ANNEXURE 2
Appendix A

CONTENTS

LESSON NAME Aquifers: Our Underground Water Source.	GRADE 4

LEARNING OUTCOMES

- Define the term *Aquifer* and be able to briefly elaborate on the structure and function of them.
- Define the term *Contaminants* and be able to identify various contaminants or pollutants which enter our water table locally.
- Construct a layered representation of an aquifer and be able to identify and expand upon what each of the layers represents.
- Interact with the aquifer model practically to showcase the movements of the contaminants within the water table and be able to describe what is happening and what impacts may be associated.
- Discuss and elaborate on the movement and interactions of contaminants within the water system and water table.
- Collectively discuss the types of contaminants prevalent in our local water table and brainstorm some of the ways in which we can mitigate or cut out the adverse effects of the contaminants.

PRIOR PREPARATION

Ensure that you have the following material ready for this lesson:

- A bag of ice to distribute to the learners' cup.
- 2 Litres of ice cream to distribute to the learners' cup.
- Multi-coloured sprinkles candy
- 2 x 2-litre Sprite Drink.

Before teaching this lesson, ask the learners to bring the following material to this class:

- A transparent cup, ideally 500ml in size
- A packet of 4 Oreos (Or any other cheaper chocolate biscuit)
- Their own straw - ideally a bamboo or metal one and not plastic

TIMING	ACTIVITY SUMMARY AND IMPLEMENTATION	NOTES

0-10 min	<u>Introduction:</u>
	
	• Introduce the topic for the day - **Aquifers** and before describing what it is to the class, pose the question to them and ask them to:
	  ○ Describe what it is and,
	  ○ What it looks like from a cross-section
	  ○ *You could ask a learner to come up and draw it to see where their knowledge is in the topic.
	  ■ If they are struggling to draw it, try and describe it to them as they attempt to draw it for interest's sake.
	• Once that is done, describe what an **aquifer** is and what function it serves:
	  ○ *An aquifer is a saturated subsurface geological formation (or a wet rocky formation underground) that holds groundwater. Groundwater is the water that has infiltrated through the soil beyond the surface and then collected in empty unsaturated spaces underground - these are aquifers.*
	  ○ Aquifers can be either confined or unconfined:
	  ■ **Confined** = *Aquifer that is below the surface that is saturated with water. Layers of impermeable rock are above and below the aquifer, causing it to be under pressure.*	

	■ **Unconfined** = *Where groundwater is in direct contact with the atmosphere. The top of this layer is called the water table, and is subject to change in various geographic areas.*	
10-20 min	<u>Set-up of Activity and Framing:</u> ● Instruct learners to gather all the resources needed for this lesson: ○ A transparent cup, ideally 500ml in size ○ A packet of 4 Oreos. ○ Their own straw - ideally a bamboo or metal one and not plastic ● Get all your material ready for distribution (Ice; Sprite; Ice-cream; Sprinkles) ● Explain to the learners that they will be constructing their own representation of an aquifer, in the form of a sweet-treat Sprite Float. ○ They will be creating the layers of an aquifer, as they are structured underground. ○ They will then observe the movements and interactions of contaminants that enter the water table and interact with aquifers. ○ Frame this as a fun activity to practically understand how water moves underground and what happens when we insert boreholes/well-points into the aquifer. ● *This activity can be done as an individual activity or in groups of 2 (learners must bring their own straw if it is done in pairs)	
20-35 min	<u>Layering our Aquifers:</u> ● Facilitate this process as smoothly as possible by distributing the material, in order, and with some insight as to what each layer represents underground: ○ Instruct the learners / pairs to get their transparent cup ready - This represents a cross-section of the earth. ○ Distribute a few blocks of ice into each cup and pour a small bit of Sprite into it - This represents the Lower Aquifer, with Sprite representing groundwater. ○ Pour a scoop of ice cream into the learners' cup and instruct them to flatten it slightly but not to compress the aquifer - This represents the clay layer above the aquifer. ○ Distribute a sprinkle of the multi-coloured sprinkles over the ice cream - This represents contaminants in our groundwater systems. ○ Instruct the learners to crush up their Oreos into a fine dust and pour this over the multi-coloured sprinkles - This layer represents the soil. ○ And finally, layer another layer of multi-coloured sprinkles over the soil layer - This again represents the contaminants but on the surface layer this time. ● The learners now have their layered aquifer representation. Allow them to see this and understand what each layer represents. Then, ○ Instruct each learner (whether they're working individually or in pairs) to insert their straw into the cup - This represents a borehole or a well-point from which we use to extract groundwater. ○ Instruct learners to focus their attention on the contaminants	

	(multi-coloured sprinkles) and the way in which they move as well as where they move ○ Then, instruct learners to drink from their straw which is placed in the Lower Aquifer (the Sprite and ice layer at the bottom) and to observe the movements of the sprinkles (contaminants): ■ They'll find that the sprinkles move their way down and eventually into the borehole/straw which indicates that when contaminants are present in our water table, we are putting our health at risk by drinking pollutants or contaminants. ■ If learners are working in pairs, allow two straws in the cup to showcase the accelerated rate of absorption and contamination spread.	
35-45 min	<u>Reflection Discussion:</u> ● Once learner have finished their drinks, regather for a discussion on the various processes at play: ○ How the aquifer changed shape once water (Sprite) was being extracted ○ How the middle layer of contaminants moved and how quickly they entered the borehole system ○ How the top layer of contaminants sunk down and how quickly they entered the borehole system ○ The pace at which this happened when there was one straw present (with learners working individually) compared to two straws (where learners were working in pairs). ● Again, frame this activity as a small representation of the layers, with a touch of fun. ○ The real processes underground happen in far bigger and slower processes. ○ And each aquifer is slightly different to the next. ● Round up the discussion by touching on a few of the contaminants that enter our water table, and potentially our boreholes: ○ Leaky septic tanks or sewage pipes ○ Landfills or leaky storage tanks ○ Agricultural pesticides and fertilizers	

MATERIALS/RESOURCES USED

- Teacher's presentation and notes
- Learner material:
  - Their own straw - ideally bamboo or metal and not plastic
  - Transparent 500ml cup
  - Packet of 4 Oreos
- Teacher material:
  - 2 Litre ice cream - Vanilla
  - A bag of ice
  - 2 Litre Sprite / Sprite Zero
  - Multi-coloured sprinkles

TEACHERS NOTES

- *As this lesson contains a fair amount of sugar, it could be a good idea to run this lesson before a PE lesson, or before an active lesson. (You can replace the items in the aquifer model to be less sugar-intense but ensure that the activity can be fun too)

LESSON NAME Digging Deep - Well-points and Boreholes	**GRADE** 5

LEARNING OUTCOMES

- Define the term *extraction* within the context of groundwater use and identify at least two methods of extracting groundwater
- Identify the various reasons why humans extract groundwater and discuss the amount of water we extract on a daily basis for different uses.
- Collaboratively create a model representation of a well-point or borehole using a few household items.
- Using the model representation, interact with it to be able to elaborate on the real-life representations.
- Communicate and collaborate effectively in groups through the process.

PRIOR PREPARATION - FOREHAND KNOWLEDGE

Ensure that you have the following material ready for this lesson:

- A sheet of nylon cloth to distribute to each group
- One elastic band per group to tie down nylon cloth
- A transparent cup, about 500ml in size
- Each learner to bring a spray tube (found on any cleaning bottle)
- A cup's worth of gravel, not too small or too big.

TIMING	ACTIVITY SUMMARY AND IMPLEMENTATION	NOTES

0-10 min	<u>Introduction and Framing:</u>
	
	• Introduce the topic for the day - Well-points and Boreholes. This topic fits into the term's focus on "*Rivers & Physical features and human activities"* in which we will be exploring the various human activities associated with the extraction of groundwater, via boreholes.
	• Before defining the term *Borehole,* pose the question to the learners and allow them to:
	  ○ Answer vocally and describe what it is and how it works
	  ○ Potentially draw what it looks like and how it functions.
	• After this, describe what it is and how they work, with reference to aquifers and underground water sources:
	  ○ Boreholes: Are wellpoints attached with a pump of sorts that extracts water from a pressurised aquifer below to be used by humans for various purposes.
	  ○ Well-points: Are very similar but just have a different method of pumping water to the surface - A windmill is a good example of a well-point.
	  ○ They are drilled deep into the ground once a survey of the water availability has been conducted. The pipe enters the water table and through the forces of water pressure, the water is pumped to the surface.
	  ○ *Suggested teaching strategy: Use visual cues and images of these components to allow learners to best understand them
	• What we use boreholes for in SA:
	  ○ South Africa has a diverse amount of groundwater available to us, which differs from area to area in our nation.
	  ○ We use groundwater locally for the following reasons:	

