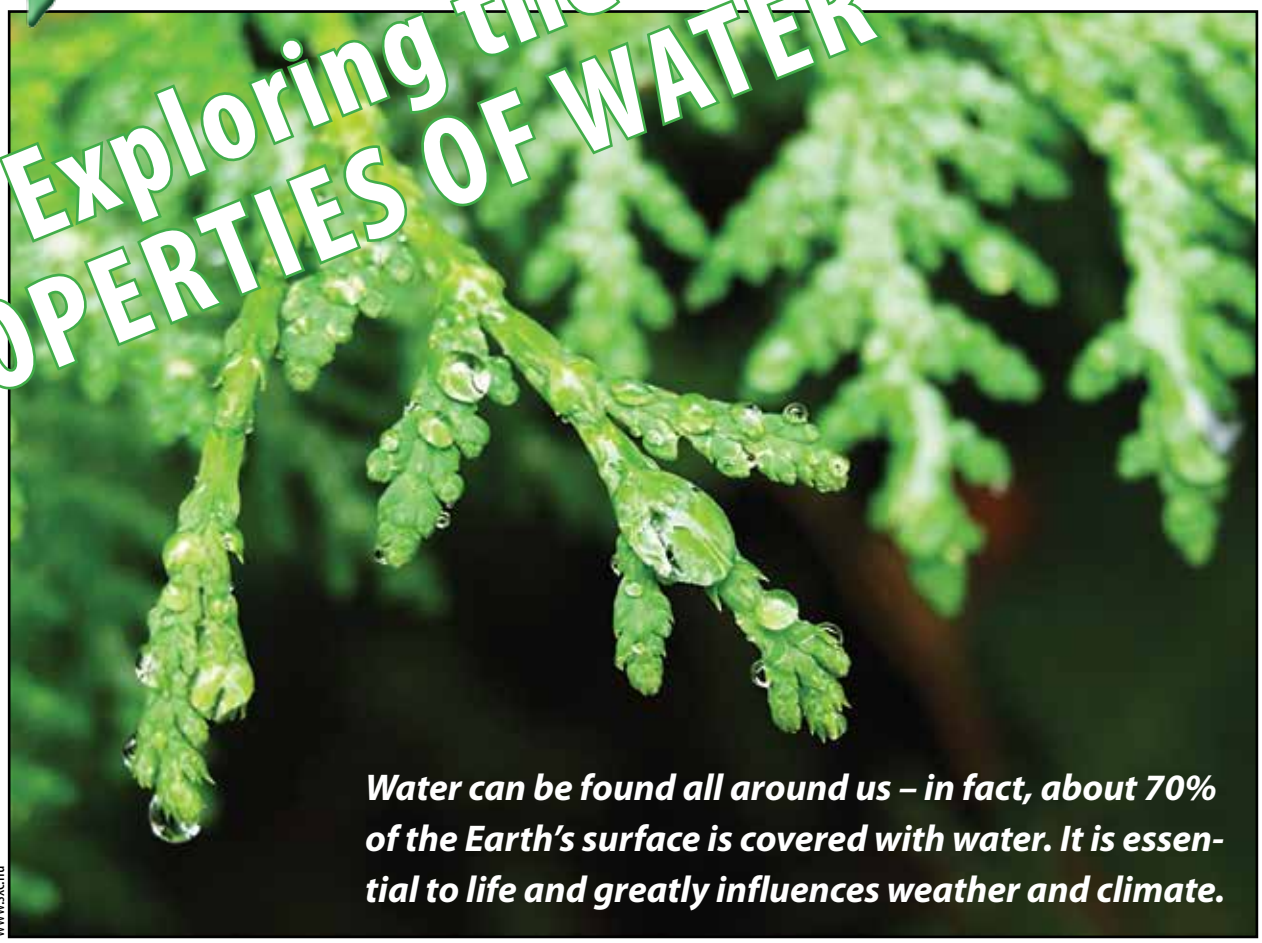
Water falls back to earth as _____ (**nria**)

We _____ (**dkrni**) water in its liquid form.

About 97% of the earth's water is found in the _____ (**coena**)

WATER Kidz

Exploring the PROPERTIES OF WATER



Water can be found all around us – in fact, about 70% of the Earth's surface is covered with water. It is essential to life and greatly influences weather and climate.

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Water is the most common substance on the planet yet it has some very unusual characteristics. Pure water is odourless and tasteless. A drop of water is made up of millions of tiny particles.

Water is one of the greatest natural examples of recycling. We use the same water today than the dinosaurs did millions of years ago.

Water has a very simple atomic structure. Water is composed of two elements, **Hydrogen** and **Oxygen**, making it a compound. Pure water has a neutral pH of 7, which is neither acidic nor basic.

2 Hydrogen + 1 Oxygen = H_2O

One of the most remarkable things about water is that it can be found in all three states of matter: solid ice, liquid water and gaseous water vapour (or steam). When water is cooled down to about 0°C it will freeze. When it is heated up to about 100°C it boils, changing from a liquid to vapour. Earth's water is constantly interacting, changing and in movement. This perhaps makes water one of the greatest examples of recycling.

Did you know that water expands (gets less dense) by 9% when it freezes? This is very unusual for liquids. Think of the ice blocks in your glass of water on a hot summer's day. It floats on top rather than sinking to the bottom. This is one of the wonderfully unusual characteristics of water. This characteristic is very helpful in nature. When a lake freezes, for example, ice forms on the surface and the water underneath stays liquid. This helps living things in the water survive cold winters.

If water contracted on changing into a solid, ice would be heavier than an equal volume of water and would sink. The bottoms of lakes and oceans would then fill with ice, out of reach of the sun's warmth. Gradually the Earth would become colder, more and more ice would form, and in time there would be little, if any, life on Earth!

UNIVERSAL SOLVENT

Another remarkable characteristic of water is that it has the capability to

www.sxc.hu

***Left**: Water is one of the greatest natural examples of recycling. We use the same water today than the dinosaurs did millions of years ago.*

***Right**: Water is sticky and elastic, and tends to clump together in drops rather than spread out in a thin film.*

dissolve many things. This means that wherever water flows, either through the ground or through our bodies, it takes along valuable chemicals, minerals and nutrients. This is why pure water is so rare to find in nature. Even rainwater, the purest natural water, contains chemicals dissolved from the air.

Have you ever tasted how salty seawater is? That is because of the dissolved salts in the water. Take a cup of water and add a teaspoon of sugar. Now stir. See how the sugar is dissolved in the water? Now take a cup of warm water and stir in a teaspoon of sugar. Which cup of water dissolved the sugar the fastest?

Minerals dissolved in water help nourish living things. Harmful substances, such as decaying animal and vegetable matter and poisonous chemicals, may also be dissolved, and for this reason it is important that sources of drinking water be tested (and why water has to be treated before we can drink it safely). It is also because water is such a good solvent, and therefore dissolves dirt, that it is used for washing.

EXTRAORDINARY PROPERTIES

Water has a high specific heat index. This means that water can absorb a lot of heat before it begins to get hot. This is why water is valuable to industries and in your dad's car radiator as a coolant. The high specific heat index of water also helps regulate the rate at which air changes temperature, which is why the temperature change between seasons is gradual rather than sudden, especially near the oceans.

Another interesting characteristic of water is that it has a high surface tension. This means that water is sticky and elastic, and tends to clump together in drops rather than spread out in a thin film. This is why water drops are, in fact, drops. This surface tension is responsible for capillary action, which allows water (and its dissolved substances) to move through the roots of plants and through the tiny blood vessels in our bodies.

You can test the capillary action of water. Place a straw into a glass of water. See how the water 'climbs' up the straw? What is happening is that the water molecules are attracted to the straw molecules. When one water molecule moves closer to a straw molecule the other water molecules (which are cohesively attracted to that water molecule) also move up into the straw. Capillary action is limited by gravity and the size of the straw. The thinner the straw or tube the higher up capillary action will pull the water.

WEB RESOURCES

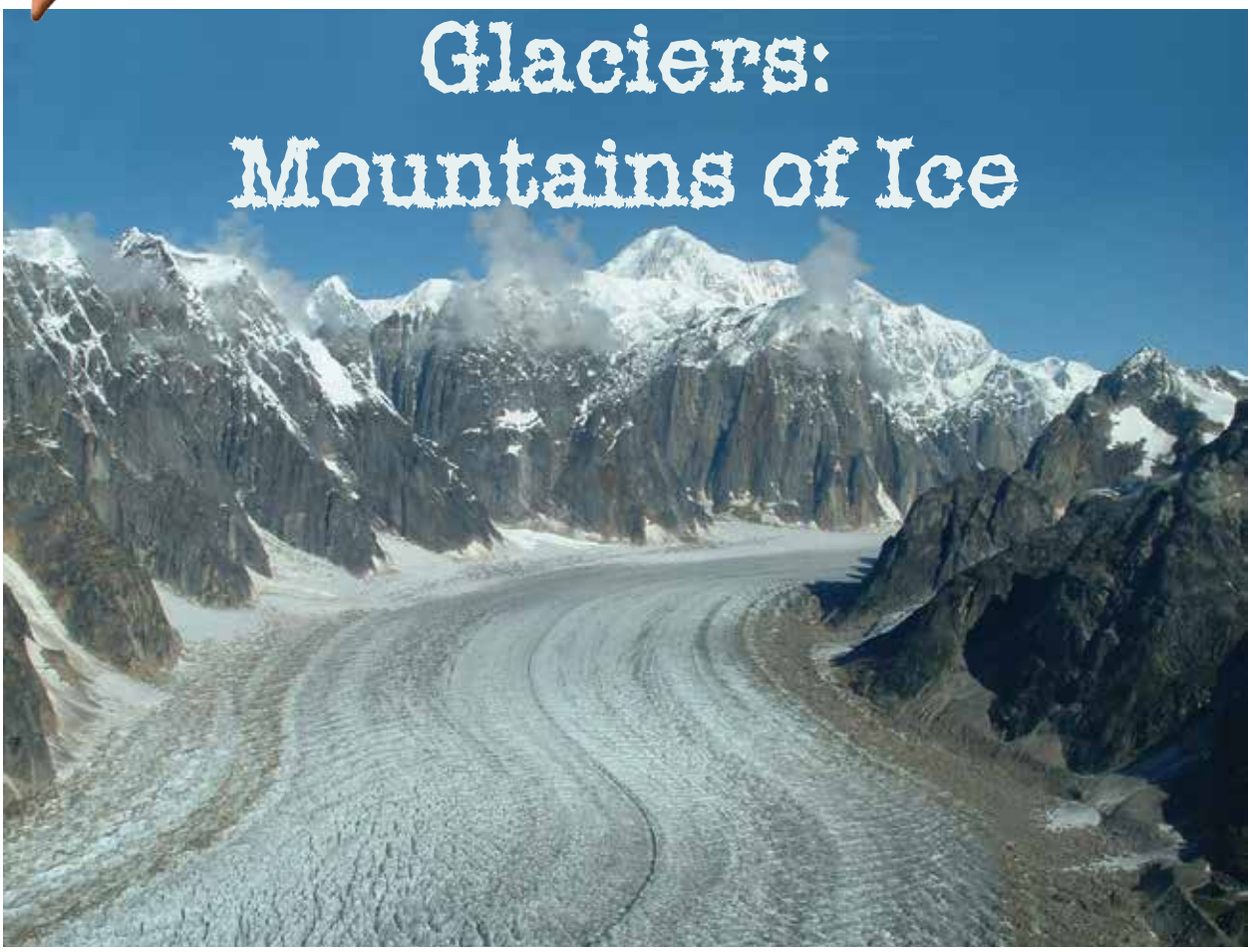
- http://science.howstuffworks.com/water-info2.htm
- http://en.wikipedia.org/wiki/Properties_of_water
- http://ga.water.usgs.gov/edu/waterproperties.html

