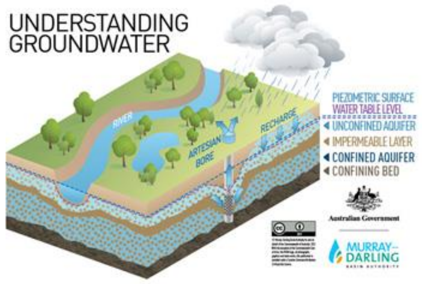
Station 7 – Groundwater

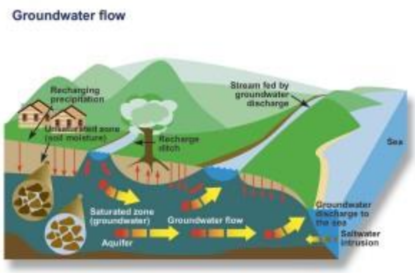
Students predict how far down they think the water table is at the Water Lab bore and use a depth gauge to measure and record the ground water height. They then enter their results into the Water Lab Groundwater Record Sheet and relate this to weekly rainfall data using the wireless weather station. Using a hand pump they collect a sample of the groundwater and compare chosen parameters (e.g. electrical conductivity, pH) to a rain water sample, observing and considering the differences.

Key concepts

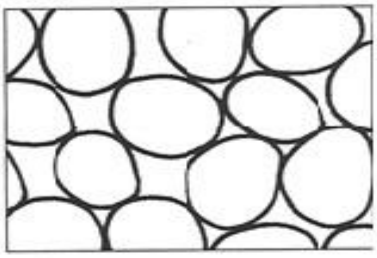


The fresh water in our world is found in three main places:

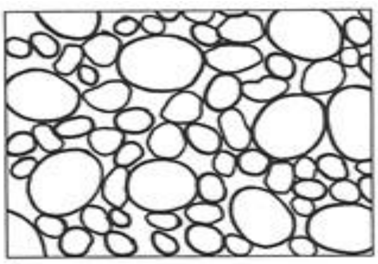
- Surface water: water collecting on the ground or in a creek, river, lake, wetland or artificial water body like a dam.
- Groundwater: water found underground in the cracks and spaces in soil, sand and rock.
- Atmospheric water: water present in the atmosphere either as a solid (snow, hail), liquid (rain) or gas (fog, mist).



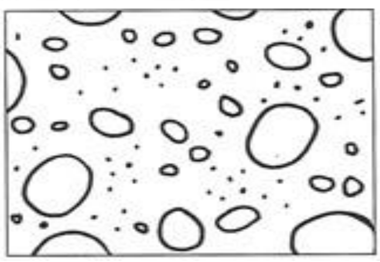
50 times more fresh water than all the earths' surface water storages combined is found underground as groundwater. The fact that groundwater is out of sight does not mean it should ever be out of mind. The main source of groundwater is rain. Some rain soaks into the ground and drains downwards to the water table. The water table is the level at which the unsaturated zone above, meets the saturated zone below. The water table is usually below the ground surface. However when it is high enough it comes to the surface naturally in springs, lakes and wetlands. (WA Water Corporation)



Groundwater flow is an important part of the water cycle. While underground springs may exist, the vast majority of groundwater occupies gaps and pores in the ground, and flows through the ground a little like water might flow through a sponge. In permeable rock, under the right circumstances, groundwater may flow quite far in short spaces of times. In other areas, groundwater may be stored for years in long-term aquifers before coming out again as groundwater discharge.



Rainwater trickles down through the soil over many thousands of years. People bore down to tap into these ancient supplies and can quickly pump out large quantities of water. As the water infiltrates through soil and rock it leaches minerals into the water. This may affect the colour, taste or salt levels and therefore influence its potential usage.



Whether water runs off depends on the nature of the ground surface. In urban areas there are more impermeable surfaces like roads and footpaths. In the rural areas far more water can infiltrate, depending on the vegetation and soil. Mostly groundwater is found in the space between soil particles and grains or in rock fractures and cracks rather than in underground lakes or rivers. These layers containing water are called aquifers and work like a sponge. (We all use water AWA). Sand, sandstone and limestone are often good aquifers.

Soil texture is determined by the relative proportion of sand, silt, clay and small rocks (pebbles) found in a given sample. Sand is gritty to the touch and the individual grains or particles can be seen with the naked eye. It is the largest of the three size classes of soil particles. Silt is smooth and slippery to the touch when wet and the individual particles are much smaller than those of sand. These individual particles can only be seen with the aid of a microscope. Clay is sticky and plastic-like to handle when wet. The individual particles are extremely small and can only be seen with the aid of an electron microscope. www.education.com

Soils are made of particles of different types and sizes. The space between particles is called pore space. Pore space determines the amount of water that a given volume of soil can hold. Porosity refers to how many pores or holes a soil has. The porosity of a soil is expressed as a percentage of the total volume of the soil material. Porosity is an important measurement in areas where drinking water is provided by groundwater reserves. www.education.com

If the grains of soil are about the same size, there is a high proportion of space between them. Therefore they can hold a considerable amount of water and it easily flows through e.g. beach sand and river pebbles. These are porous and permeable soils. When the grains are of different sizes there is less space in between and the soils are less porous and permeable e.g. some garden soils, sandy soils and limestone soils. When the grains have a wide range of sizes and are mainly small or microscopic, then the smaller ones can fill in between the larger ones and much less water can be held. They have low porosity and permeability e.g. alluvial soils and loam. (WA Water Corporation).