	■ Crop irrigation - 78% ■ Industrial uses - 4% ■ Mining - 5% ■ Stock watering - 6% ■ Domestic uses - 7%	
10-30 min	<u>Well-point or Borehole Activity:</u> ● Instruct learners to get all their model material ready and to work in pairs: ○ Transparent 500ml cup (one between 2 students) ○ Spray tube for each student ○ A cup's worth of gravel (one between 2 students) ● Frame this activity as a model representation of a borehole that the learners are going to drill into their cups. They will have two rounds of this activity: ○ **First round** - Only one spray tube will be inserted into the gravel water cup, representing only one borehole in a designated area. ○ **Second round** - Both the learners' spray tubes will be placed into the gravel cup ○ **Third round** - Both learners keep their spray tubes in the cup which is filled again with new water and then a drop of food colouring is placed onto the top layer of the water/gravel. This illustrates the role of contaminants in the water table and learners will observe the movements of the food colouring. ● Take them through the steps and facilitate appropriately: ○ **Step 1** - Cut a small piece of nylon sheet and strap it over the bottom of the spray tube using an elastic band to fasten it (This is to stop any gravel coming through) ○ **Step 2** - Fill the transparent cup with the gravel (This gravel represents the aquifer and un/saturated zone) ○ **Step 3** - Fill the cup ¾ full with water in and amongst the gravel (Instruct learners to observe the way water flows down) ■ Once this has settled, point out to them that the top of this water line is known as the Water Table, which is subject to changes over seasons or dry/wet periods. ○ **Step 4** - Round 1 will ensue where one of the learners places his/her spray tube into the cup and start spraying into another empty vessel (the spraying represents the extraction of water through a borehole) ■ Instruct learners to observe the movement of the gravel as well as the colour and sediment occurrence in the water that has been sprayed out. ■ This round represents one borehole in a designated area ○ **Step 5** - Round 2 ensues where both of the learners' spray tubes are inserted into the cup. Both learners spray water from the cup into an empty vessel ■ Instruct learners to observe the same items, but this time	

	taking note more on the rate of extraction. ○ **Step 6 -** Round 3 ensues where the cup is filled again and both spray tubes are kept in the cup too. This round, the teacher adds a drop of food colouring to the top layer to represent contaminants in the water table. ■ Learners are to then spray again as in round 1 and 2 but this time, they need to observe the movement of the food colouring as it starts seeping further down the aquifer. ■ They need to take note how long it takes for the water to be sprayed out to be coloured by the food colouring, illustrating the fact that contamination has taken place.	
30-40 min	<u>Reflection:</u> ● Learners are to engage and share feedback on a few processes involved in the model representation: ○ Movement and change of structure of the gravel ○ Impacts that the rate of extraction had on the structure of the aquifer ○ The cleanliness of the water that was sprayed out in comparison to the water that was initially poured into the cup ○ What the impacts of many boreholes in one designated land area would be on the structure of the aquifer as well as the availability of the water. ○ How long it took the water that was sprayed out to be coloured from the food colouring. ● Discuss and share insight where you can, with reference to the learning material or to the presentation.	

MATERIALS/RESOURCES USED

- A sheet of nylon cloth to distribute to the learners (Teacher brings)
- One elastic band per learner (Teacher brings)
- A transparent cup per pair of learners (Learner brings)
- A spray tube (nozzle) per learner (Learner brings)
- Food colouring - colour of your choice

TEACHERS NOTES

LESSON NAME Protecting our Precious Resource	**GRADE** 7

LEARNING OUTCOMES

- Define the term *conservation* and relate it to the context of water in South Africa by discussing the importance of conserving our water resources.
- In groups, engage in a practical representation of the availability of freshwater resources on Planet Earth with the use of various materials
- Calculate the percentages of the various water forms and resources on Planet Earth and represent them in the form of a pie chart or bar graph
- Using the calculated percentages and practical representation, elaborate on the need for humans to conserve our freshwater resources.
- Touch on and identify a few of the threats to our conservation of freshwater resources available for drinking
- In groups, using the resources included in the learning material, calculate the sectoral uses of groundwater in South Africa and touch on the sectoral threats in terms of contamination and pollution.

PRIOR PREPARATION - PRIOR KNOWLEDGE

- Ensure that you have all materials ready for the lesson (see materials/resources used)
- Before the class starts, fill the bucket with 19 litres of water and have the other materials nearby in a place where the whole class will be able to see.

TIMING	ACTIVITY SUMMARY AND IMPLEMENTATION	NOTES
0-5 min	<u>Introduction:</u> • Introduce the focus for the day: The conservation of water on planet Earth and the conservation and use of our groundwater in South Africa. • Ask learners to share some insight or experience that they may have with water conservation and groundwater use in their contexts.	

5-30 min	<u>Water as a Precious Resource Activity:</u>
	• Explain to the learners that the container with the 19 litres of water represents all the water on Earth.
	  ○ Ask them to name the sources of water on Earth *(Ice caps; groundwater; oceans; rivers; lakes; clouds; water in living organisms and in soil*)
	• Ask two learners to come up and assist with the demonstration. Ask one of them to remove 2 cups of water from the bucket, using the measuring cup.
	  ○ Ask the learners what this represents.
	  ○ **Answer** = All the freshwater on Earth.
	  ○ Ask them what the rest of the water in the bucket represents
	  ○ **Answer** = Saltwater which is all non-drinkable.
	• You can move the bucket aside. Then ask one of the students to pour out ½ a cup of water into the one-cup measurer.
	  ○ Ask the learner what the 1 ½ cups remaining represents
	  ○ **Answer** = Polar ice-caps which are frozen and therefore	

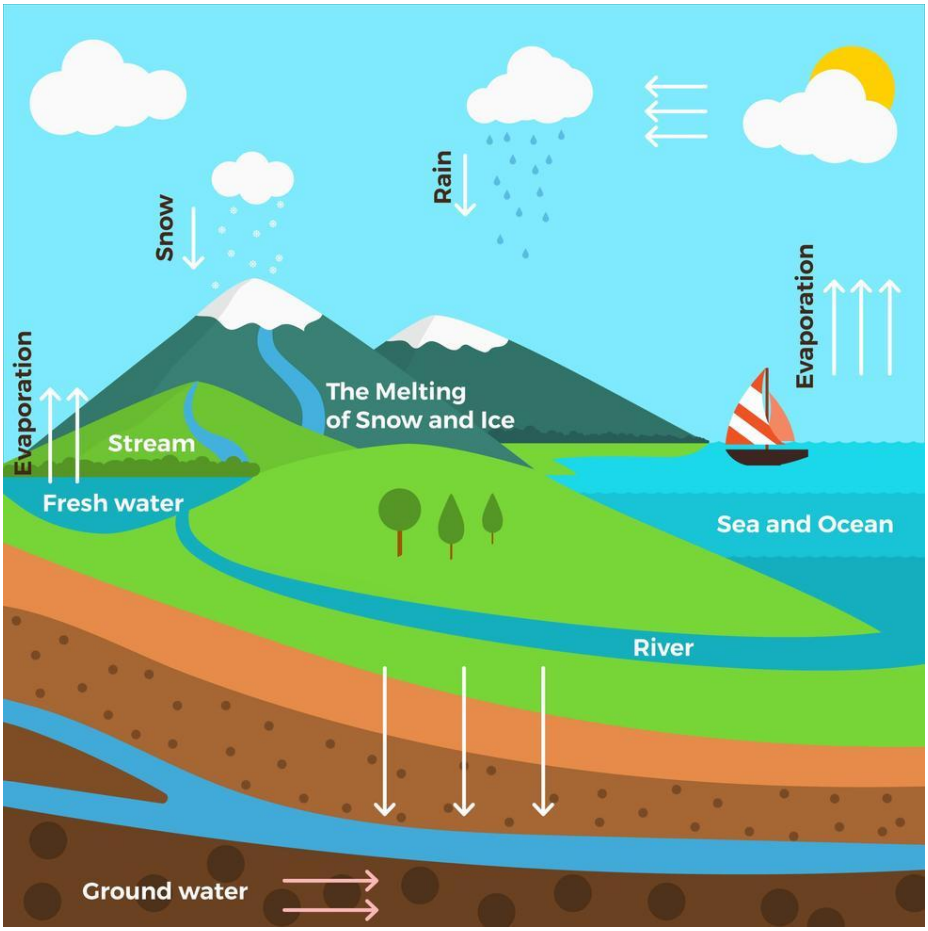
	non-drinkable ○ Ask the learners what the ½ cup of water represents ○ **Answer** = Groundwater and surface water and water vapour in the air. ● Have the rest of the class take guesses at how much of the ½ cup of water represents all the surface water available for our drinking ○ Take the eyedropper and pour out 1 drop of water into a few learners' hands. Tell them that this is how much represents all the surface water available to us and other animals for drinking. ○ The remaining water from the ½ cup represents groundwater. ● Allow them to think about this and ask questions. ○ Veer into the message that there is a fixed amount of water on planet Earth and it isn't going to change	
30-45 min	<u>Results Discussion:</u> ● Pose some reflection questions at the activity: ○ *Were you surprised at how little water there was for human use?* ○ *What do we use the available drinking water for on a daily basis?* ○ *Do you think we can cut out or change some of these activities where fresh water is being used?* ○ *Why can't we drink saltwater? Are there ways in which we can?* ○ *If the number of people on Earth keeps increasing as it is, but the amount of water stays the same , what does that mean? What might happen?* ○ *Can animals and humans live without freshwater?* ○ *Do you think the water we drink is always clean? Where do you think that water has been and what has been done to it?*	

MATERIALS/RESOURCES USED

- A 20 litre bucket (you need 19 litres of water for this activity)
- 2-cup transparent measuring cup
- 1-cup transparent measuring cup
- 1 eyedropper

TEACHERS NOTES

GROUNDWATER AWARENESS CAMPAIGN 2021 *Learner Information Pack*	
Project Organisation	The Greenpop Foundation & WWF South Africa



CONTENTS

Project Introduction

Well done for taking the first step in spreading awareness about water and groundwater in your communities. This is the most precious resource on planet Earth - water - something we need every day and cannot live without. We can easily start taking it for granted, but what if, one day, it ran out?

[Zapiro's 2017 Cartoon depicting the Cape drought. Source: Daily Maverick]

That nearly happened in Cape Town in 2017/2018, but its threat has been around for quite some time. There is a limited amount of water for us to drink on Earth, and sometimes that can change due to social and geographical factors. So we need to protect the water we have available to us. The first step in doing that is learning about the different water sources around us.

Through this project, you will learn about **groundwater** - *the water that is underground, in the spaces between rocks, soil and sand*. We may not see it everywhere, but there are places where our surface water interacts with the groundwater, which also means that we need to protect it just as much as we need to protect our surface water.