www.sxc.hu

Water is the only natural substance in all three states – liquid, solid (ice) and gas (steam) – at the temperatures normally found on Earth.

WATER Kidz

Glaciers: Mountains of Ice



Does the word 'glacier' make you think of a mountain of cold ice and snow? This is because glaciers require very specific climatic conditions. Most are found in regions of high snowfall in winter and cool temperatures in summer. These conditions ensure that the snow that accumulates in the winter isn't lost during the summer.

While most of the world's glaciers are found near the Poles, they exist on all of the world's continents, even Africa. The glaciers of Africa are limited to three specific geographic locations; two volcanoes (Mount Kenya and Kilimanjaro) and one mountain group (the Ruwenzori).

DID YOU KNOW?

The Kutiah Glacier in Pakistan holds the record for the fastest glacial surge. In 1953, it raced more than 12 kilometres in three months, averaging about 112 metres per day.

Glaciers begin to form when snow remains in the same area year-round, where enough snow accumulates to transform into ice. Each year, new layers of snow bury and compress the various layers. This compression forces the snow to re-crystallize, forming grains similar in size and shape to grains of sugar. Gradually, the grains grow larger and the air pockets between the grains get smaller, causing the snow to slowly compact and increase in density.

After about two winters, the snow turns into firn – an intermediate state between snow and glacier ice. At this point, it is about half as dense as water. Over time, larger ice crystals become so compressed that any air pockets between them are very tiny. In very cold glacier ice, crystals can reach several hundred millimetres in length. For most glaciers, this process takes over a hundred years.

Under the pressure of its own weight and the forces of gravity, a glacier will begin to move, or flow, outwards and downwards. Valley glaciers flow down valleys and continental glaciers (ice

GLACIER FACTS

- About 10% of land area is covered with glaciers at present.
- Glaciers store about 75% of the world's freshwater.
- Glacierised areas cover about 15 million square kilometers.
- Antarctic ice is more than 4 200 metres thick in some areas.
- If all land ice melted, the level of the sea would rise about 70 metres worldwide.
- Glacier ice crystals can grow to be as large as baseballs.
- Almost 90% of an iceberg is below water – only about 10% shows above water.

GLACIER SPEAK

Ablation: Loss of ice from a glacier caused by melting of vaporisation.
Arete: Sharp, narrow ridge formed as a result of glacial erosion from both sides.
Calving: The process by which ice breaks off a glacier's terminus. (Usually the term is reserved for tidewater glaciers or glaciers that end in lakes, but it can refer to ice that falls from hanging glaciers)
Crevasse: Open fissure in the glacier surface.
Esker: A sinuous ridge of sedimentary material (typically gravel or sand) deposited by streams that cut channels under or through the glacier ice.
Firn: Rounded, well-bonded snow that is older than one year.
Glacier terminus: The lowest end of a glacier. Also called the glacier toe or glacier snout.
Mountain glacier: A mountain or alpine glacier is a glacier that is confined by surrounding mountain terrain.
Ogives: Alternate bands of light and dark ice seen on a glacier surface.
Sintering: The bonding together of ice crystals.
Sublimation: The change of state from ice to water vapour or water vapour to ice.
Sun cups: Ablation hollows that develop during intense sunshine.
Surging glacier: A glacier that experiences a dramatic increase in flow rate, ten to one hundred times faster than its normal rate. Usually surge events last less than a year, but periodically, it can last between 15 and 100 years.
Tarn: A small mountain lake or pool.
Valley glacier: A mountain glacier whose flow is confined by valley walls.

sheets) flow outward in all directions from a central point. Glaciers dramatically impact their surrounding environment by reshaping the underlying and surrounding landscape as they move, through both erosion and deposition.

Not all glaciers move slowly. For example, surging glaciers experience dramatic increases in flow rate, sometimes travelling as much as ten to one hundred times faster than the normal rate of movement.

At some stage glaciers will stop growing and start to move in retreat. As large glaciers retreat, the underlying ground surface is typically scoured to most materials, leaving only scars on the underlying surface. Glacier retreat results from increasing temperature, evaporation and wind scouring. As long as snow accumulation equals or is greater than melt and ablation, glacier health is maintained.

Over the past 60 to 100 years, glaciers worldwide have tended toward retreat. Alpine glaciers, which are typically smaller and less stable to begin with, seem particularly susceptible to glacial retreat. Whether this is due to a predictable climate trend or because of increased human impacts on global climate remains to be determined.

Glaciers are a natural resource on which many people depend. For example, the people living in the city of La Paz, Bolivia, rely on glacial melting from a nearby ice cap to provide water during the significant dry spells they experience. In Switzerland's Rhone Valley, farmers have irrigated their crops for hundreds of years by channelling meltwater from glaciers to their fields.

More recently, scientists and engineers in Norway, Canada, New Zealand and the Alps have worked together to tap into glacial resources, using electricity that has been generated in part by damming glacial meltwater. In Japan, there are tremendous amounts of snow, but no glaciers. Because the country endures frequent droughts, scientists are now examining ways to create artificial glaciers that could provide more water for people.

- For more information about glaciers visit the US National Snow & Data Centre's glaciers website (http://nsidc.org/glaciers)

WATER Kidz

Sanitation – Weapon Against Death and Disease

Whether it is called a toilet, latrine, porcelain throne, john, water closet or the loo, speaking of sanitation tends to make people uncomfortable. Yet, the humble toilet is one of the most important defences against disease and death.

Courtesy of CSIR

Alternative sanitation, such as urine diversion toilets, are gaining ground in South Africa.

Why is sanitation important? Sanitation, defined as any system that safely manages human excreta, has a major impact on the health and dignity of people. Around the world, an estimated 2,6 billion (mostly poor) people, including 980 million children, lack access to proper sanitation facilities. This means they are forced to defecate in bags, buckets, fields, or roadside ditches, causing serious health risks to them and others.

Poor sanitation promotes the spread of health problems – including chronic diarrhoea, intestinal worms, bilharzia, hepatitis, and scabies. In fact, diarrhoea remains the number one killer of young children around the world. It is estimated that improved sanitation facilities could reduce diarrhoea-related morbidity in young children by more than a third. If hygiene promotion is added, such as proper hand washing, it could be reduced by two thirds.

Bad sanitation facilities pollute the environment and threaten drinking water facilities. It also threatens social and economic development as people have to stay home from school and work because of illness.

So important are toilets considered to our health that the *British Medical Journal*, following a global survey, has hailed sanitation as the greatest medical advance of the last 150 years.

Today, there is an international movement to address the lack of sanitation. This movement is largely spurred on by the United Nations General Assembly who in adopting the *Millennium Development Goals* in 2000 agreed to halve the global backlog in sanitation and water by 2015.

USEFUL WEBSITES

www.dwaf.gov.za
http://en.wikipedia.org/wiki/Flush_toilet
http://en.wikipedia.org/wiki/Sanitation
http://home.howstuffworks.com/toilet.htm
www.mieliestronk.com/troon.html
www.victoriancrapper.com
www.who.int/water_sanitation_health/publications/factsfigures04/en/
www.worldtoilet.org

SANITATION IN SOUTH AFRICA

South Africa supports these goals, and the government has taken up the challenge to wipe out the water and sanitation backlog in this country. It has set itself even more stringent targets, aiming to ensure that all buckets in formal settlements are eradicated by December 2007, all clinics have safe and adequate water and sanitation by December 2007, and that all households have access to basic sanitation by 2010.

The latter will be no mean feat as an estimated 15 million people still don't have access to acceptable toilet infrastructure in South Africa. The country is making steady progress, however. Last year, an additional 250 000 households received access to basic sanitation.

Improved sanitation does not necessarily have to mean a flush toilet. Full water-borne sanitation is extremely expensive to implement as well as operate and maintain. These systems also use a lot of water. There are many alternative forms of sanitation which are gaining popularity around the world, for example, urine diversion (UD) systems.

In UD systems, waste is deposited in a chamber and dry material (usually sand or ash) is added after each use to deodorise decomposing faeces while controlling moisture and facilitating biological breakdown (composting). Urine is diverted through a specially adapted pedestal. In South Africa, most of the urine is led to a soakaway pit, but it can be tapped and used as a fertilizer in home gardens.

Other sanitation options include ventilated improved pits (VIPs – the most popular basic sanitation applied in South Africa), pour-flush toilets, aqua-privies, conservancy tanks, septic tanks or shallow sewers.

FLUSH TOILETS IN HISTORY

- **26th century BC**: Flush toilets were first used in the Indus Valley Civilisation, in India. The ancient cities of Harappa and Mohenjo-daro had a flush toilet in almost every house, attached to a sophisticated sewerage system.
- **15th century BC**: Flush toilets were found in the remains of the Minoan city of Akrotiri.
- **1596**: Sir John Harrington is said to have invented 'the Ajax', a flush toilet, for Elizabeth I of England.
- **1738**: A valve-type flush toilet is invented by JF Brondel.
- **1775**: Alexander Cummings invents the S-trap, still used today. It uses standing water to seal the outlet of the bowl, preventing the escape of foul air from the sewer.
- **1824**: The first public toilet appears in Paris, France.
- **1859**: Queen Victoria's toilet is decorated with gold.

