Under the Microscope with Waterwise Schools

The activities in this booklet were developed by the Water Corporation in conjunction with the Science Teachers' Association of Western Australia, in support of an initiative of the Chief Scientist of Western Australia and the Rotary Club of Freshwater Bay. They were first used with three primary schools in the Rotary Club's locality: Mount Claremont, Claremont and North Cottesloe.

AN INITIATIVE OF THE ROTARY CLUB OF FRESHWATER BAY

STAWA SCIENCE TEACHERS' ASSOCIATION OF WESTERN AUSTRALIA

WATER CORPORATION | EDUCATION

Introduction

Under the Microscope with Waterwise Schools has been developed to foster primary school students' interest in the role of science and the use of microscopes, using water as a context. This project is an initiative of the Chief Scientist of Western Australia, Professor Lyn Beazley, and the Rotary Club of Freshwater Bay, with support from the Science Teachers' Association of Western Australia and the Water Corporation.

The Waterwise Schools Program

The Waterwise Schools Program aims to educate students, their families and wider communities about the need to value, protect and conserve our precious water sources.

The program takes a long-term, whole-of-school approach to water education and complements the *Curriculum Framework* across all major learning areas, especially Science and Society and Environment. Most importantly, it tackles real issues facing the community, such as preservation of wetlands, protection of catchment areas, stormwater management, water supply, water conservation, and wastewater management. And it emphasises the importance of water in keeping the body healthy.

The program provides an opportunity to change students' behaviour towards the use of water so that in the future they become advocates and spokespeople for the adoption of responsible water use habits. At the same time, they acquire knowledge of water issues and will be able to make informed decisions in the future. After all, the future of our water sources is in their hands.

Who Uses Microscopes?

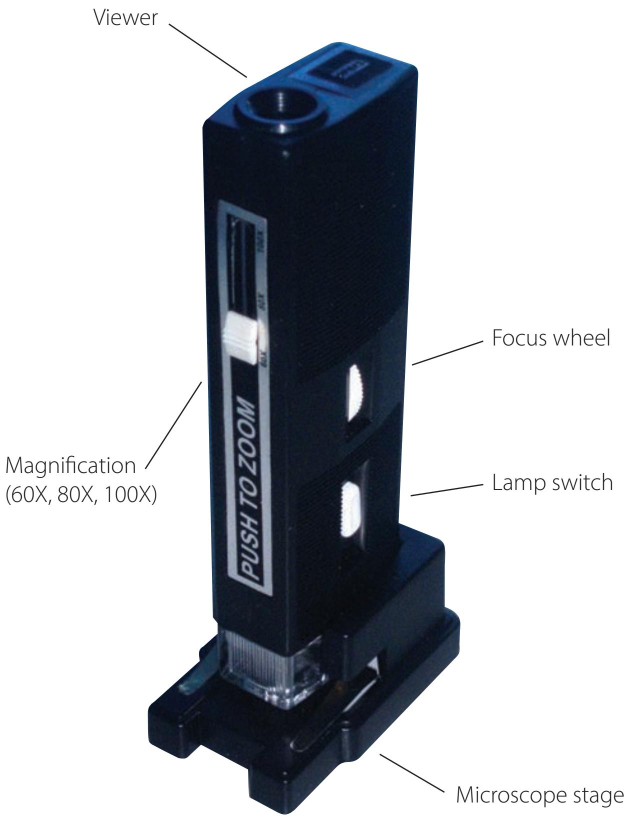
Microscopes are used in a variety of water-related fields by organisations such as the Water Corporation, the Department of Health, the Department of Agriculture and Food and the Botanic Gardens and Parks Authority.

Medical research scientists use many different types of microscopes for a variety of studies. A cell biologist may use a fluorescent tag to examine the location of a given protein in a cell, for example.

Lab technicians use microscopes to examine samples from patients or in experiments.

Field biologists use microscopes to assist in the study of an organism's structure or to help determine diversity in a given area. For example, a field biologist may record the number of different species found in samples of pond water taken over a period of time.

The Microscope



Activities to Get You Started

1 How to Make a Sticky Tape Slide

Materials

- clear sticky tape
- microscope

Procedure

- Tear a 6–7 cm long piece of sticky tape and place it, sticky side up, on a desk or table.
- Fold over about 5 cm of the tape on each end. This gives you finger holds on the sides of the slide. Keep your fingers away from the sticky part.
- Set the magnification on the microscope at 60X.
- Place the object that you want to examine in the centre of the sticky part of your slide.
- Adjust the magnification upwards as required and focus as necessary when looking at the object.
- Always label each slide you make with a pen or permanent marker so you know what is on them.