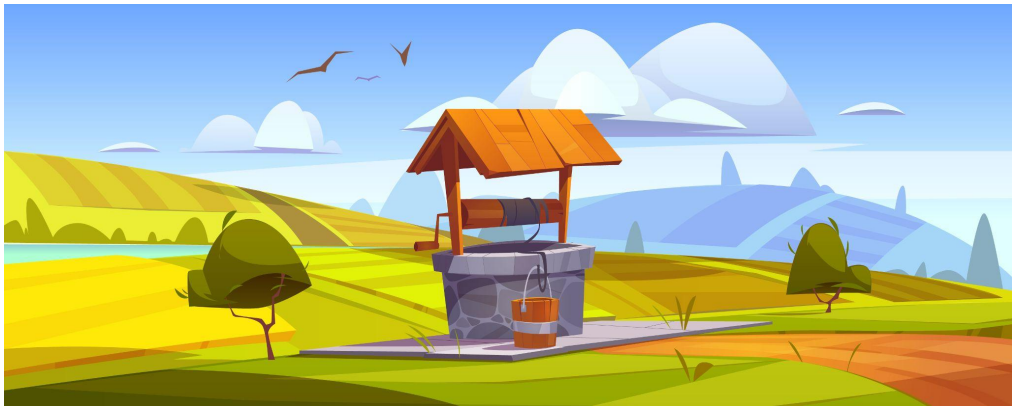


Image source: www.freepik.com / created by: Upklyak

Your job is to be stewards of water awareness in your school, family and community by spreading awareness about groundwater in your province. You'll be surprised how many people don't know much about it!

But by doing this poster, you're also entering a competition to win some amazing prizes for yourself, your school and your teacher in charge at school.

- **For the winning poster group, each learner will receive an educational tablet of their own to use as you please.**
- **For the teacher in charge of the winning poster group, an interactive classroom whiteboard is up for grabs.**
- **And for the school where the winners are based, a R10 000 cash prize is available.**

We encourage you to be as creative and inspiring as possible - water is an amazing and dear thing to us, and everyone will relate to it in some way.

[Cape Town Drought 2017. Photo: Michael Candelori]

Learning the Basics of Groundwater

Groundwater can be a hard thing to visualise or imagine. But it becomes far easier to learn about it once you break it down into the various components that contribute to the movement of groundwater.

a. The water / hydrological cycle: How it works

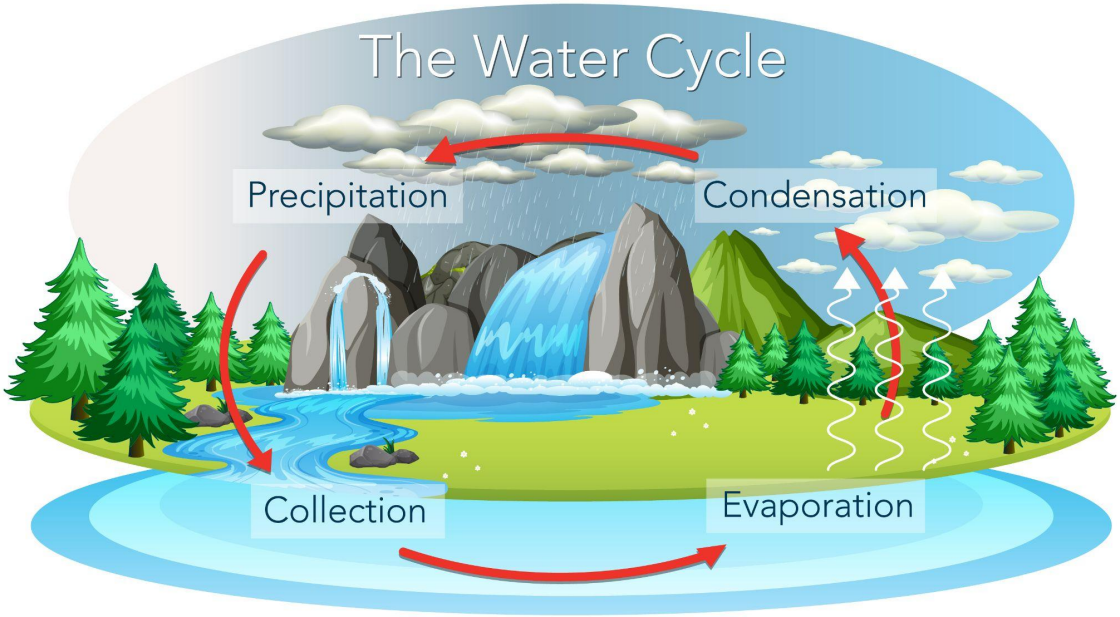


Image source: www.freepik.com / created by: Brgfx

There is a fixed amount of water on Earth, which means that all the water on Earth has been here forever and will stay here forever. However, the water isn't always in a fluid state, with water constantly changing from water to ice to vapour. This constantly changing cycle is the hydrological cycle, and it serves vital functions to our ecosystems and society.

Groundwater makes up the part of the Hydrological cycle that is underground in the gaps and formations underground. Here, the water moves from area to area, predominantly via the force of gravity, and has discharge points in the form of springs or wetland estuaries. When water is not moving underground, it is stored in subsurface geologic formations, also known as aquifers. This is where we can access groundwater for drinking, agricultural or domestic uses.

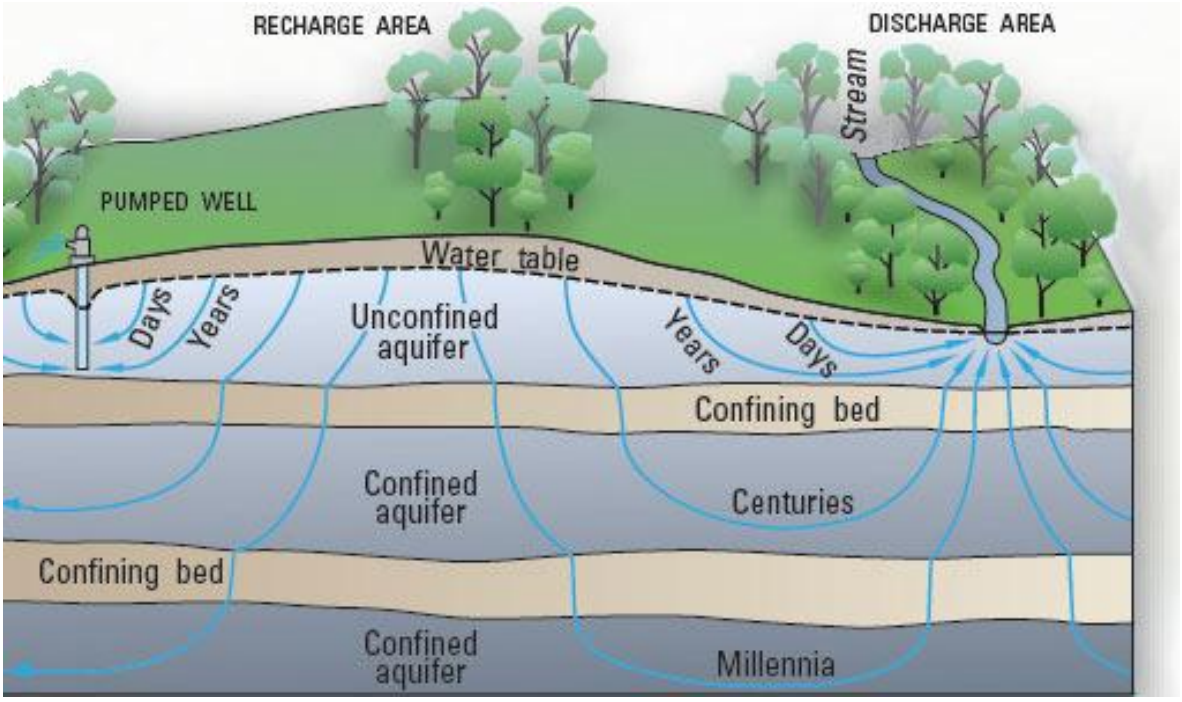
b. Groundwater in the water / hydrological cycle

GW makes up the component of the Water Cycle that is underground. Our Groundwater resources outweigh our freshwater resources considerably. Take the following scenario, for instance:

- *If you had a 19litre bucket of water in front of you and extracted 2 cups worth of water from it, those 2 cups would represent all the freshwater on planet Earth.*
- *The remaining water in the bucket would represent all the saltwater in our oceans, which make up 70% of the Earth's surface area.*

- *From those remaining 2 cups of water, one and half of them would represent the freshwater frozen in the polar ice caps.*
- *That then leaves us with half a cup of water. Most of it is underground in the form of groundwater, leaving only a fraction (1 x tsp) on the surface available for drinking.*
- *This surface freshwater is everything that is stored in our dams, rivers and lakes and is of utmost importance to protect as we rely on it for hydrating 7.6 billion people and many other animals.*