Kathy Eates

DID YOU KNOW?

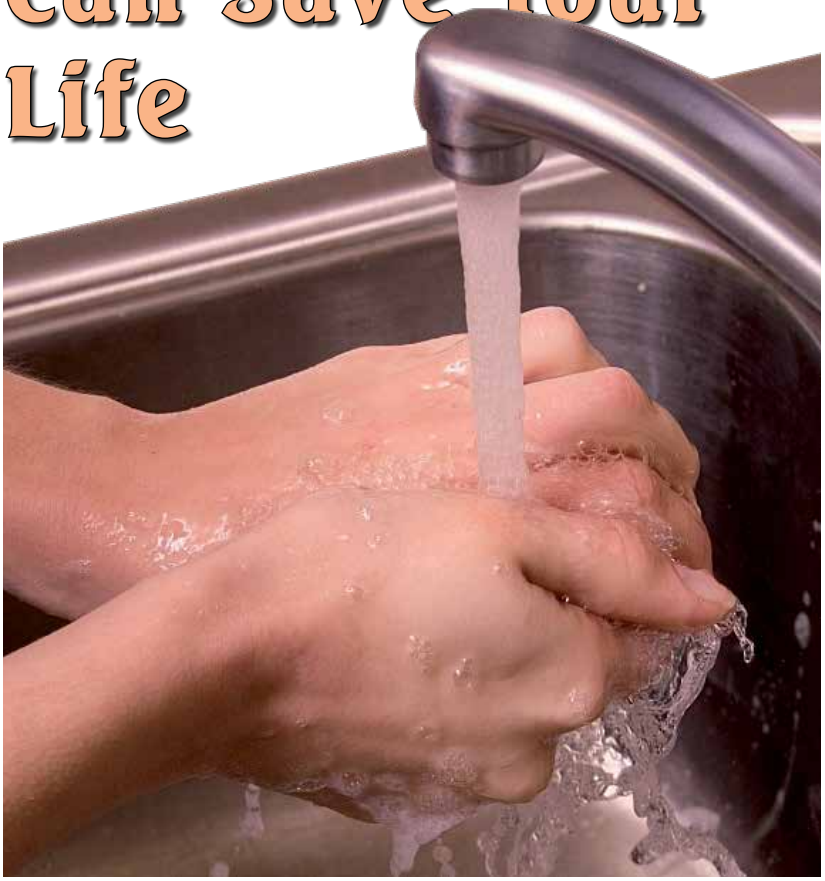
World Toilet Day is celebrated on 19 November

Far left: An aqua privy is another form of sanitation.

Left: The government hopes to eradicate the backlog of those people who still have to use bucket toilets by the end of this year.

WATER Kidz

Washing Hands Can Save Your Life



Millions of germs – bacteria and viruses – lurk everywhere.

These germs can be found in the bathroom, in the kitchen, in the garden, on our pets, even at work and at school. Germs can cause many different illnesses, such as colds and flu, eye and mouth infections and diarrhoea or even cholera and typhoid. Germs are transmitted in several different ways, especially by touching dirty hands or changing dirty nappies.

Other ways include through contaminated water and food, through droplets when someone coughs or sneezes, through contaminated surfaces and through a sick person's bodily fluids. If people pick up germs from one of these sources, they can unknowingly become infected simply by touching their eyes, nose or mouth.

The simple act of washing hands with soap and water is one of the best ways to keep ourselves and our families healthy. Research has shown that hand washing can significantly reduce the two leading causes of child deaths in the world – diarrhoeal disease and acute respitary infection (such as pneumonia). This makes hand washing more effective than any single vaccine or hygiene behaviour.

Unfortunately, many people in the country do not wash their hand regularly. An international hygiene survey conducted among a number of countries, including South Africa, found that nearly 70% of the country's people are at risk of transmitting dangerous infections because they do not wash their hands regularly. Almost half of the 1 000 people surveyed in the country believed that disinfecting surfaces, avoiding close contact with others and not letting animals in the house were more effective in preventing disease than hand washing. This is not true – hand washing remains the best way of preventing the spread of disease.

HOW DO YOU WASH YOUR HANDS PROPERLY?

Step 1:
Wash you hands in warm water.
Step 2:
Use soap (it does not need to be anti-bacterial soap) and lather up for 10 to 15 seconds (about as long as it takes for you to sing Happy Birthday). Make sure you get in-between the fingers and under the nails where uninvited germs like to hang out. Do not forget to wash your wrists!
Step 3:
Rinse and dry well with a clean towel.

You need to wash your hands: before eating and cooking; after using the toilet; after cleaning around the house; after touching your pets; before and after visiting or taking care of sick relatives or friends; after blowing your nose, coughing or sneezing; and after changing the baby's nappy.

DID YOU KNOW?

According to the Water Supply & Sanitation Collaborative Council, one gram of faeces can contain 10 million viruses, a million bacteria, a thousand parasite cysts and a hundred worm eggs.

HOW GERMS ARE SPREAD

Nose, mouth, or eyes to hands to others: Germs can spread to the hands by sneezing, coughing or rubbing the eyes and then can be transferred to other people. Simply washing your hands can help prevent such illnesses as the common cold or eye infections.

Hands to food: Usually germs are transmitted from unclean hands to food by an infected food preparer who didn't wash his or her hands after using the toilet. The germs are then passed to those who eat the food. That is why it is important to always wash your hands after using the toilet and before preparing food.

Food to hands to food: Germs are transmitted from raw foods, such as chicken, to hands while preparing a meal. The germs on the hands are then transferred to other uncooked foods, such as salad. Cooking the raw food kills the initial germs, but the salad remains contaminated.

Animals to people: Animals, such as dogs and cats, also carry germs. It is important to wash your hands after petting animals or touching any surfaces they come into contact with, such as their bedding.

Infected child to hands to other people: Germs are passed from a child with diarrhoea to the hands of the parent during nappy changing. If the parent doesn't immediately wash his or her hands, the germs that cause the diarrhoea are then passed on to others.

DIARRHOEA: WORLD KILLER

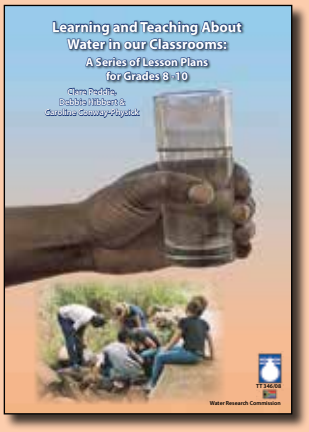
Diarrhoea remains a significant world health problem, with more than three million episodes occurring each year. Many people die from diarrhoea, and children under the age of five are particularly vulnerable.

Persistent diarrhoea can also contribute to malnutrition, reduced resistance to infections, and sometimes impaired growth and development. The organisms causing diarrhoea can be transmitted from infected faeces to people through food and water, person-to-person contact, or direct contact.

Hand washing after going to the toilet, and before preparing and eating food can reduce the risk of diarrhoea.

Carina Teichert

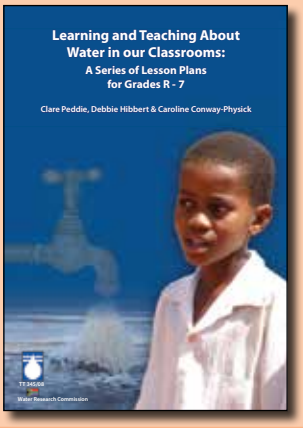
It is important that we wash our hands before preparing food.



WATER LEARNING PLANS FOR EDUCATORS

The Water Research Commission has published a series of lesson plans on water for grades R to 10. The lesson plans, developed with Share-Net, are linked to the South African Curriculum. Each lesson pack contains five lessons, with each lesson focusing on a different learning area – these can be used as they are, or adapted to suited the local context. Each lesson is concluded with a rubric of criteria to assess the learners. Learning Outcomes and Assessments Standards covered during each lesson are given in the summary at the beginning of the pack.

The lesson plans are available free of charge. Contact Publications at Tel: (012) 330-0340 or Fax: (012) 331-2565 or E-mail: orders@wrc.org.za. The lesson plans can also be downloaded from www.wrc.org.za/publications_education.htm



WATER Kidz

Exploring the Link Between Water and HIV

On 1 December the world will celebrate World Aids Day. The theme for 2008 was 'leadership' to encourage leaders at all levels to stop the disease.

HIV infection has reached epidemic proportions. According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), AIDS has killed more than 25 million people since it was first recognised on 1 December, 1981, making it one of the most destructive pandemics in recorded history. It is estimated that about 0,6% of the world's population is infected with HIV. Last year about 2,7 million people were newly-infected. More than 6 000 lives are lost every day to the disease.

AIDS IN SOUTH AFRICA

AIDS continues to be the leading cause of death in Africa which is home to 67% of all people living with HIV. In Africa, 60% living with HIV are women and three out of four young people living with HIV are female.

South Africa has one of the highest prevalence of HIV in the world. While the epidemic seems to have stabilised in South Africa a significant proportion of people in the country are living with the disease. At present, the country has an estimated 5,7 million people living with HIV.

According to the Human Sciences Research Council (HSRC), HIV prevalence by province shows that among people aged two years and older KwaZulu-Natal (16,5%), Mpumalanga (15,2%) and Free State (12,6%) have the most people living with HIV. Among those aged between 15 and 49 the HIV prevalence is highest in Mpumalanga and KwaZulu-Natal. People living in informal settlements have by far the highest HIV prevalence.

HIV strikes people across lines of race, gender and social standing, however, informal settlements have been shown to have the highest incidence of HIV.

AIDS & WATER

AIDS is not a water-related disease, and HIV is not spread via contaminated water or poor hygiene. Yet there is a more important link between HIV/AIDS and water than people realise.

Easy access to safe and sufficient water and sanitation is indispensable for people living with HIV/AIDS. Diarrhoea and skin diseases are among the most common opportunistic infections in people living with the disease. For some patients, diarrhoea can become chronic, weakening them even more.

In order for HIV-infected people to remain healthy as long as possible and for people with AIDS to reduce their chances of getting diarrhoea and skin diseases, adequate water supply and sanitation facilities are of the utmost importance, especially if people do not have access to antiretroviral treatment. Clean water is also needed to take medicines.