The ideal material for the accumulation of groundwater is one which is both porous and permeable. Soil permeability relates to the ease with which water moves through the soil. The amount of watering you should do on your garden varies greatly depending on soil type and climate. Gardens with native plants and mulch will require minimal watering. 40% of the water we use every day is used outside therefore more water can also be saved by knowing your soil type and its permeability. (WA Water Corporation)

There are significant sand beds along the coast of NSW which are highly permeable and easily recharged through rainfall. They are also very vulnerable to contamination e.g. fertilisers, pesticides, leaking septic, wastewater, urban runoff, tip sites and salt water intrusions. (NSW Groundwater Dependent Ecosystem Policy 2002)

Images

http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=300688DC-1 Groundwater flow:
Soil sizes: WA Water Corporation.

Water literacy list

Aquifers: Porous and permeable materials which contain usable quantities of groundwater.

Discharge: An area where water exits the groundwater system e.g. springs, rivers, wetlands or the oceans.

Groundwater: The water in the saturated zone. The level below which all the spaces are filled with water is called the water table. Above the water table lies the unsaturated zone. Here the spaces in the rock and soil contain both air and water. Water in this zone is called soil moisture. The entire region below the water table is called the saturated zone. http://www.ec.gc.ca/eau-water

Permeability: Relates to the ease with which a fluid is transmitted through a substance. WA Water Corporation

Porosity: Relates to the ability of a substance to store water in pore spaces. WA Water Corporation

Recharge: Water that reaches the water table (mainly rain). WA Water Corporation

Salinity: Salinity is the saltiness of a body of water. It refers to the concentration of dissolved salts in water or soil and is expressed in terms of concentration (mg/L) or electrical conductivity (EC). http://www.mdba.gov.au

Saturated soil: Most pore spaces in the soil are filled with water.

Unsaturated soil: Most pore spaces in the soil are filled with air.

Water table: The level at which the unsaturated zone (above) meets the saturated zoned below. WA Water Corporation

Teacher reference

We all use water - 3 Groundwater AWA – Link to pdf

Groundwater the hidden source of life: global groundwater issues
http://www.youtube.com/watch?v=Iht9WBBXepA

Groundwater without boundaries: sharing aquifers
http://www.youtube.com/watch?v=zJrj24shS_A

Water sources, including groundwater explained by Canadian Government.
http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=79BB602D-1

Link to our local water supply and sustainable water use

Our region's existing water sources can comfortably meet demand for water in the short to medium term. However, it is essential and responsible to plan for our region's longer term needs. To maintain a sustainable water supply for the region, Rous Water has developed the Future Water Strategy. The Strategy will guide long-term water planning and provide certainty about water needs and infrastructure development over the coming decades. Over the next 50 years, changes to climate and rainfall patterns are expected to reduce the reliability of rainfall for the region. At the same time, water use is forecast to increase as population grows. Based on these predictions, by around 2024, demand for water will match what current sources can reliably supply. Rous Water's Future Water Strategy has three key actions. Groundwater plays a significant role in this:

- Key action 1—Maximise water efficiency through demand management and conservation.
- Key action 2—Investigate increased use of groundwater as a new water source.
- Key action 3—Investigate the suitability of water re-use as an additional new water source.

For more information visit the Rous Water website, Future Water Strategy Section:
http://www.rouswater.nsw.gov.au/cp_themes/default/page.asp?p=DOC-BYN-38-23-04

Kids section

American video to explain groundwater.
http://www.youtube.com/watch?v=oNWAerr_xEE

Animated video of precipitation, evaporation and the flow of groundwater
http://www.youtube.com/watch?v=GK4aBFRJytQ

Science scenarios - Research and design an experiment that will show each statement to be correct:

- Water transpires from leaves, this helps the plants draw water and nutrients from the soil.
- When it rains pollution on the land will affect the water quality.
- Some water from the water cycle seeps into underground aquifers.
- Different soils have different abilities to hold water.

Experiments

Measure soil porosity

The space between particles is called pore space. It determines the amount of water that soil can hold. Porosity refers to how many pores, or holes, a soil has. Porosity is an important measurement in areas where drinking water is provided by groundwater reserves.

What you need:

- 3 metric measuring cups, 100 ml graduated cylinder, water, permanent marker
- Soil samples: sand, clay and small pebbles (can be obtained from various field locations such as a rock quarry, road cuts, etc.).

What you do:

1. Fill one measuring cup to 200 ml with sand, the second cup with 200 ml of clay and the third with 200 ml with small pebbles.
2. Fill a graduated cylinder to 100 ml with water.
3. Slowly and carefully pour the water into the first cup until the water just reaches the top of the sand.
4. Pour slowly so no water spills out of the measuring cup. Record exactly how much water was used.
5. Use the formula below to calculate the percent porosity for the sand:
6. Repeat the same procedure with the clay and the pebbles.
7. Record the results in a table similar to the one shown

Soil Type	Total sample volume	Amount of water added to sample	Porosity
Sand	200 ml		%
Clay	200 ml		%
Pebbles	200 ml		%

To calculate: Porosity = (Amount of water added to sample ÷ Total sample volume) x 100

PREDICT, OBSERVE & EXPLAIN

Source www.education.com

Measure soil permeability

What you need: 3 large funnels, aquarium filter wool, 3 types of soil, stop watch, cup and water.

What you do:

1. Stand each funnels in a measuring cup.
2. Put a wad of filter wool to block each funnel neck.
3. Measure an exact amount of each soil to put in each funnel.
4. Start your stop watch as you pour a measured amount of water onto the top of each soil and allow it to filter through.
5. Record the time it takes from the first drops to drop from the funnel and the time it takes to collect a given amount of water in the measuring cup.

PREDICT, OBSERVE & EXPLAIN

Source: WA Water Corporation – What is Groundwater.