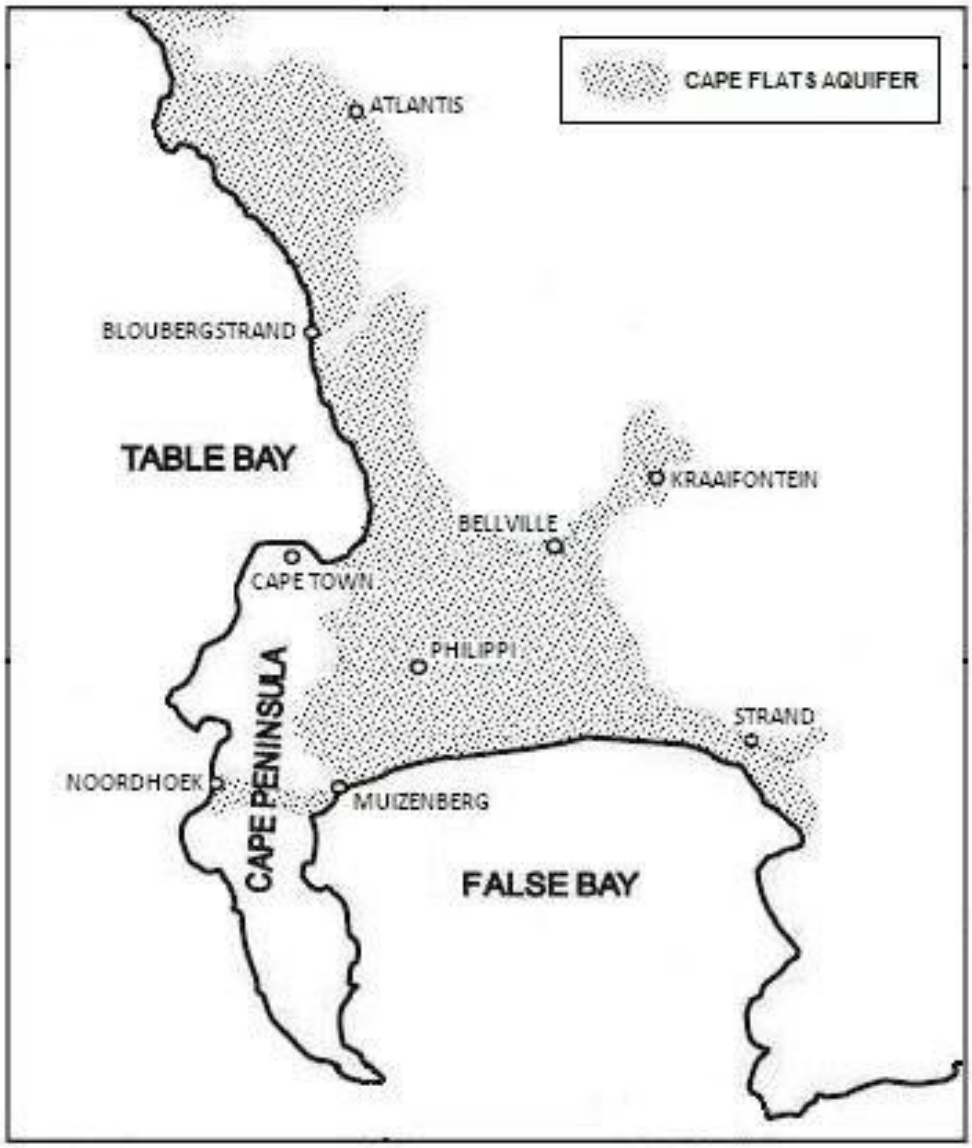
c. Aquifers and the Cape Flats Aquifer



[Image showcasing the structure of both a confined and unconfined aquifer with predicted timeframes for extraction and re-charge]

The term Aquifer literally means 'to carry water'. They are underground, water-carrying formations that can either be confined or unconfined. *(Confined* means that there is a layer of impermeable rock above it, whereas unconfined means that there is a permeable layer above the aquifer. *Permeable* means that water can pass through it, whereas *impermeable* means water cannot pass through it). They come in various shapes, sizes and structures and can be somewhat elusive from most as they are very hard to monitor, access and see.

In Cape Town, we are situated on a very unique and shallow aquifer known as the Cape Flats Aquifer. With its very flat land and sandy soils, the Cape Flats is a water-available area with various points where the groundwater can seep through and onto the land surface. The structure of the Cape Flats Aquifer is both an advantage and a disadvantage in the sense that it makes for very easy borehole drilling and water access but poses large threats of contamination from humans due to its high permeability as a result of the very sandy soil.



[The regional extent of the Cape Flats Aquifer]

Many geologists and experts are attempting to best understand the patterns and threats linked with the Cape Flats Aquifer as borehole numbers have increased dramatically over the past five years. But for now, it is up to us, the citizens of Cape Town, to ensure that we use water responsibly and ensure that what we put back into the water table is not of any large threat or danger.

d. Using Groundwater: Well-points and Boreholes

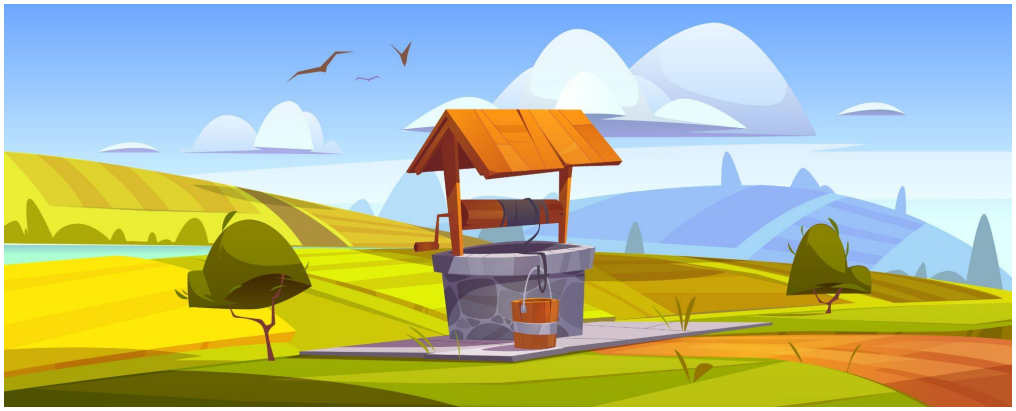


Image source: www.freepik.com / created by: Upklyak

We access and utilise groundwater resources when it is discharged onto the Earth's surface in the form of a freshwater spring or a wetland or estuary. But we can also access it through man-made methods such as boreholes or windmills, which are well-points that are drilled into the ground and attached with a pump of sorts. When planning on drilling for a borehole, there are a variety of maps and tools one can use, but first, an analysis of the area and the aquifer needs to be conducted.

With the rapid increase in borehole numbers over the last few years, we are entering areas of uncertainty regarding our utilisation of groundwater resources. Therefore, it is vitally important that municipalities track and register groundwater users to ensure that there is consistency and effective management of our natural resources.

e. Contamination: The biggest threat to our groundwater resources

Image source: www.freepik.com / created by: Vectorjuice

There are two looming threats to our groundwater resources and aquifers:

1. Over-extraction or overutilisation (i.e. Using too much of the available groundwater)
2. Contamination and/or pollution of Groundwater

Contamination happens when pollutants and waste enter the water table and start interacting with groundwater. This can occur in a variety of ways, predominantly through industrial waste, municipal waste, leaky sewage pipes or irresponsible agricultural practices with high chemical fertiliser usage. In addition, we can contaminate groundwater through:

- Leaky landfills or sewage lines
- Fertilisers, livestock waste and insecticides entering the water table
- Vehicle pollution, oil and petrol waste
- Industrial waste and chemical spills

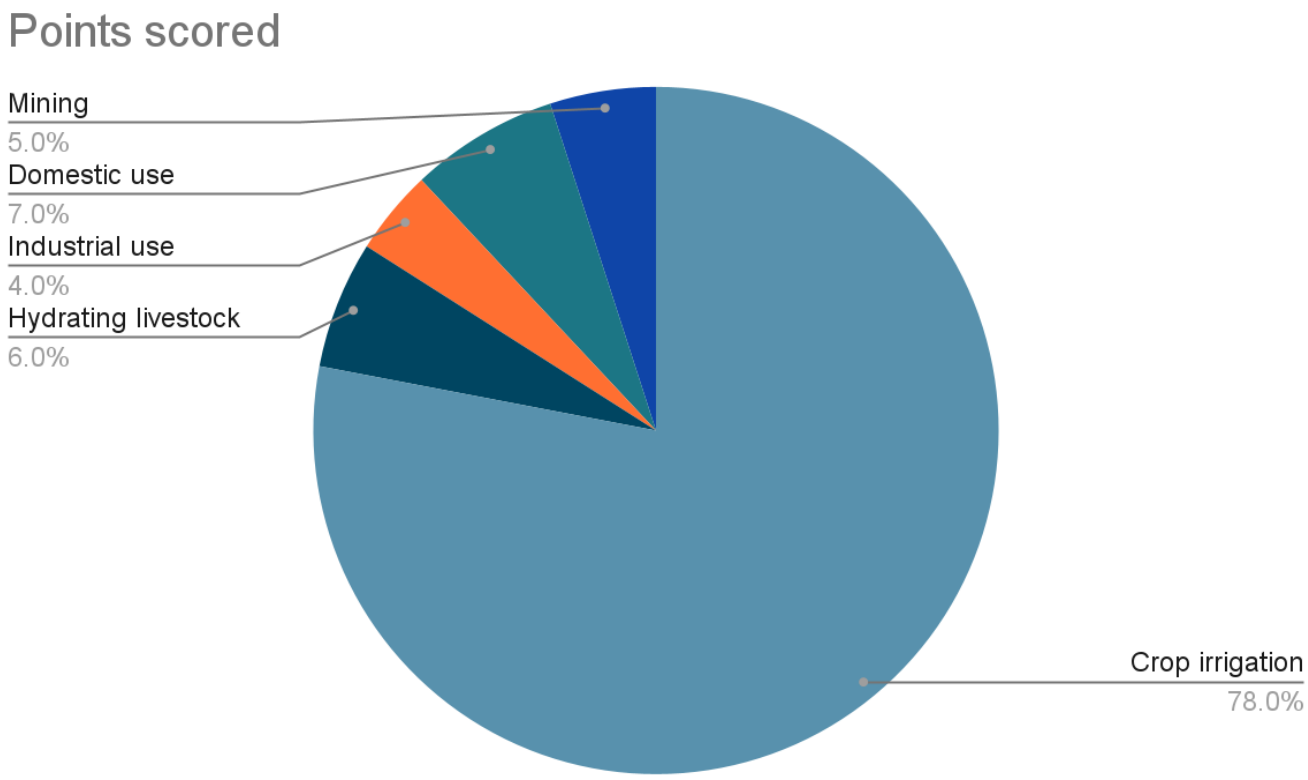
Once groundwater is contaminated, it circulates through the hydrological cycle as polluted water. It can even be stored in aquifers to resurface many years in the future whilst still posing a pollution threat. The issue with the contamination of our groundwater resources is the fact that nearly half of the world's population relies on GW for drinking, only placing ourselves and our health in danger.

Image source: www.freepik.com / created by: Brgfx

f. Groundwater in South Africa: Looking into the future

The total amount of groundwater will always be a tricky number to identify accurately, but geologists and hydrogeologists have estimated that we have 10 Gariep dams worth of water underground.