Good-quality water is also crucial for HIV-positive mothers who cannot breastfeed their babies for fear of infecting them. Unsafe water used in infants' feed increases the risk of diarrhoeal diseases and infant mortality.

ONLINE RESOURCES

Aids Foundation South Africa (www.aids.org.za)
Human Sciences Research Council (www.hsrc.ac.za/Media_Release-256.phtml)
South African Department of Health (www.doh.gov.za)
Wikipedia (http://en.wikipedia.org/wiki/HIV)
Treatment Action Campaign (www.tac.org.za)
Water Research Commission HIV/AIDS DVD for councillors (http://www.wrc.org.za/hiv_water_vid.htm)
International Water & Sanitation Centre (http://www2.irc.nl/page.php/114)

WHAT IS AIDS?

Acquired immune deficiency syndrome (AIDS) is the final and most serious stage of HIV disease, which causes severe damage to the immune system. Human immunodeficiency virus (HIV) causes AIDS. The virus attacks the immune system and leaves the body vulnerable to a variety of life-threatening infections. Common bacteria, yeast, parasites and viruses that ordinarily do not cause serious disease in people with healthy immune systems can cause fatal illnesses in people with AIDS.

The virus can be transmitted: through sexual contact, through blood (for example, through the sharing of needles), and from mother to child (for example through breastfeeding). HIV is not spread by casual contact such as hugging, by touching items previously touched by a person infected with the virus, during participation in sports or by mosquitoes.

There is no cure for AIDS at this time. However, a variety of treatments are available that can help keep symptoms at bay and improve the quality of life of those who have already developed symptoms, for example, antiretroviral therapy.

Source: www.healthline.com

In South Africa, home-based caregivers provide critical support for people who are HIV infected. They require up to 200 litres of water per day for every patient. Water is needed to bath patients and for washing soiled clothing and linen. Finally, water is needed to keep the house environment and toilet clean in order to reduce the risk of opportunistic infections.

QUALITY SERVICES WITHIN REACH

For people weakened by disease it also becomes important that water-supply points and toilets are easily accessible and close to where they are needed. This not only reduces the burden of long-distance water collection, for example, fetching water on caregivers or those who are weak. Critically too, it cuts the risk of girls and women being attacked while fetching water or relieving themselves in remote places, and thus reduces vulnerability to infection with HIV.

In addition, the design of water-supply and sanitation infrastructure needs to take into account, for example, those fetching water are now children or older people who have particular requirements (pump handles not too high, pumping not too heavy, etc). This is because water collection tasks are increasingly falling on children and the elderly as a consequence of AIDS. Toilet structures, on the other hand, need to be big enough to accommodate more than one person (for example, when weakened patients require assistance to go to the toilet).

Chris Kirchhoff/Media Club SA)

We all need to be educated about HIV/AIDS.

HIV/AIDS FACTS AND FIGURES

- South Africa has the sixth-highest prevalence of HIV in the world, with 28% of the population estimated to be infected.
- Women face a greater risk of HIV infection. On average in South Africa there are three women infected with HIV for every two men who are infected. The difference is greatest in the 15-24 age group, where three young women for every one young man are infected.
- HIV in children is high. Approximately 130 000 children aged between two and four and about 214 000 children between five and nine are HIV positive. Most of them have had HIV since birth.

WHERE DOES THE RED RIBBON COME FROM?

The Red Ribbon was created in 1991 by the Visual AIDS Artists Caucus in New York, USA. It has since become the international symbol of HIV and AIDS awareness. People wear the ribbon to demonstrate their care and concern about the disease. It is also a symbol of hope – that the search for a vaccine and cure to halt the suffering is successful and the quality of life improves for those living with the virus.

Source: UNAID

WATER Kidz

Wiping Out Waterborne Diseases

Earlier this year at least four people died and more than 600 were infected when typhoid fever broke out in Delmas, Mpumalanga. But what is typhoid fever and where does it come from?

Typhoid fever is an acute severe illness caused by the bacterium *Salmonella typhi*. The bacterium lives only in humans. Persons with typhoid fever carry the bacteria in their bloodstream and intestinal tract. In addition, a small number of persons, called carriers, recover from typhoid fever but continue to carry the bacteria. Both ill persons and carriers shed *S. typhi* in their faeces (stool).

Typhoid fever was described as long ago as ancient Greek times, and has claimed many lives over the centuries. In the Anglo-Boer war, for example, the British lost more troops from typhoid fever than from war wounds.

Today, it is estimated that at least 12 to 13 million cases occur per year worldwide. In South Africa, the disease is endemic, meaning that it is constantly present, and occurs at a low level of frequency, although the potential for outbreaks does exist.

HOW DO YOU GET TYPHOID FEVER?

You can get typhoid fever if you eat food or drink beverages that have been handled by a person who is shedding *S. typhi* or if sewage contaminated with *S. typhi* bacteria gets into the water you use for drinking or washing food. Once *S. typhi* bacteria are eaten or drunk, they multiply and spread into the bloodstream. This is why it is so important that you wash your hands after going to the bathroom and before handling or eating food.

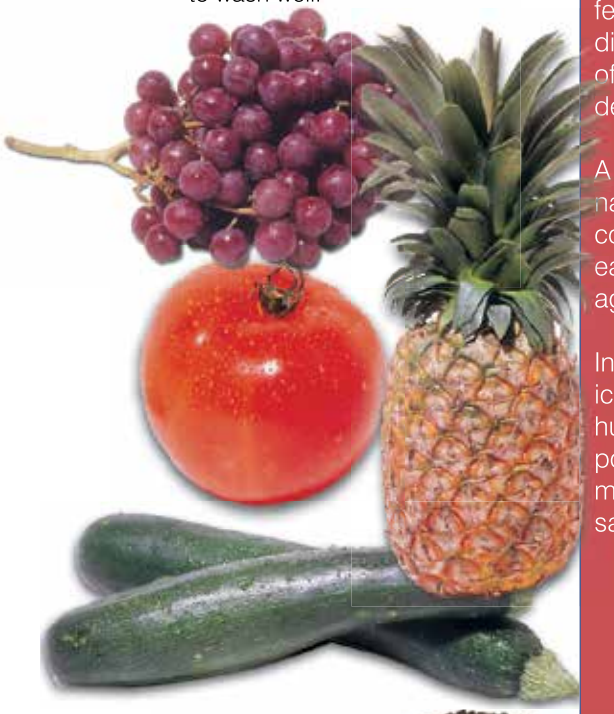
Symptoms can be mild or severe and include fever as high as 39˚C to 40˚C, malaise, headache, constipation or diarrhoea, rose-coloured spots on the chest area and enlarged spleen and liver. Most people show symptoms one to three weeks after exposure.

It is said that, if left untreated, about 12% to 20% of people with typhoid will die. However, with appropriate antibiotics, the mortality rate is less than 1%. In untreated cases, the infection usually lasts two to four weeks. About 10% of survivors will relapse, and about 3% will become carriers.

WHAT PRECAUTIONS CAN I TAKE?

- Always wash your hands well with soap and water after going to the toilet and before handling food or eating.

- Boil water before drinking.
- Avoid fruit and vegetables that cannot be peeled, e.g. lettuce are easily contaminated and difficult to wash well.



ANOTHER WATERBORNE DISEASE: CHOLERA

Cholera is an acute, diarrhoeal illness caused by infection of the intestine with the bacterium *Vibrio cholerae.* About one in 20 infected persons has severe disease characterised by profuse watery diarrhoea, vomiting, and leg cramps. In these persons, rapid loss of body fluids leads to dehydration and shock. Without treatment, death can occur within hours.

A person may get cholera by drinking water or eating food contaminated with the cholera bacterium. In an epidemic, the source of the contamination is usually the faeces of an infected person. The disease can spread rapidly in areas with inadequate treatment of sewage and drinking water.

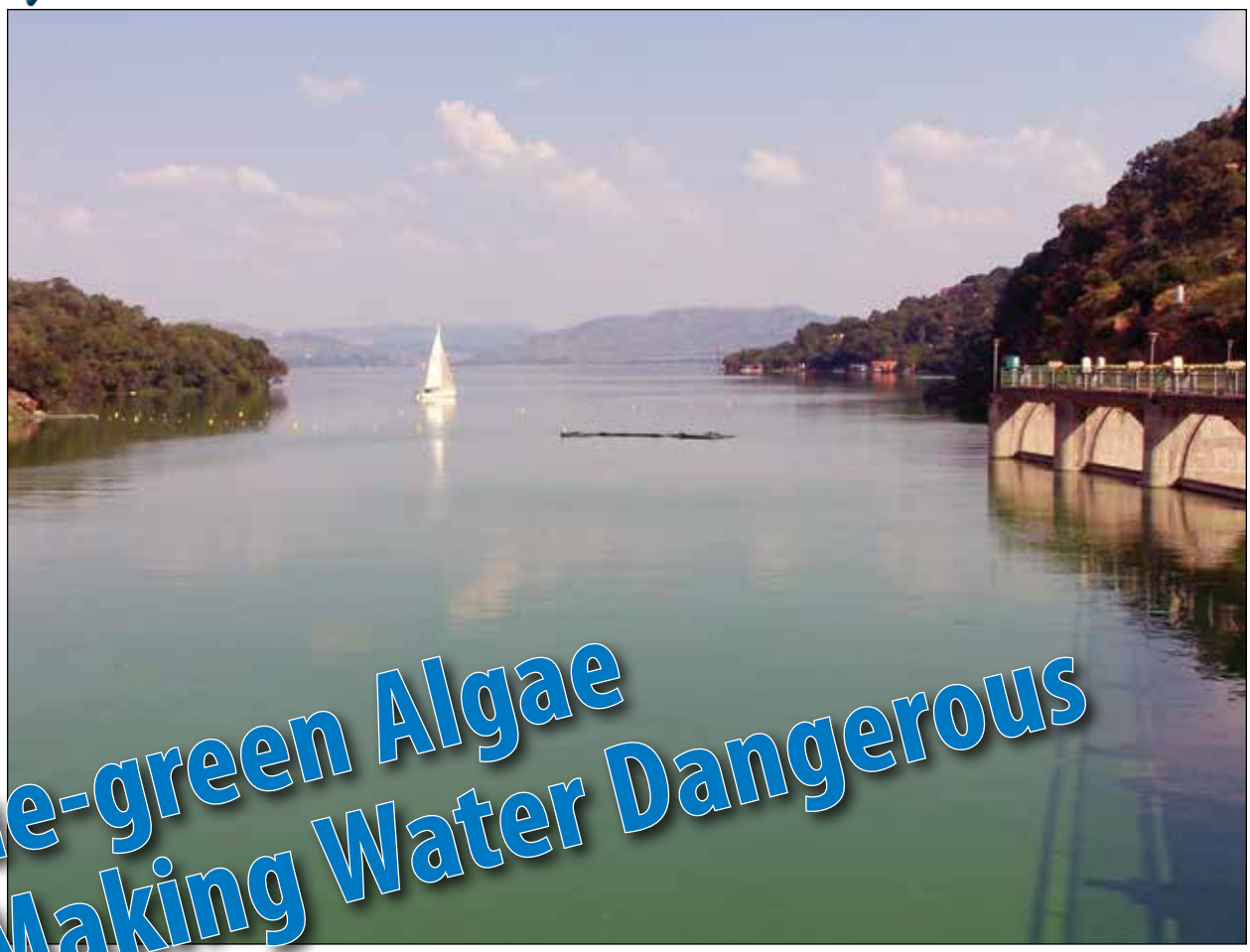
In 2001/2002, South Africa suffered one of the worst cholera epidemics in its history, when more than 100 000 people were infected and hundreds died. The most severely affected areas were the country's poorest provinces KwaZulu-Natal and Eastern Province where millions of people did not have access to clean water and proper sanitation.