Note: Some students may have difficulty making these. Teachers may need to prepare the slides for students or assist those having difficulty.

2 Looking at Text on Paper: Slide Manipulation and Field of View

Materials

- clear sticky tape
- a page of newspaper
- scissors
- microscope
- microscope data sheet (see back page)

Procedure

- Prepare a sticky tape slide.
- Find the word 'water' in a newspaper story and cut it out.
- Place the word on the sticky tape slide.
- Put the slide on the microscope stage so that you can read the word from above the microscope before you look at it through the microscope.
- Set the magnification of the microscope to 60X and look for the letter 'e'. Draw what you see on the microscope data sheet. How is it different from what you saw before looking through the microscope?
- Move the slide to the left across your microscope stage. Which way does the letter 'e' move?
- What happens when you move the slide away from yourself?
- Observe the letter 'e' with the higher magnification lens—first 80X and then 100X.
- Draw what you see on the microscope data sheet. You should now see more of the fine texture of the paper.
- As you increase the magnification, you can see less and less of the letter 'e' because the field of view gets smaller. This explains why you must carefully centre small specimens within your field of view, before changing lenses. Complete the following statement:

  The higher the magnification, the ___________________________ (smaller/larger) the field of view.

Extension

Using your microscope, investigate the size of the field of view at each magnification. (Hint: Use the diameter of the circle containing the image you see when looking down the microscope as a measure of the field of view.)

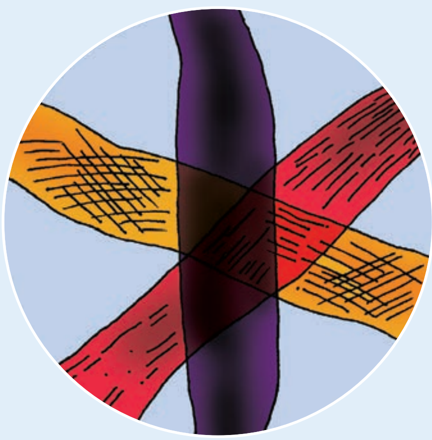
3 Looking at Coloured Threads: Depth of Field

Materials

- clear sticky tape
- scissors
- three different coloured cotton or woollen threads
- microscope

Procedure

- Prepare a sticky tape slide.
- Cut 1 cm lengths of each of the three different coloured threads.
- Overlap the three threads on your sticky tape slide, as shown in the picture. Record the order in which you overlap the colours.
- Place the slide of the overlapping coloured threads on the microscope stage so that you can look at them through the microscope. Set the magnification of the microscope to 60X.
- Work out the relative position of all three coloured threads by raising and lowering the viewer slowly. This is known as 'focusing up and down'. Observe the order in which the threads go in and out of focus. As your viewer approaches the slide, the first thread to come into focus is on the top.
- Swap slides with another student. Try to work out the order in which they overlapped the colours. Check with them to find out if you were correct.
- Describe the depth of field.



Soils and Water Storage

Soil type affects how well plants grow, and how effectively we can water them. Soil is a mixture of mineral particles, water, air, living organisms and decomposed organic matter. The size of the mineral particles determines the spaces available for the other elements and, hence, the fertility, water-holding capacity and drainage capability of the soil.

Porosity relates to the ability of a soil to hold water in the spaces between individual particles or grains. Permeability relates to the ease with which a fluid is transmitted through the soil.

What Type of Soil Will Store the Most Water?

Materials

- clear sticky tape
- a sheet of white paper
- a cup each of different sand types (yellow sand, garden soil, beach sand, clay, river sand)
- microscope
- microscope data sheet (see back page)
- metric ruler

Procedure

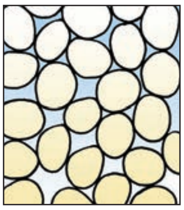
- Set the microscope to magnification 60X and hold it over a cup of one of the sand types. Estimate the amount, as a percentage, of air space between the grains as seen through the microscope.
- Prepare a sticky tape slide.
- Sprinkle a few granules of the sand in the middle of the sticky part of the slide. Label the slide.
- Place the slide on the microscope stage and view the composition of the sand using the microscope on magnification 60X (see below things to look for).
- Describe and draw what you see on a microscope data sheet.
- Repeat these steps with the other sand types.