That totals about 235.5 billion m3 of water. In terms of the sectoral use of GW in SA, we rely on it for the following purposes:



Project Aims, Timeline and Materials

a. Project Details

Your project aims to **create awareness about groundwater through an informative poster**. You will have two months to create a poster in groups of 2-3 that aims to:

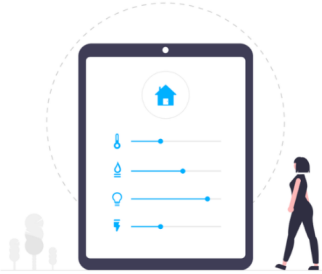
1. Create awareness about groundwater in Cape Town and South Africa
2. Inform the readers about the different aspects of groundwater, highlighting its importance in the Cape context
3. Encourage the protection of our groundwater resources following periods of drought
4. Supply readers with sufficient information to act upon the call for protection of our groundwater
5. Be as creative as possible in compiling an informative poster

b. Poster Competition Details

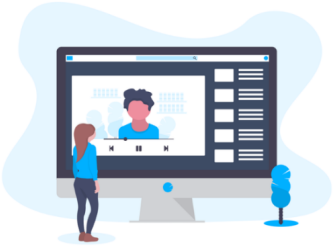
- **Commence date:** 7th June 2021
- **Close date (submissions due):** 6th August 2021
- **Learners:** All learners in grades 4-7 are welcome to compete
- **While completing your posters, you should aim to:**
    - Create awareness through creativity and the correct information
    - Conduct research on the subject matter where more information is needed
    - Collaborate and communicate effectively in pairs or in groups of 3
    - Include relevant and contextually correct images, diagrams and graphics
- **The poster should be formatted to:**
    - An A2 piece of paper in size
    - Can be written, drawn or printed (with no preference to those who can print it)
    - Include labels and descriptions to any images or diagrams used.
    - Make sense when reading all aspects of the poster
- **The rubric will guide you in creating a poster that is:**
    - Well organised and easy to read
    - Informative and includes accurate information
    - Creative and engaging to read
    - Well researched and executed

c. Timeline

Date	Timeline Items
7th June - 6th August 2021	Poster competition launches on the 7th of June and runs through for two months until the 6th of August. • Grade 4-7 learners are eligible to partake in the poster competition • Learners can work individually, in pairs or in groups of three (but no more) • Teachers to facilitate this process where needed
6th August 2021	Final date for poster submission
13th August 2021	Poster competition winners announced • Prize for the best poster = Educational tablet for each learner • Prize for the teacher in charge of the best poster = Interactive whiteboard • Prize for the school where the winning poster's students come from = R10 000 cash prize.



For the winning poster group - Each learner will win an educational tablet



For the teacher in charge of the winning poster group - An interactive whiteboard is up for grabs

For the school from which the winners from - a R10 000 cash prize is available

d. Poster Rubric

Category	8-10	6-8	4-6	0-4
Research and Understanding of the topic	Relevant and accurate information is included in the poster, displaying a thorough understanding of the topic	Accurate information is well researched and demonstrates a good understanding of the topic	Accurate information reflects some research and a general understanding of the topic	Information shows little research and understanding of the topic
Visual - Use of graphics, diagrams and images	Pictures and graphics used to cover all topics of the subject. Brief description of the images given. Visuals add and complement understanding of the information included and are portrayed neatly. Glue and tape are not obvious and borders used on the images.	Pictures and graphics used to cover each topic of the subject. Brief descriptions not used or given. Visuals add understanding to the topic. Information is portrayed neatly. No borders included, and glue and tape are not obvious.	Pictures and graphics used to cover a few aspects of the poster. Descriptions not given. Visuals do not always add understanding. Neatly portrayed information. White on white. Glue and/or tape are visible.	Pictures and graphics used to cover a few aspects of the poster. Descriptions not given. Visuals do not always represent ideas in the poster or add understanding. Information is portrayed with little care.
Poster organisation	Information is neatly written or typed may be read from 4ft away. Headings Are used effectively. Poster tells a story. Observer could quickly find information if asked a factual question. Color/texture is used to visually organise the material.	Information is neatly written or typed may be read from 2ft away. Headings are used effectively. Poster tells a story. Observer could quickly find information if asked a factual question.	Information is neatly written or typed may be read from 2ft away. Headings are used, but not always correctly or appropriately. Observer could find information easier is more headings were given.	Information is sloppily written. Difficult to read. Material is Not organised. Printed and pasted with little thought. Not enough information to really organise. Observer must read entire poster to find information.
Writing, spelling and grammar	Information is obviously not copied and pasted. Spelling and grammar are	Information is obviously not copied and pasted. A few minor mistakes.	Unclear if information is copied and pasted. Mistakes occur regularly.	Information is obviously copied and pasted. Mistakes detract from the

	correct.			understanding
Creativity	Poster is highly creative in its presentation and shows careful thought in design and organisation. Creativity relates to the research topic.	Poster is creative and shows some thought in design and organisation. Creativity rates to the research topic.	Poster is creative but shows little thought in design and organisation. Creativity in the poster may not reflect the topic.	Poster shows little to no creative input and effort in either design or organisation. Creativity does not reflect the research topic.
Awareness	Poster is exceptionally effective at raising awareness, action and behaviour change amongst the readers.	Poster is highly effective at raising awareness, action and behaviour change amongst the readers.	Poster is reasonably effective at raising awareness amongst the readers. Although no action or behaviour change is encouraged	Poster is not effective in raising awareness among the readers. No action or behaviour change is encouraged.
Total Points	**/ 60 points**			

e. What is an informative awareness poster?

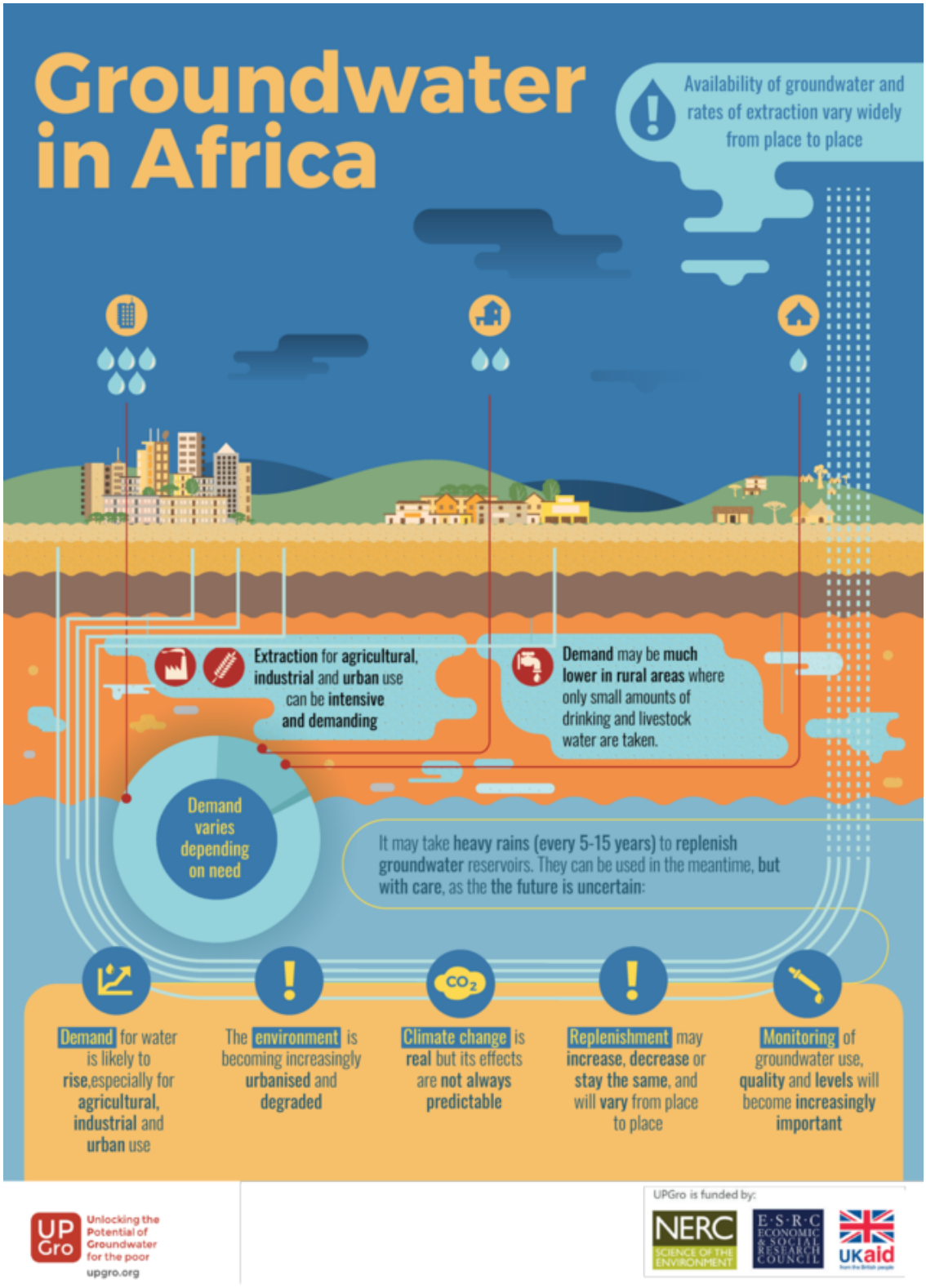
An informative awareness poster tells the audience and readers something they may not have known before. It aims to inform and create awareness on a particular topic or issue that applies to all of us, that is what makes this type of poster a perfect match for raising awareness on groundwater.

When creating an informative poster, your group should aim to:

- Plan the message that your poster is trying to get across beforehand
- Consider who will be reading your poster and what information they may want to learn about
- Decide on and select a template to use in constructing your poster
- Make the important information readable from 2m away
- Select and use a colour pallet or theme
- Keep the text clear and to the point
- Keep word count between 300-800 words
- Select a call-to-action that the readers can use (a call-to-action is something the reader may feel inclined to do after reading your poster)
- Effectively use graphics and images to complement the information

f. Examples of informative awareness posters

COVID-19 has seen a huge array of informative posters being portrayed around our communities as we attempt to limit the spread of the virus.