IF YOU ARE BEING TREATED FOR TYPHOID FEVER, REMEMBER THE FOLLOWING:

- Take the prescribed antibiotics for as long as the doctor has asked you to take them.
- Wash your hands carefully with soap and water after using the bathroom.
- Do not prepare or serve food to other people.

WATER Kidz

Blue-green Algae – Making Water Dangerous



Heidi Snyman

Hartbeespoort Dam, perhaps South Africa's most well documented case of a eutrophied water body.

In South Africa, we are highly dependent on surface water (rivers and dams) for our daily water supply. Pollution of these water bodies can have serious effects, such as eutrophication and the presence of algal blooms.

Nutrient enrichment (eutrophication) remains one of the leading causes of water quality impairment in the world. Agricultural and urban runoff, municipal and industrial wastewater effluents, and septic tank leach fields all contribute plant nutrients (such as phosphorus and nitrogen compounds) as well as other pollutions which eventually end up in our rivers and dams.

Water bodies that are eutrophic experience an increase in algae, especially cyanobacteria. Cyanobacteria (also known as blue-green algae) are organisms with some characteristics of bacteria and some of algae. They are natural inhabitants of many inland waters, estuaries and the sea. A mass of cyanobacteria in a body of water is called a bloom. When you see a bloom of cyanobacteria in water, it will often appear blue-green (hence the common name). These blooms are not only aesthetically unpleasant but also release bad smells.

Extreme and prolonged eutrophication leads to the deterioration of water quality, taste and odour problems, oxygen depletion and decline of more desirable fish species. The resultant prolific growth in algae also disrupts water treatment, which means the water is more expensive and difficult to treat for drinking water purposes.

CYANOBACTERIAL TOXINS

Cyanobacteria are made up of cells, which can house poisons called cyanobacterial toxins.

Cyanobacterial toxins are usually released into water when the cells rupture and die. Many people have become ill from exposure to freshwater cyanobacterial

DID YOU KNOW?

Eutrophication and associated cyanobacterial blooms have been recognised as a problem for hundreds of years. The first recorded episode of animal poisoning attributable to cyanobacteria occurred in Australia in 1878.

WHAT DOES IT MEAN?

Algal bloom: A mass of cyanobacteria in a body of water.
Cyanobacteria: Simple, single-celled or filamentous organisms that are similar to algae in their photosynthetic abilities.
Cyanobacterial toxins: The natural produced poisons stored in the cells of certain species of cyanobacteria.
Eutrophication: The enrichment of water bodies (such as dams and lakes) with plant nutrients, particularly phosphorus and nitrogen compounds.

toxins, experiencing symptoms such as headaches, fever, diarrhoea, abdominal pain, nausea and vomiting. If you swim in contaminated water you may get itchy and irritated eyes and skin, as well as other hay fever-like allergic reactions.

Cyanobacterial toxins are deadly to animals. Most water-based poisonings by cyanobacteria occur when heavy surface growths or scums accumulate near shorelines of lakes and dams where animals have free access to high concentrations of these toxic cells.

One group of toxins produced and released by cyanobacteria are called microcystins because they were isolated from a cyanobacterium called ***Microcystis aeruginosa***. Microcystins are the most common of the cyanobacterial toxins found in water, as well as being the ones most often responsible for poisoning animals and humans who come into contact with the water.

It is important to note that the presence of cyanobacterial blooms do not always mean that the water is contaminated. About 30% to 50% of cyanobacterial blooms are said to be harmless because they contain only non-toxic species of cyanobacteria.

HISTORY OF CYANOBACTERIA-LINKED INCIDENTS IN SA

Local records of animals poisoning incidents that can be attributed to cyanobacteria data back to the 1920s, when mass mortalities of thousands of cattle, sheep, horses and rabbits living around pans in the north-eastern Free State and south-eastern Transvaal were reported.

The local farmers referred to the condition as 'pan sickness' and although veterinary officers from Onderstepoort suspected algal poisoning it was only after the construction of the Vaal Dam in 1938 that the causative link could be confirmed. As the dam filled, it flooded large areas of fertile farmland, resulting in eutrophic conditions that triggered a bloom of cyanobacteria. This caused the deaths of thousands of animals on farms adjacent to the dam in the summers of 1942 and 1943. Since that time numerous cases have been reported involving wildlife, livestock, fish and bird fatalities.

Hyacinth, a water weed, is also associated with eutrophication.

Today, the Vaal Dam, as well as other dams known to be eutrophic (including Hartbeespoort, Rietvlei, and Roodeplaat dams) are monitored regularly by the authorities for any signs of algal blooms. Unfortunately, more people, more urbanisation and more industrial and agricultural activities mean more pollution, and eutrophication (with associated cyanobacterial blooms) seems to be on the increase.

REMEDIATION PROGRAMMES

At some dams remediation programmes have been launched in an attempt to improve the water quality. One such a programme is being undertaken at Hartbeespoort Dam.

Known as ***Harties Metse A Me***, the remediation programme includes a range of activities to improve the state of the Hartbeespoort Dam. These activities include, among others, a resource management plan, which will determine the use of the dam; a monitoring programme to ensure water quality issues are addressed; restoring shoreline vegetation and placing booms in the dam to assist with physical removal of algae and hyacinth, a water weed.

Eutrophication not only spoils the aesthetic appearance of a dam but negatively affects recreational activities such as water-sports and angling.

Unfortunately there are still thousands of households in South Africa making use of unsafe toilets.

Lani van Vuuren

Whether you call it a water closet, a lavatory or a loo, while we don't always like talking about them we cannot deny the importance of toilets in our lives.

Access to safe sanitation is one of the cornerstones to a healthy life. Toilets are so important to us, in fact, that they even have their own dedicated day. World Toilet Day is celebrated every year on 19 November to raise awareness of the importance of safe sanitation and of the plight of the 2,6 billion people around the world who still lack access to this important human right.

Lani van Vuuren

A urine diversion toilet in a nature reserve in Pretoria.

Lack of sanitation facilities forces people to defecate in the open, in rivers or near areas where children play or food is prepared. This increases the risk of transmitting disease. Children are hardest hit by a lack of access to safe toilet facilities. Every year, an estimated 1,5 million children die in Africa under the age of five as a result of diarrhoea – a disease caused by inadequate sanitation and water. This disease kills more young children every year than HIV/AIDS, malaria and measles combined. Studies show that improved sanitation can improve diarrhoea deaths by a third.

Millions of people are also missing school or work because of illness as a result of having no toilet access. For women and young girls it can be dangerous if they have to relieve themselves in community toilets or in the bushes, especially at night.

Sanitation is not only necessary to improve people's health and dignity it is also a good investment. The Word Toilet Association reports a strong link between the absence of good sanitation and poverty. The economic growth in Europe and North America went hand in hand with the large-scale introduction of sanitary conditions, resulting in individual health gains and increased labour productivity (because if people are healthy they tend to be more productive). Toilets are a symbol of better health, higher income, more education, higher social status and a cleaner living environment.

WHOSE IDEA WAS IT ANYWAY?

Humans have been looking for ways to manage their excretions for thousands of years. It is estimated that 4 000 to 5 000 years ago, there were already toilet systems using water in places such as Syria and China. The Greeks possessed toilets and sewerage systems as early as 2 500 BC.

Around a thousand years later, the Romans built the Cloaca Maxima, Ancient Rome's huge drainage system. In addition, the Romans had latrines, the use of which was reserved solely for the rich, who met in these informal settings to discuss and do both their big and small business. At the same time, communities in what is now Pakistan and north-western India had water-cleaning toilets that used flowing water in each house that were linked with drains covered with clay bricks.

Early toilets that used flowing water to remove the waste are also found at Skara Brae in Scotland. Some of the houses there had a drain running directly beneath them, and some of these had a cubicle over the drain.

MULTIMEDIA RESOURCES

- http://www.wateraid.org/documents/splish_splash_flush.pdf (video on the importance of toilets)
- http://www.time.com/time/health/article/0,8599,1940525,00.html (article on the history of toilets)
- http://www.worldtoiletday.org/
- http://home.howstuffworks.com/toilet.htm
- http://www.youtube.com/watch?v=C_PAUUX36IA (video on the history of the toilet)
- http://www.bbc.co.uk/news/world-asia-20258175#TWEET346927 (BBC report on the world's first toilet theme park)
- http://www.csir.co.za/Built_environment/santechcentre/

Lani van Vuuren

Not all toilets are connected to wastewater treatment plants. Here a worker is cleaning an on-site, VIP toilet.

Sanitation technology got a little lost in the West after the fall of Rome. In Europe during the Middle Ages, they did make use of a garderobe in castles – a protruding room with a tiny opening usually reserved for nobility, from which waste fells into the castle moat. Later this was replaced by a box and a lid.

The modern toilet is said to have been invented by Englishman, Sir John Harrington, in 1596. This new kind of 'water closet' comprised a raised cistern with a small pipe down which water ran when released by a valve. Queen Elizabeth I had one installed in one of her palaces. About 200 years later Alexander Cummings developed the S-shaped pipe underneath the basin to keep out smells. The basic design of the toilet has not changed much since then.