Things to Look For

- Size of the grains: put a metric ruler under your microscope to get an idea of their size.
- Shape of the material: is it smooth or rough?
- Type of material and colours that make up the sand: is it made from minerals like quartz, feldspar or mica or from tiny bits of broken shells or plant material?
- How is the beach sand or river sand (which has been pushed around by moving water) different from your garden sand?
- Which soil sample has the most amount of space between grains?
- Which soil sample could store the most water? Explain your choice. Devise an investigation to test your hypothesis.

Extension

- Which type of soil would allow rainfall to soak in most easily?
- Which soil type would have the greatest runoff during heavy rain?
- Why do people in Perth's coastal suburbs use a lot of water on their gardens during summer?
- What types of plants should be grown in these areas?
- Which soil type would allow water to be drawn from it easily?
- What effects do soil-wetting agents have?
- The coastal soils near Perth are formed over limestone, while the soils in the Darling Range are formed over granite. Which of these rock types allows water to move through more easily? Explain your answer.



Well sorted soil grains (uniform soil): The grains that make up the soil, sediment or sedimentary rock are said to be well sorted if most are about the same size. The grains may be large, medium, small or very small. Because they are well sorted, there is a high proportion of space between the grains. This type of material is able to hold a considerable volume of water, which flows through the soil easily. Soils of this type are porous and permeable. Examples: beach sand, river pebbles, marbles in jars.

Medium sorted soil grains: The grains that make up the soil are said to be medium sorted if they are of different sizes, but with a small range of size, and a majority of grains are the same size. There is a fairly high proportion of space between the grains, and large volumes of water can be held in the soil. Soils of this type are less porous and less permeable than well sorted soils. Examples: some garden soils, sandy soils, limestone soils.

Poorly sorted soil grains: The grains that make up the soil are said to be poorly sorted if the range of sizes is wide, and no one size is in a majority. Many of the grains are microscopic and are able to fill the spaces between the larger grains. The proportion of soil space is low, and little soil water can be held. Soils of this type have low porosity and low permeability. Examples: alluvial soils, loam.

Water Corporation Topic Booklet Links

- Wetlands in Our Community (Middle Childhood)
- Waterwise Outside the Home (Middle Childhood)
- Waterwise Gardens at School (Early Adolescence)

Garden Plants and Water Supply

In Perth and the South West region of Western Australia, reduced rainfall in recent years means that we need to conserve water. One way of doing this is to plant Waterwise plants in our gardens. Waterwise plants are adapted to our climate and need less water than delicate species found in northern European style gardens. For example, eucalypts have toughened leaves and can turn their leaves to reduce the surface area facing the sun, while succulent plants like cacti can store water.

How Do Plants Obtain Water from the Soil?

Some of our water is obtained from underground supplies, and we have bores to pump it to the surface. Roots are a plant's water bore. The root system brings water from the ground to the surface parts of the plant. In this activity, you will use your microscope to take a closer look at the roots of a plant and how they work.

Materials

- weed plant samples (roots intact) from home or from the school grounds (remove with a spade as this will keep the root cap intact)
- microscope
- plastic gloves
- cup of water

Procedure

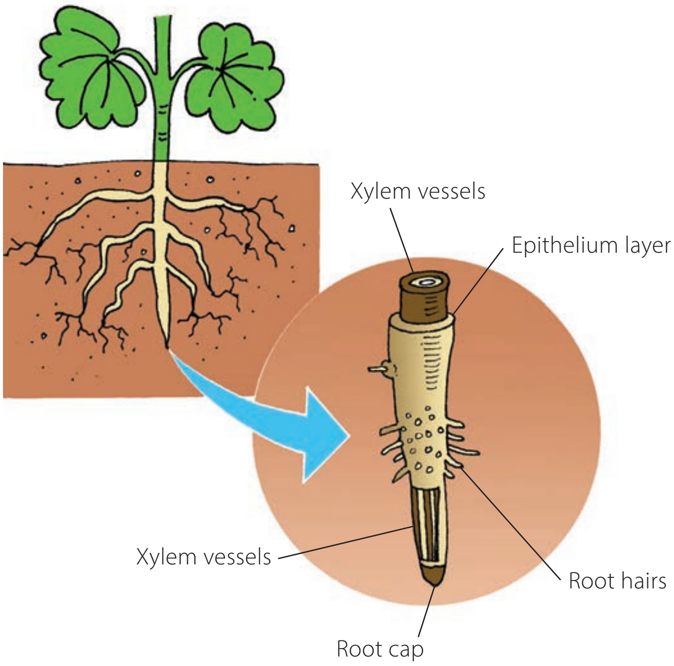
- Carefully and gently wash the sand off the roots of your weed plant samples.
- Draw up a table similar to that shown to record your observations.