This poster seeks to raise awareness on the topic you and your group are embarking on - Groundwater in the South African context.

This poster seeks to raise awareness around healthier eating habits by illustrating the dangers that unhealthy eating habits pose.

GROUNDWATER AWARENESS CAMPAIGN 2021 *Teacher Information Pack*	
Project Organisation	The Greenpop Foundation & WWF South Africa
Contact Person	Damien Hewitt damien@greenpop.org C: +27 71 319 5754

CONTENTS

Welcome to the Groundwater Awareness Project

a. Welcome

We welcome you and your school community to an innovative project that seeks to create and spread awareness about Groundwater and the importance of protecting our water resources in the Western Cape. Following on from the drought that Cape Town experienced in 2017/18, we were all made aware of the fact that our most precious resource, water, was under threat due to a variety of causes.

[Photo: Michael Candelori]

The drought had a significant impact on our everyday behaviour as we all started reducing our water consumption as *Day Zero* loomed around the corner - making us the first major city in the world to run the risk of running dry of drinking water.

The drought also impacted the methods in which we sourced water as local springs were full to the brim with long queues and many patient people. Apart from the springs, many households, schools, and organisations drilled boreholes to start accessing our underground water supply, also known as groundwater, from the aquifer beneath our very feet.
However, large amounts of these boreholes went through without extensive knowledge on the threats that over-extraction or contamination may pose.

This is what this project and accompanying material seeks to do - create awareness about the Cape Aquifer and articulate the challenges, threats and methods of protection to the very people who rely on it - citizens of the Cape Town community.

b. Awareness through Education

"*Education is the most powerful weapon you can use to change the world".* - Nelson Mandela.

A quote we've heard many times, but one that still rings true to us, especially to the teachers who are creating change in the thousands of classrooms countrywide.

Environmental degradation, biodiversity loss, natural resource exploitation are all consequences of climate change, the biggest threat to our collective existence. However, for effective change to be implemented within these changing climates, a mindset and behavioural change will need to occur. These changes rely on some form of education and awareness, which is what is at the heart of this project.

This project seeks to creatively inspire learners to be agents of awareness and change within their communities and networks through a poster competition that aims to articulate the uses, threats, and means of protecting our groundwater resources. This is a tricky topic that is not widely known about or taught in schools, but one which is undoubtedly one of the most critical aspects of our ecosystems.

c. Positively contributing to water awareness in SA

Droughts are not solely confined to the Western Cape and Cape Town; they are widespread across sub-Saharan Africa and highly prevalent in many parts of South Africa. They pose considerable threats to agriculture, the economy and human health and livelihoods.

By engaging your learners in this project and its educational resources, you positively contribute to water awareness in our country and positive environmental change and action.

Project Partners

This project is a collaboration between various role-players and contributors who all seek to be stewards of environmental education and change within South African communities.

a. **Greenpop**
Greenpop is an award-winning registered non-profit organisation headquartered in Cape Town, South Africa. They work to restore ecosystems and empower environmental stewards through reforestation, urban greening, sustainable development, and environmental art projects across Sub-Saharan Africa.

Greenpop's involvement in this project is based on educational awareness through the poster competition and associated educational material.

b. **WWF-SA**
WWF is one of the world's leading independent conservation organisations that works to look after our natural resources - oceans, land, and wildlife - to continue to benefit from food, water, and a healthy climate.

c. **Danish Embassy in South Africa**
Funders of this project, and various other environmental projects, the Ministry of Foreign Affairs of Denmark is a strong advocate for a more sustainable world and aims to become one of the world's five most sustainable foreign services within the next five years.

d. **TinToy Productions**
TinToy Films is an award-winning, full-service film production company creating TV commercials, branded content, music videos and short films.

Project Aims and Timeline

a. Project Aims

As illustrated, the two core aims for this project are the follows:

1. To create and spread awareness creatively and engagingly within our primary schools in Cape Town
2. To continue having a positive impact on the environmental education practices in South African schools.

These two aims combine awareness with education as the learners will be agents of both in their communities by partaking in a poster competition that will educate the learners on groundwater and have a positive reach to families, communities, and neighbourhoods.

A project such as this ensures that environmental education can spread awareness in communities whilst also ensuring that learners are engaged, creative and satisfied with the learning process.

Another aim of the project is to equip South African educators with sufficient learning material to continue these lessons and projects for years to come. That is why the teacher package includes a variety of lessons to be used in varying grades in future years.

b. Project Timeline

Date	Timeline Items
03/06/2021 - 04/06/2021	Educational material distribution ● Three animated videos ● Teacher information pack ● Learner information pack ● 3 Geography lessons
07/06/2021 - 06/08/2021	The poster competition launches on the 7th of June and runs for two months until the 6th of August. ● Grade 4-7 learners are eligible to partake in the poster competition ● Learners can work individually, in pairs or groups of three (but no more) ● Teachers to facilitate this process where needed
06/08/2021	Final date for poster submission
13/08/2021	Poster competition winners announced ● Prize for the best poster = Educational tablet for each learner ● Prize for the teacher in charge of the best poster = Interactive whiteboard ● Prize for the school where the winning poster's students come from = R10 000 cash prize.

Contextualising the Subject of Groundwater

To ensure all relevant parties in the school environment understand the topic and focus for the project, we have included some further information on what groundwater and aquifers are and why they matter so much to both the broad ecosystem as well as to us.

a. The water / hydrological cycle: How it works

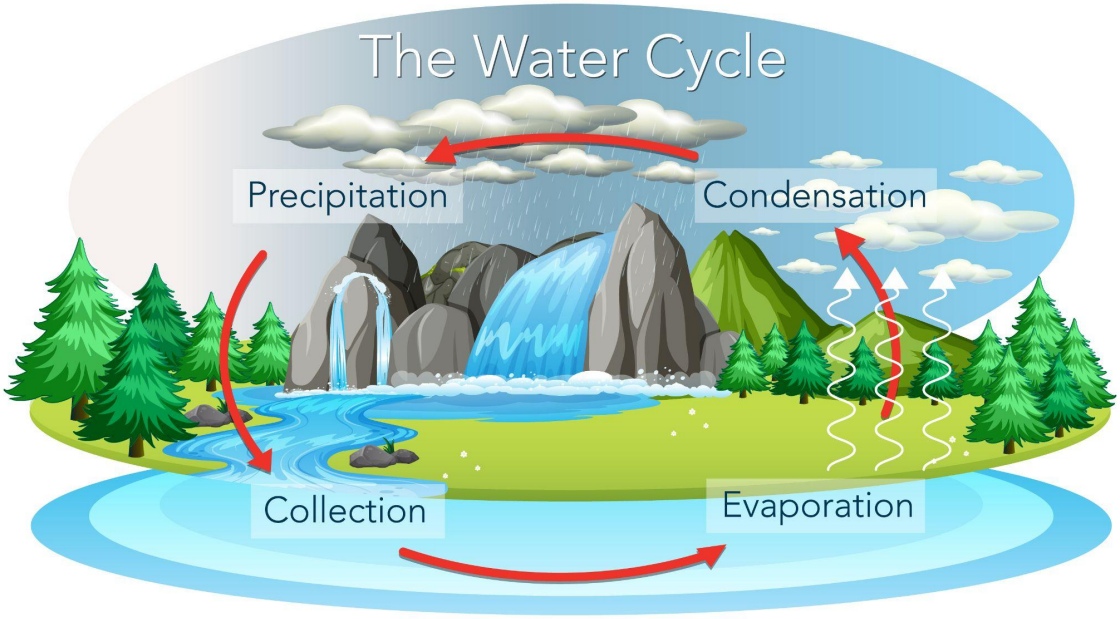


Image source: www.freepik.com / created by: Brgfx

There is a fixed amount of water on Earth, with water changing forms constantly from water to ice to vapour. This continually changing cycle is the hydrological cycle, and it serves vital functions to our ecosystems and society.

Groundwater makes up the part of the Hydrological cycle that is underground in the gaps and formations underground. Here, the water moves from area to area, predominantly via the force of gravity, and has discharge points in the form of springs or wetland estuaries. When water is not moving underground, it is stored in subsurface geologic formations, also known as aquifers. This is where we can access groundwater for drinking, agricultural or domestic uses.

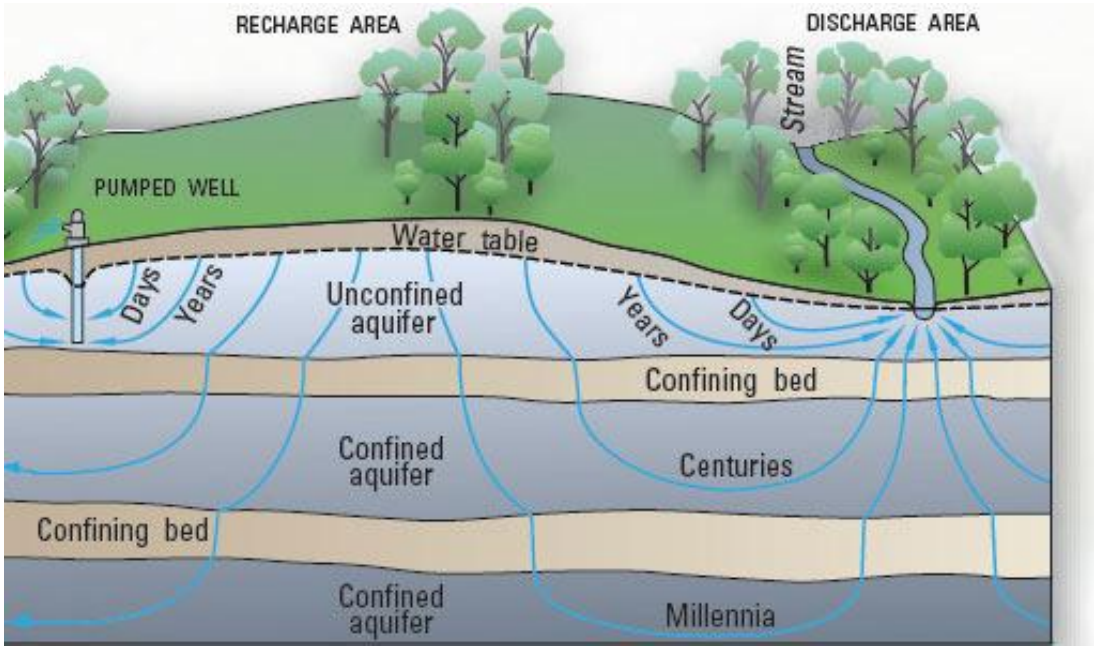
b. Groundwater in the water / hydrological cycle