Interestingly, toilet paper had been used in early medieval China. Elsewhere people have made use of all sort of materials, from wool and lace to leaves, grass, seashells to plant husks. In Ancient Rome, a sponge on a stick was commonly used, which was placed in a bucket of water after use. Modern toilet paper was invented by Joseph Gayetty in 1857, who sold his medicated paper in packages of flat sheets.

DIFFERENT KINDS OF TOILETS

When we think of a toilet many of us automatically think of a flush toilet. However, there are actually many types of safe sanitation options out there. A visit to the CSIR Sanitation Technology Demonstration Centre in Pretoria is well worth it to see all the options available in South Africa.

The basic-level sanitation technology that is rolled out most often in South Africa is the ventilated improved pit (VIP) toilet, a type of pit latrine that has to adhere to a certain standard.

A sanitation technology that is used quite widely in the Durban area is the urine diversion toilet. Waste is deposited in a chamber and dry material (usually sand or ash) is added after each use. Urine is diverted through a specially adapted pedestal. In South Africa, most of the urine is led to a soak-away pit, but it can be used as fertilizer for home gardens.

Other sanitation options include pour-flush toilets, aquaprivvies, conservancy tanks, septic tanks or shallow sewers.

Perhaps it is time we see the porcelain throne for what it is – a truly marvellous thing! ❑

DID YOU KNOW? SOME TOILET FACTS

- In 2007, the readers of the *British Medical Journal* voted sanitation the greatest medical milestone of the last 150 years.
- In November last year the Korean city of Suwon opened the world's first toilet theme park. The Restroom Cultural Park has a museum displaying toilet engineering from Rome, Europe, and ancient Korea.
- The average person visits the toilet 2 500 times a year (About 6-8 times a day).
- The oldest working toilet that we know of can be seen in Knossos in Greece in a small castle. The flushing toilet is still functioning about 4 000 years after it has been built.
- South Africa has its own sanitation technology demonstration centre, located at the CSIR, in Pretoria, where visitors can see life-sized examples of safe sanitation technologies.
- One in three people in the world do not have access to basic sanitation. The regions with the lowest coverage are sub-Saharan Africa (31%), southern Asia (36%) and Oceania (53%).
- The first house to have a flush toilet in South Africa belonged to Scottish railwayman James Douglas Logan, who installed them in his Matjiesfontein home around 1890.

www.wikipedia.org

Public toilets were used by the wealthy to discuss business in Ancient Roman times.

WATER Kidz

Climate Change

Every June sees World Environment Day celebrations being held all across the world. One focus is on the effects of climate change – an issue affecting everybody on Earth.

WHAT'S THE BIG DEAL?

The climate of the world varies from one decade to another, and changing climate is natural and expected. Why are we worried about it now? Growing scientific evidence is suggesting that human industrial and development activities of the past two centuries are causing changes over and above natural variation.

Climate change is the natural cycle through which the Earth and its atmosphere are going to accommodate the change in the amount of energy received from the sun. The climate goes through warm and cold periods, taking hundreds of years to complete one cycle (think of the ice age, for example). Changes in temperature also influence the rainfall, but the biosphere is able to adapt to a changing climate if these changes take place over centuries.

Unfortunately, human activities are causing the climate to change too fast (using climate computer programs scientists predict the mean air temperature over South Africa could increase with an estimated 2°C over the next century).

WHAT CAUSES IT?

The global climate system is driven by energy from the sun, thus warming the Earth. Several gases in the atmosphere act to trap the energy from the sun, thus warming the Earth. These gases are called 'greenhouse gases' and the process is called the 'greenhouse effect'.

Without the greenhouse effect, the Earth would not be warm enough for human, plants, and animals to live. But if the greenhouse effect becomes stronger, extra warming may cause problems for humans, plants and animals. Human activities, such as the burning of fossil fuels (such as coal and oil), and deforestation (chopping up of natural forests) is increasing the amount of greenhouse gases (such as carbon dioxide) in the atmosphere.

Whenever we ride in or drive a car, we are adding greenhouse gases to the atmosphere. The trash we send to landfills produces a greenhouse gas called methane. Methane is also produced by the animals we raise for dairy and meat products. Also when factories make the things we buy and use everyday, they too are sending greenhouse gases into the air.

HOW MIGHT CLIMATE CHANGE INFLUENCE SOUTH AFRICA?

At this stage we don't know for certain what will happen (climatologists are not fortune tellers!) but science provides some clues. According to the South African Weather Service higher temperatures will influence the rainfall, but it is still uncertain how the annual rainfall will change. It could increase in some parts of the country and decrease in other parts. South Africa is already a water-scarce country, and a reduction in rainfall amount or variability, or an increase in evaporation (due to higher temperatures) would place further strain on our limited water resources.

Climate change may also the magnitude, timing and distribution of storms that produce flood events. Arid and semi-arid regions, which cover nearly half of South Africa, are particularly sensitive to changes in precipitation (i.e. rainfall), and desertification, which is already a problem in South Africa, could intensify.

In addition, there are several important insect-carried diseases which are sensitive to climate. A small increase in temperature would allow, for instance, malaria to spread into areas which are currently malaria-free, and would increase its severity where it already occurs.

HELPFUL WEBSITES

http://www.weathersa.co.za/References/Climchange.jsp
http://soer.deat.gov.za/themes.aspx?m=519
http://epa/gov/climatechange/kids/index.html
http://tiki.oneworld.net/global_warming/climate_home.html
http://globalwarmingkids.net
http://science.howstuffworks.com/global_warming.htm
www.coolkidsforacoolclimate.com
www.pewclimate.org/global-warming-basics/kidspage.cfm
www.deat.gov.za
www.dwaf.gov.za

www.sxc.hu

Growing world populations and a rise in industrialised cities are leading to a rise in greenhouse gases.

Historically, maize production has contributed to about two thirds of grain production in South Africa. If the climate becomes hotter and drier, maize production will decrease by about 10% to 20% over the next 50 years. An increase in pests and diseases would also have a detrimental effect on the agricultural sector, and invasive plants could become a greater problem.

If the warming of ocean water were to continue unabated, the polar icecaps will melt and the sea level will rise. This is anticipated in the next century. The consequences in South Africa of a small sea level rise are not very extensive because the coastline is relatively steep. However, changes in the oceans due to climate change could result in major changes in fish resources, which will affect South African communities dependent on fishing as a source of food and income.

CLIMATE CHANGE WORDS

Atmosphere: The mixture of gases surrounding the Earth. The Earth's atmosphere consists of about 79,1% nitrogen (by volume), 20,9% oxygen, 0,036% carbon dioxide and trace amounts of other gases. The atmosphere can be divided into a number of layers according to its mixing or chemical characteristics, generally determined by temperature.

Climate: Climate is the average of weather over time and space. A simple way of remembering the difference is that 'climate' is what you expect (for example, cold winters) and 'weather' is what you get (for example, a rain storm).

Climatologist: A person who studies climate.

Global warming: Global warming refers to an average increase in the Earth's temperature, which in turn causes changes in climate. A warmer Earth may lead to changes in rainfall patterns, a rise in sea level, and a wide range of impacts on plants, wildlife and humans.

Greenhouse effect: The effect produced as greenhouse gases allow incoming solar radiation to pass through the Earth's atmosphere, but prevent most of the outgoing infrared radiation from the surface and lower atmosphere from escaping into outer space. This process occurs naturally and has kept the Earth's temperature warmer than it would otherwise be. Present life on Earth could not be sustained without the natural greenhouse effect.

Greenhouse gas: Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), halogenated fluorocarbons (HCFCs) , ozone (O_3), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs).

Weather: Weather is the specific condition of the atmosphere at a particular place and time. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season.

Source: EPA

Plants, in particular, have trouble keeping up with rapid climate change. Small, isolated populations could go extinct as a result. South Africa is home to about 10% of all the plant species in the world, of which about half occur nowhere else on Earth. Warming, and a change in the seasonal rainfall of the Cape floral kingdom, which is unique to South Africa, are issues of particular concern to conservationists.

WHEN DO YOU SEND GREENHOUSE GASES INTO THE AIR?

Whenever you:

- Watch TV
- Use the air-conditioner
- Play a video game
- Listen to a stereo
- Turn on a light
- Use a hairdryer
- Wash or dry clothes
- Use a dishwasher
- Microwave a meal

Why? To perform any of these functions, you need electricity. Electricity comes from power plants, which use coal and oil to make electricity. Burning coal and oil produces greenhouse gases.

WHAT CAN YOU DO TO SLOW DOWN CLIMATE CHANGE?

- Replace regular light bulbs with compact fluorescent light bulbs.
- Walk, bike, carpool or take public transport – you will save 0,5 kg of carbon dioxide for every kilometre you don't drive.
- Recycle more – you can save 1 100 kg of carbon dioxide a year by recycling just half of your household waste.
- Avoid products with lots of packaging - you can save 550 kg of carbon dioxide if you cut down your garbage by 10%.
- By adjusting your geyser thermostat down a few degrees you can save up to 800 kg of carbon dioxide a year.
- Plant a tree – a single tree will absorb one ton of carbon dioxide over its lifetime.
- By simply turning off electric and electronic devices (such as your computer and your television) when not in use you save thousands of kilograms of carbon dioxide a year.

Source: WWF

WATER Kidz

Watching the Clouds Go By

Have you ever lain on your back on a Sunday afternoon and just watched the clouds go by? Do you know how they form and what their purpose is?

Clouds are actually suspended masses of water and ice floating above us. Clouds form when warm, supersaturated air rises and condenses in cooler temperatures, releasing its watery burden and creating thousands of millions of droplets that are only micrometers in size.

DID YOU KNOW?

English naturalist Luke Howard created the system of cloud classification in 1803, based on Latin roots for layer (*stratus*), curl of hair (*cirrus*), heal (*cumulus*) and violent rain (*nimbus*).

There are 27 different sub-types of cloud – from the wispy to the ominous. Clouds are named according to their height and form. Cirrus typically forms high in the sky (above 6 000 metres), when strong winds sweep ice crystals into shapes that remind of wisps of fleece.

Impenetrable grey sheets, stratus creates the rainy-day look typical of Cape winters. Altostratus forms in the middle of the cloud-forming layer of the atmosphere (2 000 to 6 000 metres) and may contain ice and water. Rain-bearing sheets of cloud are called nimbostratus.