Draw a diagram of the plant and root system	
Write a description of the root system	

- Examine a single root under the microscope. Look closely at the tip of the root. You should be able to see hair-like structures called root hairs. The plant takes up most of the water and minerals that it needs through these root hairs. Describe what you see and record your observations in the table.

Draw a diagram of the root system as seen under the microscope	
Write a description of the root system as seen under the microscope	

The root system



Note: Xylem vessels are hollow tube-like cells responsible for transporting water from the roots. They may be seen as light cylindrical structures in the centre of the root.

Extension

- Draw a diagram of the tip of a root. Label the root hairs, the growing cells and the root cap.
- Research the importance of the root hairs and the root cap.
- Research root adaptations to a dry climate. Did your plant sample display any adaptations in its root structure (e.g. a deep tap root or a wide spreading root structure)? Relate this to how a plant obtains water from the soil (e.g. clover).

Water Corporation Topic Booklet Links

- Waterwise Outside the Home (Middle Childhood)
- Waterwise Gardens at School (Early Adolescence)

Safety notes:

- Please check with a parent/guardian before taking cuttings, as some plants like oleander and lantana are dangerous, and some people may be affected by pollen or have allergies to plants like grevillea.
- As a precaution, wear gloves when collecting plant samples and wash hands afterwards.

Plants and Water Transport

Water pipes bring water from dams and underground supplies to our homes and schools. Stems are a plant's water pipeline. Inside the stems are lots of thin tubes (vessels), some of which carry water and minerals up from the roots while others transport sugars from the leaves to all parts of the plant. In this activity, you will use your microscope to look at the water transport system in stems of a plant.

How Does Water Move from the Plant Roots to their Leaves?

Materials

- a head of celery (stem with leaves)
- a thin slice of celery (called a cross-section)
- 2 jars or plastic water cups
- water
- 2 different food colours
- microscope

Procedure

- View the cross-section of celery under the microscope. Draw and describe what you see.

  Note: Students should be able to see vascular bundles (visible with the naked eye) as clusters of cells near the outer edge of the stem.

- Half fill your two containers with water. Add one food colour to one container and the other food colour to the second container.
- Split the celery stem halfway up to the leaves. Place one half of the stem in one water container and the other half in the second, as shown in the diagram.
- Label the containers with your name and put them in a safe place.
- Predict how you think water travels up the celery stem and what you expect to see after the coloured dye has had time to move up the stem to the leaves.

  Note: The vascular bundles should be clearly visible as the areas where most of the dye has been absorbed.

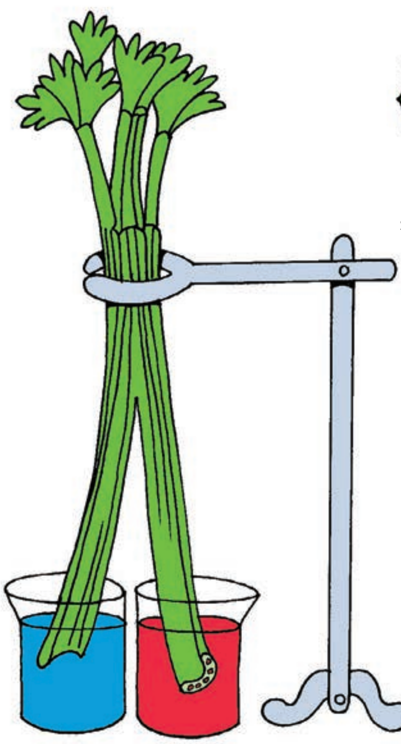
- Observe after an hour or two or the next day. The coloured water should have moved up the celery stems to the leaves. Draw and describe what you see.
- Explain your observations.
- Ask your teacher to cut a thin slice of celery from each of the different coloured stems.
- Observe each slice under the microscope. Draw and describe what you see.
- Explain why only some parts of the stem have changed colour. What do you think these parts are?