GW makes up the component of the HC that is underground and outweighs our freshwater resources considerably. Take the following scenario, for instance:

- *If you had a 19litre bucket of water in front of you and extracted 2 cups worth of water from it, those 2 cups would represent all the freshwater on planet Earth.*
- *The remaining water in the bucket would represent all the saltwater in our oceans, which make up 70% of the Earth's surface area.*
- *From those remaining 2 cups of water, one and half of them would represent the freshwater frozen in the polar ice caps.*

- *That then leaves us with half a cup of water, of which most of it is underground in the form of groundwater, leaving only a fraction (1 x tsp) on the surface available for drinking.*
- *This surface freshwater is everything that is stored in our dams, rivers and lakes and is of utmost importance to protect as we rely on it for hydrating 7.6 billion people and many other animals.*

c. Aquifers and the Cape Flats Aquifer



[Image showcasing the structure of both a confined and unconfined aquifer with predicted timeframes for extraction and re-charge]

The term Aquifer means 'to carry water'. They are underground, water-carrying formations that can either be confined or unconfined. (Confined means that there is a layer of impermeable rock above it, whereas unconfined means that there is a permeable layer above the aquifer). They come in various shapes, sizes and structures and can be somewhat elusive from most as they are very hard to monitor, access and see.

In the Cape Town context, we are situated on a unique and shallow aquifer known as the Cape Flats Aquifer. With its very flat topography and sandy soils, the Cape Flats is a water-available area with various discharge points for the aquifer in the form of estuaries and wetlands. The structure of the Cape Flats Aquifer is both an advantage and a disadvantage in the sense that it makes for effortless borehole drilling and water access significant threats of contamination from humans due to its high permeability as a result of the very sandy soil.

Many geologists and experts are attempting to understand best the patterns and threats affiliated with the Cape Flats Aquifer as borehole numbers have increased dramatically over the past five years. But for now, it is up to us, the citizens of Cape Town, to ensure that we use water responsibly and ensure that what we put back into the water table is not of any large threat or danger.

d. Using Groundwater: Well-points and Boreholes

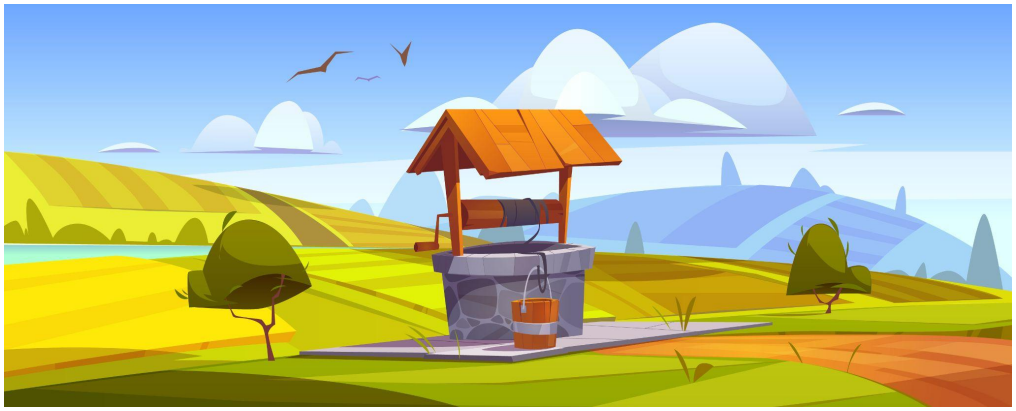


Image source: www.freepik.com / created by: Upklyak

We access and utilise groundwater resources when it is discharged onto the Earth's surface in the form of a freshwater spring, a wetland, or estuary. But we can also access it through artificial methods such as boreholes or windmills, which are well-points drilled into the ground and attached with a pump of sorts. When planning on drilling for a borehole, a variety of maps and tools can be used, but first, an analysis of the area and the aquifer needs to be conducted.

With the rapid increase in borehole numbers over the last few years, we are entering areas of uncertainty regarding our utilisation of groundwater resources. Therefore, it is vitally important that municipalities track and register groundwater users to ensure that there is consistency and effective management of our natural resources.

e. Contamination: The biggest threat to our groundwater resources

Image source: www.freepik.com / created by: Vectorjouice]

There are two looming threats to groundwater and aquifers:

1. Over-extraction or overutilisation (i.e. Using too much of the available groundwater)
2. Contamination and/or pollution of Groundwater

Contamination happens when pollutants and waste enter the water table and start interacting with groundwater. This can occur in various ways, predominantly through industrial waste, municipal waste, leaky sewage pipes or irresponsible agricultural practices with high chemical fertiliser usage.

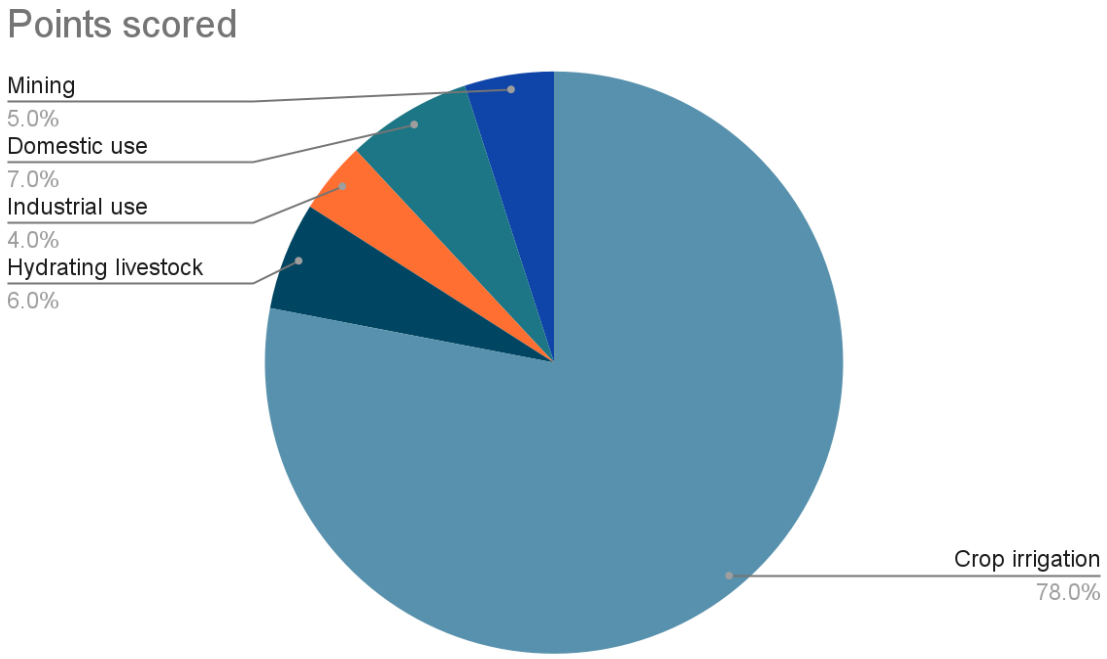
Once groundwater is contaminated, it circulates through the hydrological cycle as polluted water. It can even be stored in aquifers, only to resurface many years in the future whilst still posing a pollution threat. The issue with the contamination of our groundwater resources is the fact that nearly half of the world's population relies on GW for drinking, only placing ourselves and our health in danger.

Image source: www.freepik.com / created by: Brgfx

f. Groundwater in South Africa: Looking into the future

The total amount of groundwater will always be tricky to identify accurately, but geologists and hydrogeologists have estimated that we have 10 Gariep dams worth of water underground.

That totals about 235.5 billion m3 of water. In terms of the sectoral use of GW in SA, we rely on it for the following purposes:



Additional Educational Lessons

To ensure that water awareness in your school continues further than this poster competition, we have designed and included three lessons to use in your classroom for years to come. The lessons have been aligned to the CAPS curriculum to ensure easy integration into your annual teaching plans. In addition, they aim to bring the key concepts of groundwater into the subject of Geography (Social Sciences).

The tables below summarise the background, content, requirements and curriculum alignment for each lesson.