Those cauliflower-shaped clouds are called cumulus. These clouds begin in the lower level of the sky and may tower up to 16 km high. Although all clouds are white, dense, rain-bearing clouds with vertical development (cumulonimbus), often capped with an anvil-shaped head, appear dark grey when viewed from below.

Of the various miscellaneous cloud types, heavy mamatus, formed when clouds sink in air, is the most recognisable. Mammatus is characterised by grey cloud that hangs like cows udders, and is often a harbinger of rain. Other types of clouds are orographic clouds. These clouds are formed as moist air rises over mountains or other major geographic features. The air floats up the side of the mountain and cools quickly, condensing and turning into a cloud.

A pileus cloud is a smooth cloud that is found over or on the top of a major geographic feature, like a mountain. A contrail (short for CONdensation TRAIL) is a cloud-like vapour trail that forms behind some aircraft when flying in cold, clear, humid air. The contrail forms from the water vapour contained in the jet's engine exhaust.

Clouds play an important part in trapping and reflecting heat back to Earth – this is the 'greenhouse effect' that allows us to survive on Earth. Low, white, lumpy cumulus reflects sunlight away from the Earth, while thin, wispy, high-altitude clouds transmit light and trap heat, warming the Earth.

STORM CLOUDS

Storm clouds start small and grow as warm, humid air rises in an unstable atmosphere. Here, cool and warm air mixing creates strong updraughts that support large amounts of water.

CLOUDS ON THE WEB

- http://en.wikipedia.org/wiki/Clouds
- www.carlwozniak.com/clouds
- http://pals.agron.iastate.edu/carlson/main.html

MAKING CLOUDS

Clouds are created in five ways:

- As air heated by the ground rises in thermal currents into cold air.
- As air is forced upward by a topographic feature such as a mountain (called an orographic cloud).
- As two fronts meet and the warmer front is forced to rise.
- As turbulent air currents sweep across the Earth's lumpy surface.
- As cold air meets the warm ocean surface.

Eventually the updraughts weaken, or the amount of water becomes so great that the updraught can no longer support it aloft, and it falls to the ground as rain. Severe storms usually hit in the afternoon when the Earth's surface is hottest, but can be difficult to predict.

Hailstorms are the bane of car insurance companies and crop farmers, dangerous to anyone caught unawares. Hailstorms form as small particles of ice circulate in the updraughts of storm clouds, and can increase their size by accumulating layers and colliding with other ice fragments.

Clouds can also become electrically charged, building up a negative charge at the base and a positive charge at the top of the cloud. Although the mechanism is poorly understood, the charge imbalance may be created as collisions knock electrons off water molecules within the cloud. The intensive electric field created repels the electrons at the Earth's surface, creating a positive charge on the ground. Lightning addresses this imbalance with a surge of electricity, heating the air to around 30 000˚C.

WATER Kidz

Halting the Scourge of Desertification

Desertification has been called 'the greatest environmental challenge of our times'. But what is it and why should we be concerned about it?

Almost 40% of the Earth's total land surface is dryland. These semi-arid areas are defined by their modest water supply (they receive less than 600 millimetres of rain a year). They are not as dry as deserts, although they often border deserts. Drylands are called by many names: plains, grasslands, savannas or steppes.

Dryland ecosystems are especially fragile, and can easily be overused by the people who depend on them, resulting in the degradation of the land. For example, overgrazing by livestock can encourage wind and water erosion, while the collection of firewood reduces or eliminates plants that help to bind the soil. Irresponsible agricultural practices, such as overcultivation, can exhaust the soil, preventing further plant growth.

These poor land management practices can turn productive dryland into non-productive desert. This is known as desertification. When these practices described above coincide with drought, a regular phenomenon in countries with erratic rainfall, such as South Africa, the rate of desertification increases dramatically.

As vegetation cover and soil layers are reduced, rain drop impact and runoff increases. This means water is lost off the land instead of soaking into the soil to provide moisture for plants. Even long-lived plants that would normally survive droughts die. As protective plant cover disappears, floods become more frequent and more severe. Desertification is self-reinforcing, in other words, once the process has started, conditions are set for continual deterioration.

Increasing human population and poverty contribute to desertification as poor people may be forced to overuse their environment in the short term, without the ability to plan for the long-term effects of their actions. Where livestock has a social importance beyond food, people might be reluctant to reduce their stock numbers.

RESTORING THE LAND AT OKHOMBE

In Okhombe, in the northern Drakensberg, KwaZulu-Natal, the local community has been taught how to use its land and water resources better. Overgrazing by cattle and goats has led to widespread erosion in the area. The community does not only lose land that could be used for food production. Huge loads of silt also lands up in nearby rivers and dams. This reduces the capacity of the storage reservoirs and is expensive to remove. To restore some of these degraded areas, people have been showed how to implement erosion control techniques, including placing stone packs inside dongas, planting vetiver grass on contour lines, and building cattle steps. Community-participative monitoring and evaluation projects have also been put in place to help assess whether these techniques are successful.

USEFUL WEBSITES

www.deat.gov.za
www.botany.uwc.ac.za/Envfacts/facts/desertification.htm
www.undp.org/drylands/

Courtesy of SA Tourism

Over 90% of the Northern Cape is potentially susceptible to desertification.

Erosion is one of the characteristics of desertification.

KNOW THE LINGO

Deforestation: The permanent destruction of indigenous forests and woodlands.

Desertification: The process which turns productive dryland into non-productive desert as a result of poor land management.

Drylands: Areas usually bordering deserts that have an annual rainfall of less than 600 millimetres.

Erosion: The removal of soil by the action of water or wind.

DID YOU KNOW?

- About 3,6 billion of the world's 5,2 billion hectares of useful land for agriculture has suffered erosion and soil degradation.
- A third of all people on Earth – about two billion – are potential victims of desertification's creeping effect. If left unchecked, as many as 50 million people (that is the entire population of South Africa) could be displaced due to severe desertification.

Courtesy of SA Tourism

Overgrazing can lead to the degradation of productive soil.

Desertification reduces the ability of land to support life, affecting wild species, domestic animals, agricultural crops and people. Around the world, it is estimated that between 10% and 20% of drylands are already degraded. The greatest impact of desertification is in Africa, as two thirds of the continent comprises desert or drylands. South Africa is losing about 300 to 400 million tons of topsoil every year. Areas such as the Northern Cape are especially prone to desertification.

To halt desertification the number of animals on the land must be reduced, allowing plants to regrow. Soil conditions must be made favourable for plant growth by, for example, mulching. Mulch (a layer of straw, leaves or sawdust covering the soil) reduces evaporation, suppresses weed growth, enriches soil as it rots, and prevents runoff and hence erosion. Reseeding may be necessary in badly degraded areas. Locally-available materials, such as rock packs, can be used to fill up eroded areas.

However, the only realistic large-scale approach is to prevent desertification through good land management in dryland areas.

– The Creeping Disaster

When we think of drought, most of us immediately think of 'no rainfall'. But drought is much more complicated than that.

Basically, drought occurs when there is less rainfall than expected over an extended period of time, usually several months or longer. How bad a drought is usually depends on how little precipitation falls, how long the drought lasts, and the size of the area that is affected.

Unlike other natural disasters, such as hurricanes, earthquakes, fires and floods, droughts do not appear suddenly and, while they might not appear as frightening, droughts can have far-reaching effects. Drought doesn't have a clear beginning or end. It starts slowly, and for that reason it is often called a 'creeping phenomenon'.

The damage caused by drought is not always seen right away. Farmers, who need adequate water to grow crops and raise livestock, usually feel the effects of drought first. In poor, rural areas, people are dependent on rain to grow their own food, so a drought can mean hunger and starvation.

There are four main types of drought:

- **Meteorological drought** is brought about when there is a prolonged period with less than average precipitation (i.e. rain). Less than 75% of normal rainfall is regarded as a severe meteorological drought, however, a shortfall of 80% of normal rainfall can cause crop and water shortages.
- **Agricultural drought** is brought about when there is insufficient moisture for crop or range production. This can arise even in times of average precipitation, owing to soil conditions or agricultural techniques.
- **Physiological drought** is a condition afflicting plants that have been exposed to too much salt, preventing them from absorbing water from the soil.
- **Hydrological drought** is when water reserves available in sources such as rivers and dams fall below average.

Drought produces a complex web of impacts that spans many sectors

WATER WORDS

Climate: Day-to-day weather over a long period of time. Climatology is the study of climate.
Drought: It is a deficiency of rainfall over a period of time, resulting in a water shortage for some activity, group, or environment sector.
Drought index: A numerical scale that scientists use to describe the severity of a drought.
El Niño: A weather phenomenon that occurs in the eastern and central equatorial Pacific Ocean. During an El Niño, the affected area's winds weaken and sea temperatures become warmer.
Weather: The condition of the Earth's atmosphere over a brief period of time, like day or a week.

Drought often exacerbates environmental problems such as soil erosion.

HELPFUL WEBSITES

- http://en.wikipedia.org/wiki/Drought
- www.weathersa.co.za
- http://www.drought.unl.edu/kids/index.htm
- www.sciencenewsforkids.org

of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is so integral to our ability to produce goods and provide services.

The potential economic impacts of drought includes farmers losing money because of destroyed crops; water companies having to spend money on new or additional water supplies; increased irrigation costs and increased importation of food (more expensive). There are also environmental impacts, such as the loss of fish and wildlife habitat; loss of wetlands; increased groundwater depletion; more wildfires; lower water levels in dams; lack of food and drinking water for wild animals; and soil erosion. Drought also has social impacts, such as health problems related to low water flows; loss of human life; reduced incomes; water user conflicts and mental and physical stress on people.

Unfortunately, being among the thirty driest countries in the world, drought is a normal, recurrent feature in South Africa. In the past, droughts have resulted in significant economic, environmental and social impacts.

Climate variability of South Africa is determined by prevailing patterns of sea surface temperature, atmospheric winds, regional climate fluctuations in the Indian and Atlantic Oceans and by the the El Niño phenomenon, a warming of sea-surface temperatures which influences atmospheric circulation, and consequently rainfall and temperature.

During periods of low rainfall, people of the government, farmers, business people and the general public often require additional information regarding rainfall for decision making and planning. With this in mind, the South African Weather Service has created a drought monitoring desk where information regarding observed rainfall and long-range forecasts are presented in one place for easy access. It also provides an opportunity for people to compare this year's rainfall figures with figures from previously dry periods.