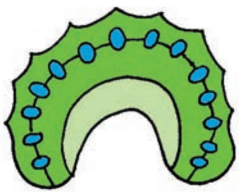
Extension

- Stems have special vessels that transport water and minerals from the roots to other parts of the plant. Find out the name of these vessels.
- These vessels also help to support the plant. How are they able to do this?
- Plants also have vessels that carry glucose (sugar), made during photosynthesis, to every part of the plant. What are these vessels called?
- What is photosynthesis?
- Why do plants need glucose?
- Draw and label a diagram showing how water moves from the roots to the leaves of a plant. Next to your plant, draw a diagram showing how our water is supplied from a bore to our kitchen tap at home. Discuss the similarities and differences.

Water Corporation Topic Booklet Links

- Waterwise Outside the Home (Middle Childhood)
- Waterwise Gardens at School (Early Adolescence)





Cross-section of the celery stem showing the blue dye in the xylem vessels

Plants and Water Loss

A plant loses water vapour through its leaves in a process called transpiration. Water escapes through tiny holes found on the underside of leaves called stomata (singular: stoma), which also allow carbon dioxide and oxygen in and out. The diagram shows what stomata look like under a very high-powered microscope. Waterwise plants are adapted to our arid climate. In this activity, you will use your microscope to look at leaves to observe the different types of adaptations and, where possible, to find the leaves' stomata.

How Do Leaves Allow Water to Escape during Transpiration?

Materials

- fresh leaf samples of plants from home or from the school grounds (pick leaves mid-morning after exposure to sunlight, which opens their stomata, making them easier to see; geranium leaves should give a good result for this part of the activity)
- scissors
- microscope
- plastic gloves

Procedure

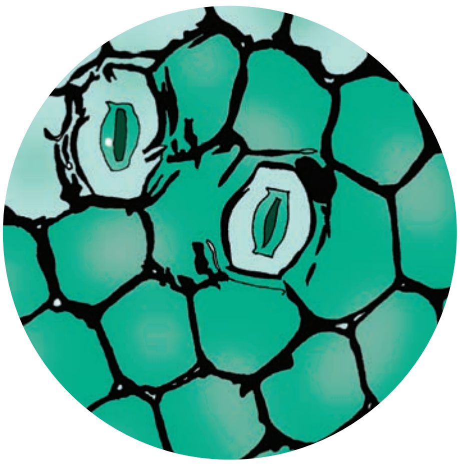
- In groups, discuss the characteristics of the leaves. Draw up a table to sort the leaves according to some of the common adaptations that help the plant save water. It may help to ask the following questions:
  - Does it feel furry or hairy like a lavender or geranium leaf?
  - Is it a small leaf like the Geraldton wax?
  - Does it have a toughened leaf surface like the eucalypt?
  - Does it store water like the cactus leaf?
- Examine each leaf under the microscope and add any extra details to your table.

Plant name	
Diagram of the leaf	
Leaf characteristics	
Type of water-saving adaptation	
Diagram of leaf under the microscope	

- Using your microscope on maximum magnification 100X, look at the underside of a geranium leaf. Can you find some stomata? Move the leaf sample so that you can see the edge of the leaf. Are there noticeable differences in the leaf edge? Try to explain why certain leaves display these adaptations (e.g. serrated edge versus smooth leaf hairs).

- Draw and describe what you see. Try some of the other leaves.

Notes: 1. Students should see pin-pricks of light on a darker background and each dot of light is a stomate. 2. To see hairs on the leaf sample under the microscope, view the edge of the leaf.



Stomata under the microscope at 1000X

Extension

- Will transpiration in a plant be greatest on a warm, sunny day, a cold, damp day or at night?
- Explain why only some of the water that rises up a plant from the roots escapes through the leaves.
- Why is transpiration important to plants?
- Describe a method of collecting clean drinking water that uses transpiration in plants. Draw and label a diagram to explain your method.

Water Corporation Topic Booklet Links

- The Water Cycle (Early Childhood)
- Waterwise Outside the Home (Middle Childhood)
- Waterwise Gardens at School (Early Adolescence)

Microscope Data Sheet

Activity: ____________________

Date of slide: ____________________ Name of sample: ____________________

Observations and sketches for 60X magnification

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60X magnification

Observations and sketches for 80X magnification

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80X magnification

Observations and sketches for 100X magnification

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100X magnification

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ISBN 174043613