Lesson 1 - Grade 4: Aquifers	
Lesson Background	An aquifer can be an exceptionally difficult thing to visualise since we can only see and interact with tiny components of it. Although not dealt with extensively in classrooms or water-related conversation, aquifers are some of the most vital components of our water cycle. They are underground geological formations that become saturated with water once it drains down through the cracks and pores in the soil and rock. This lesson aims to showcase a model representation of an aquifer to the learners by emulating its structure in a cup to illustrate: (i) the structure and make up of the various layers and, (ii) the dangers that contamination can cause once they have infiltrated through and into an aquifer and our water table. Through creating a model representation, in a fun way, the learners are set to understand and grasp the idea of aquifers a bit better, which will guide responsible actions with our water use

	and possible contamination.
Content Included	• Aquifers and their structure and function in the water cycle • Contaminants and pollutants to groundwater • How we access groundwater through boreholes and well-points • Limiting the contamination of groundwater resources
Material Requirements	• A bag of ice • 2 litres vanilla ice-cream • Multi-coloured sprinkles • 2 x 2-litre Sprite / Sprite Zero • A transparent 500ml cup per learner • Packet of 4 Oreos / any other chocolate biscuit per learner • One straw (ideally metal or bamboo) per learner

Curriculum Alignment	• Grade: 4
	• Subject: Geography / Social Sciences
	• Term: 4
	• Term focus: Water in South Africa
	  ○ Uses of water
	  ○ Water as a resource
	  ○ Accessing water
	  ○ Polluting water and wastewater

Lesson 2 - Grade 5: Digging Deep	
Lesson Background	Humans have been extracting groundwater for hundreds of years through various mechanisms which have been hydrating ourselves and the land we farm and cultivate. Our activities with groundwater extraction will inevitably have some impact on the surface water, such as rivers and dams, as well as an impact on the land structure itself. This lesson aims to illustrate the role, function and structure of well-points and boreholes in our groundwater abstraction. The learners will create a model representation of a borehole in an 'aquifer' to illustrate the (i) effects of over-extraction on the aquifer and (ii) comparing the effects of one vs two boreholes in the same area. As homework tasks, learners will label and identify the various parts of a borehole and elaborate on the importance of strategic and smart borehole drilling.
Content Included	• Groundwater extraction through wells and boreholes • Structure of well-points and boreholes • Threats to groundwater extraction • Human impact on water resources
Material Requirements	• A sheet of nylon cloth to distribute to the learners (Teacher brings) • One elastic band per learner (Teacher brings) • A transparent cup per pair of learners (Learner brings) • A spray tube (nozzle) per learner (Learner brings) • Food colouring - colour of your choice
Curriculum Alignment	• Grade: 5 • Subject: Geography / Social Sciences

	● Term: 2 ● Term focus: Rivers and Features in SA / Human Activities ○ Rivers in SA ○ Physical features and human activities ○ Links between physical features and where people live

Lesson 3 - Grade 7: Protecting our Precious Resource	
Lesson Background	There is a finite amount of water on planetEarth that is never going to change. Still, only a minute fraction of all the water on Earth is actually safe to drink, making the cause for the conservation of our freshwater resources stronger than ever. This lesson aims to showcase water distribution across the planet, exploring how much is in our oceans, ice caps and underground. Understanding this fuels the cause for conservation of our surface freshwater resources which we rely on for drinking. From this, learners identify the various threats and pollutants to our freshwater and elaborate on how we can protect our most precious resource. As an optional extra, you could have the students research and tabulate the sectoral uses of groundwater in SA.
Content Included	● Natural resources and conservation of them ● Water as a finite resource on Earth ● Distribution of water resources on Earth ● Causes for groundwater conservation
Material Requirements	● A 20-litre bucket (you need 19 litres of water for this activity) ● 2-cup transparent measuring cup ● 1-cup transparent measuring cup ● One eyedropper
Curriculum Alignment	● Grade: 7 ● Subject: Geography / Social Sciences ● Term: 4 ● Term focus: Water in SA / Natural Resources and Conservation ○ Natural resources ○ Management of resources ○ Water in SA

Cross-curricular Opportunities

Even though *groundwater* may be confined to certain subjects, there is no limit to its inclusion in the holistic school environment. As functional as it is, water is also the source of life for the planet, which makes it something that can apply to all corners of life.

Below are some ideas to use in integrating groundwater-related themes and ideas into various subjects at school.

a. Languages

Have your kids create an informative poster on groundwater to spread awareness in the community or construct their own emails to a water-management department or organisation to follow up with groundwater monitoring. If you want the learners to get vocal, allow them to conduct a spoken piece of poetry about the value and preciousness of water. Alternatively, learners can wear the teachers' hats as they get a chance to research a ground-water related topic and present their findings on it to the class. By sharing some facts with the class, they can practice their reading, listening and speaking skills.

b. Social Sciences

Humans have relied on water forever, making it a tremendously valuable resource to us. Have the learners track back a timeline of local rivers and river catchment areas that have played host to different settlements over thousands and thousands of years. Or get the learners to conduct an interview with both a parent and a grandparent to showcase the different personal relationships with water that we've forged through generations.

Or in Geography, have the learners track the GPS coordinates of the primary water sources in Africa or, to further that, have them navigate their way on a map from Cape to Cairo, attempting to use as little land-based transport as possible.

c. Mathematics

Allow the learners to conduct a personal water audit, tallying their total water use over a period of 24 hours or allow them to break down the sectoral uses of water in South Africa to gain insight into how much water goes where. To further that, have the learners conduct a water audit of the school and provide recommendations for water-saving and awareness.

d. Life Orientation / Life Skills

Allow the learners to see water differently as they create water-related artworks showcasing their own take on what water means and how intrinsically connected we are to it. Or allow the learners to activate their right to protest as they create water-awareness posters to spread awareness about water pollution at the hands of various industries.

e. Technology

Inspire students to build a water clock to measure time and calculate the flow rate of water or alternatively have them build a birdbath from upcycled materials to inspire bird activity at school or at home. Or have a water-themed term by focussing all the attention on the different mechanisms, systems and tools we use in and around water; who knows what amazing ideas can come from the classroom.

f. Natural Sciences

Learners can trace the source of their water from taps or tanks to the spring or catchment it came from. Or learners can contribute positively to the community by conducting basic water tests on a local river nearby the school.

Appendix 1: Poster Competition Instructions

To commence proceedings in the groundwater awareness campaign poster competition, start by sharing some surface-level information with the learners, highlighting the topic focus as well as the incentives to the poster competition.

Following a short introduction of the topic and poster competition, show the three short animated videos included in the project package. These short videos should (i) elicit interest in participating in the poster competition and (ii) inform the learners on the basics of the subject matter and focus for the posters.

Follow the steps below:

- **Step 1:** Introduce the poster competition and subject matter to the class
- **Step 2:** Play the three short animations and have short discussions straight after them to gain an idea of where the learners' understanding of the subject matter is at.
- **Step 3:** Hand out the poster competition resources to the learners:
    - Learner information packs
    - Poster competition information
- **Step 4:** Allow the learners to form groups of 2-3 in which they will partake in the poster competition.
- **Step 5:** Facilitate the process where and when you can over the course of the poster competition.
- **Step 6:** Collect the completed posters at the end of the competition period and await contact from the Greenpop team for collection.
- **Step 7:** Following the judgements of all the posters, we will inform you of the results to relay them back to the learners.

Key Poster Competition Details:

- **Commence date:** 7th June 2021
- **Close date (submissions due):** 6th August 2021
- **Learners:** All learners in grades 4-7 are welcome to compete
- **Requirements:** The learners are to create an informative poster that relays important information about groundwater in the Western Cape, with reference to:
    - *How we use groundwater and what we use it for*
    - *What groundwater is and where it is stored*
    - *How much groundwater we have available to us in SA*
    - *Risks and threats to contamination and pollution of groundwater resources*
    - *Ways of mitigating the adverse effects of groundwater pollution*
    - *Responsible actions we can adopt with our groundwater use*
- **While completing their posters, learners should aim to:**
    - Create awareness through creativity and the correct information
    - Conduct research on the subject matter where more information is needed
    - Collaborate and communicate effectively in pairs or in groups
    - Include relevant and contextually accurate images, diagrams and graphics
- **The poster should be formatted to:**
    - An A2 piece of paper in size
    - Can be written, drawn or printed (with no rubric preference to those who can print it)
    - Include labels and descriptions to any images or diagrams used.
    - Make sense when reading all aspects of the poster.

Appendix 2: Poster Rubric (For the competition)

Category	8-10	6-8	4-6	0-4
Research and Understanding of the topic	Relevant and accurate information is included in the poster, displaying a thorough understanding of the topic	Accurate information is well researched and demonstrates a good understanding of the topic	Accurate information reflects some research and a general understanding of the topic	Information shows little research and understanding of the topic
Visual - Use of graphics, diagrams and images	Pictures and graphics used to cover all topics of the subject. Brief description of the images given. Visuals add and complement understanding of the information included and are portrayed neatly. Glue and tape are not obvious and borders used on the images.	Pictures and graphics used to cover each topic of the subject. Brief descriptions not used or given. Visuals add understanding to the topic. Information is portrayed neatly. No borders included and glue and tape are not obvious.	Pictures and graphics used to cover a few aspects of the poster. Descriptions not given. Visuals do not always add understanding. Neatly portrayed information. White on white. Glue and/or tape are visible.	Pictures and graphics used to cover a few aspects of the poster. Descriptions not given. Visuals do not always represent ideas in the poster or add understanding. Information is portrayed with little care.
Poster organisation	Information is neatly written or typed may be read from 4ft away. Headings Are used effectively. Poster tells a story. Observer could quickly find information if asked a factual question. Color/texture is used to visually organise the material.	Information is neatly written or typed may be read from 2ft away. Headings are used effectively. Poster tells a story. Observer could quickly find information if asked a factual question.	Information is neatly written or typed may be read from 2ft away. Headings are used, but not always correctly or appropriately. Observer could find information easier is more headings were given.	Information is sloppily written. Difficult to read. Material is not organized. Printed and pasted with little thought. Not enough information to really organise. Observer must read entire poster to find information.
Writing, spelling and grammar	Information is obviously not copied and pasted. Spelling and	Information is obviously not copied and pasted. A few	Unclear if information is copied and pasted. Mistakes occur	Information is obviously copied and pasted. Mistakes detract

	grammar are correct.	minor mistakes.	regularly.	from the understanding
Creativity	Poster is highly creative in its presentation and shows careful thought in design and organisation. Creativity relates to the research topic.	Poster is creative and shows some thought in design and organisation. Creativity rates to the research topic.	Poster is creative, but shows little thought in design and organisation. Creativity in the poster may not reflect the topic.	Poster shows little to no creative input and effort in either design or organisation. Creativity does not reflect the research topic.
Awareness	Poster is exceptionally effective at raising awareness, action and behaviour change amongst the readers.	Poster is highly effective at raising awareness, action and behaviour change amongst the readers.	Poster is reasonably effective at raising awareness amongst the readers. Although no action or behaviour change is encouraged.	Poster is not effective in raising awareness among the readers. No action or behavior change is encouraged.
Total Points	**/ 60 points**			