Assessing the severity of a drought period and the magnitude of the impact base purely on the definition of 'percentage of normal rainfall' is extremely difficult, and so other drought indices are also monitored. High temperatures, high wind, low soil moisture and low relative humidity, for example, can aggravate the severity of drought conditions.

To mitigate against the effects of drought, several dams have been built in South Africa to store water for times of need. The country also has several water transfer schemes that transports water over long distances from one area to another, for example, the Lesotho Highland Water Project, which stores water in Lesotho before transferring it to Gauteng.

SOUTHERN AFRICA'S WORST DROUGHT

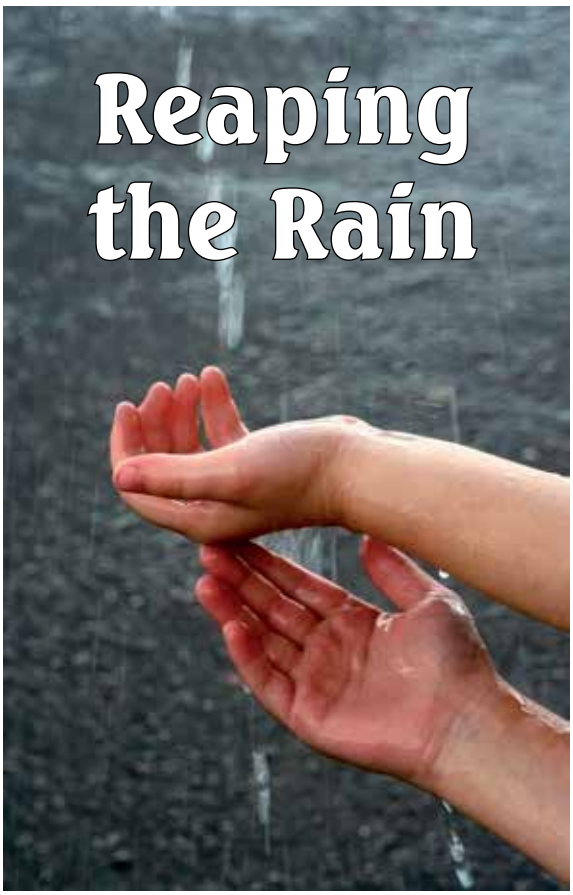
Southern Africa (including South Africa) experienced one of the worst meteorological droughts of the century in 1991-92. From central Zambia through central Malawi and Mozambique southward, there were seasonal deficits of as much as 80% of normal rainfall. Abnormally high temperatures exacerbated the extreme dryness.

An estimated 30 to 40 million of the region's 100 million inhabitants were directly affected. The drought halved the region's grain harvest and required ten million tons of grain to be imported, the bulk within a 12-month period. Many people faced possible malnutrition and starvation.

The level of the Kariba Dam, which supplies power to Zambia and Zimbabwe, fell below the level required to generate hydroelectric power. The drought also resulted in increased unemployment, heavy government expenditure burden, and reduced industrial production due to curtailed power supply.

WATER Kidz

Reaping the Rain



The term 'harvesting' usually conjures up images of a farmer on his tractor, working in his field of mealies. But did you know we can also harvest rainwater?

Rainwater harvesting simply refers to the collection and storage of rainwater (or other forms of precipitation) for future use. Millions of people around the world, especially those living in semi-arid and arid regions (such as South Africa), lack access to good quality water for drinking, growing and preparing food. Water is also needed to provide water for animals, vegetables, crops and trees.

Where groundwater and surface water sources are in short supply, rainwater may be a sustainable alternative or supplement. Rainwater harvesting is practiced by many communities around the world. The practice is becoming more widespread as people realise the importance of conserving water.

RAINWATER HARVESTING AROUND THE WORLD

There are many examples of rainwater harvesting around the world, some dating back thousands of years. Extensive rainwater harvesting apparatus existed 4 000 years ago in the Palestine and Greece, for example. In ancient Rome, residences were built with individual cisterns and paved courtyards to capture rain water to augment water from cities' aqueducts.

Traditionally, in Uganda and Sri Lanka, rainwater is collected from trees using banana leaves or stems as temporary gutters. Up to 200 litres may be collected from a large tree in a single storm.

In Western Europe, the Americas and Australia, rainwater was often the primary water sources for drinking water. In all three continents it continues to be an important water source for isolated homesteads and farms. In Japan, several cities are using rainwater sources inside the city boundary to restore the original water cycle and secure water for emergencies.

Countries such as Germany have developed sophisticated rainwater harvesting systems. One such system incorporates clever computer management systems, submersible pumps, and links into the greywater and main domestic plumbing system.

For more information:

- http://en.wikipedia.org/wiki/Rainwater_harvesting
- http://www.soilforlife.co.za/docs/biophile/Biophile%205.pdf

CATCHING AND STORING RAINWATER

Catching and storing rainwater from the roof of houses, schools and other buildings is the most common form of rainwater harvesting. Even a small roof can collect a lot of water during light rain.

Water is usually channelled from the roof into a gutter and then channelled into clean drums, large buckets, old baths or any kind of water collection tank (plastic tanks of different sizes can also be purchased commercially). A mesh over the top of the downpipe keeps leaves out. It is best to cover the container to reduce water loss through evaporation. To prevent mosquitoes from breeding in the water, add a few drops of cooking oil.

If a large tank is used remember that silt could enter the tank, so to make sure it does not become a problem, the tank should have its tap placed at least 50 millimetres from the bottom. It is best to raise the rain tank about 300 millimetres off the ground so that a bucket can be placed underneath it to collect the water for use.

Another idea for catching rainwater is to bend a piece of iron sheeting into a V shape

and place it on wooden poles so that it is supported at a slant. Keep it from blowing away in strong winds by securing it with wire. A drum placed at the lower edge will catch the water. Rainwater can also be collected from gutters, paved areas and driveways.

This water can be used to flush toilets, wash laundry, showering or bathing, irrigation and livestock watering. The water may require treatment before drinking.

In a country such as South Africa where 35% of the population are vulnerable to food insecurity (meaning families often do not have enough to eat) rainwater harvesting can go a long way in contributing towards increasing household food and/or income (through the sale of vegetables, for example).

An example of a closed reservoir used to store rainwater for food growing purposes.

Rainwater contributing to food schemes in many communities in South Africa.

GIS FOR SCHOOLS

The City of Cape Town with partner organisations is developing a hands-on geographic information systems (GIS) project for high schools based in urban nature reserves. The environmental education centres at Rondevlei and Tygerberg Nature Reserves are preparing to support GIS-based fieldwork. As part of this project, called Youth, Urban Nature & GIS, senior learners will be able to experience how nature conservationists use GIS technology to monitor and care for nature.

Learners will use hand-help global positioning system (GPS) units to locate monitoring sites and record coordinates; monitor plants, animals and the environment and record observations in a database; construct GIS layers; and display findings and digital photographs using GIS technology.

By monitoring the environment, learners will help the nature reserves to care for nature in the City of Cape Town. Schools will also have access to these records, and learners will be able to analyse data that different schools collect over months and even years. Based on the success of the project, the City plans to extent it to more nature reserves.

The Western Cape Education Department has already selected six schools to take part in the pilot project this year. In 2008, the reserves will make GIS-based fieldwork part of their senior high school programme.

For more information, contact Lindie Buirski at the City of Cape Town Environmental Resource Management Department, at Cell: 084 629 9305

Website links to other water education resources

LOCAL WEBSITES

Water Research Commission's Learning page
http://wrcwww/Pages/Learning.aspx

Water-related lesson plans for schools
http://wrcwww/Pages/Learning_School_lessonplans.aspx

WESSA Envirokids water-related lesson plan
http://www.wessa.org.za/documents/envirokids/05-06-09/EK_Vol_30_1_%20Lesson%20Plan%20R.pdf

Department of Water Affairs
www.dwa.gov.za

Department of Environmental Affairs
www.deat.gov.za

My Water page (to check drinking water quality in your area)
http://www.dwa.gov.za/dir_ws/DWQR/Default.asp?PageID=7&PageHeading=My Water

Umgeni Water's education page
www.umgeniwater.co.za/water_education/ees.asp

Water information from Rand Water
www.randwater.co.za/CorporateResponsibility/WWE/Pages/WaterInformation.aspx

Johannesburg Water
www.johannesburgwater.co.za/

Learn how the water purification process works at Midvaal Water
www.midvaalwater.co.za/home.html#Overview

Overview of water resource management in South Africa
www.info.gov.za/aboutsa/water.htm#waterresourcesmanagement

River Health Programme
www.csir.co.za/rhp/

City of Cape Town's tips to save water
www.capegateway.gov.za/eng/pubs/public_info/H/86404

Consortium for Estuarine Research and Management
http://www.upe.ac.za/cerm/

Mondi Wetlands Project
www.wetlands.org.za

INTERNATIONAL WEBSITES

The Groundwater Foundation Kid's Corner
www.groundwater.org/kc/kc.html

H2O University
www.h2ouniversity.org/html/

Kid's Water Zone (New Jersey section of the American Water Works Association)
http://njawwa.org/kidsweb/Default.html

Water science for learners and teachers (US EPA)
www.epa.gov/waterscience/learn/

Waterbusters game
www.savingwater.org/waterbusters/

Fun water saving games
www.wateruseitwisely.com/kids/index.php

The story of water
www.fcwa.org/education/kids.htm

Wastewater treatment for kids
www.metrocouncil.org/environment/Kids/

Exploring estuaries (US EPA)
www.epa.gov/owow/estuaries/kids/

Wildlife and water fun quiz (San Diego Zoo)
http://www.sandiegozoo.org/kids/games/watergame.html

Water conservation
www.k12science.org/curriculum/drainproj/

Water wise schools (Peace Corps)
http://www.peacecorps.gov/wws/

UN Environment Programme youth website
http://www.unep.org/tunza/

Learn about water quality parameters
www.ncsu.edu/sciencejunction/depot/experiments/water/

Watershed game
www.bellmuseum.org/distancelearning/watershed/watershed2.html

Interactive environmental game
www.olliesworld.com

National Geographic kids' page
http://kids.nationalgeographic.com

Building Big for information on dams
http://www.pbs.org/wgbh/buildingbig/

How Stuff Works
www.howstuffworks.com