

# Role of forests in environmental protection



Science

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Practical Lesson



Activity information

<b>Level:</b>	Junior secondary school Years 7 – 10
<b>Duration:</b>	Approximately 4 lessons: • preparation • collect samples • lab work • write up
<b>Preparation:</b>	<ul style="list-style-type: none"><li>• Making air quality test strip tool</li><li>• organising equipment for water sampling</li><li>• collect notes for field trip • appropriate clothing &amp; hat • first aid kit • phone</li></ul>
<b>Summary:</b>	Students will examine the various roles forests play in protecting the environment. They will understand, measure, and calculate water and air quality parameters used as indicators of environmental health, and interpret their findings.



## Background information

- Despite Australia being such a vast country, 89% of our 22.7 million population lives in urban areas, being cities, towns or villages (ABS Sept 2012). In fact, Australia is one of the most urbanised countries in the world. However these urban areas rely heavily upon natural resources and their products from rural areas such as water, food and fibre, with human well-being directly influenced by the health of the environment from which they are sourced. Forests play an important role in protecting these natural resources. Various parameters are commonly measured as indicators of environmental health at the ecosystem or catchment level. These include water quality, air quality, biodiversity (species and abundance) and soil fertility, some of which we will explore below.

## Water quality

- Forests help preserve water quality around waterways and reservoirs (storages). They stabilise soils and filter suspended sediments and contaminants including pesticides and fertilizers before they reach water supplies. Water quality is important for the health of water users including humans, livestock and aquatic animals, plants and microorganisms. For humans, the better quality of water that reaches storages, the less treatment required prior to consumption. This is then less cost to state and local government councils who are responsible for providing quality drinking water to citizens.

Forests absorb rain and slow storm runoff, thereby refilling underground aquifers and reducing flooding. When it rains they trap sediment and debris from runoff like a giant filter and remove nutrients before they can enter reservoirs. Forests also improve water quality by limiting erosion and reduce water loss from evaporation.

### Who sets guidelines for water quality testing?

The Australian New Zealand Environment Conservation Council (ANZECC) set guidelines for fresh and marine water quality. Thresholds for human consumption are contained in the Australian Drinking Water Guidelines 2011

[www.nhmrc.gov.au/guidelines/publications/eh52](http://www.nhmrc.gov.au/guidelines/publications/eh52)

### Water testing kits

School Streamwatch kits can be used, otherwise obtain kits from Vendart

[www.vendart.com/lamotte-individual-testkits.php](http://www.vendart.com/lamotte-individual-testkits.php)

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## Interpreting water quality data

Water quality	Interpretation	Possible source
Dissolved oxygen levels below 5mg/L	Oxygen levels below level required to maintain ecological health of waterway	Organic matter Leaves Sewage
Phosphorus level above 0.05 mg/L	Nutrient levels above ANZECC guidelines for protection of ecological health of freshwater ecosystems – danger of algae bloom	Fertilizer Detergents Sewage
Turbidity levels above 10 NTU	Excess sediment is washing into waterway	Construction sites Erosion of soil from cleared land
Biochemical oxygen demand above 2 mg/L	Excess organics matter in waterway	Excess leaves and other organic matter Sewage Excess growth of water plants and algae
Faecal coliform levels above 600 colonies/100 mL	Water is unsafe for swimming	Sewage Animal droppings Dairy and feedlot contamination
Water smells of oil and grease; oily 'rainbow' slick on the water surface	Water is being contaminated by oils and greases	Oil dripping from cars onto roads and driveways Oil and grease being tipped into stormwater drain Illegal dumping
pH outside range 6.5 – 8.5 units	Water is being contaminated with acid pollutants if lower than 6.5	Acid sulphate soils Pollution from industry
Salinity above 830 $\mu\text{S}/\text{cm}$	Water is unsafe for drinking and watering plants	Loss of forest cover Urban stormwater Mine tailings runoff Salt water contamination
Rubbish and litter	Rubbish on streets being washed into stormwater system	Uncovered rubbish bins Littering

(Table adapted from NSW Government Department of Environment and Heritage – Water quality testing, and Greening Australia – Performing basic water quality tests)



Forested catchment, Brunkerville District Hunter Valley NSW



## Activity 1

1. Collect water samples in groups from the two sites you wish to test; such as a water storage in a forested catchment; urban stormwater runoff; drinking reservoirs; agricultural runoff; or industrial waste water. Try to collect water that has not been disturbed when sampling.
2. Take samples back to your classroom and analyse as soon as possible. Store samples in the fridge overnight if necessary. Record results in data table that follows.

### **SAFETY**

*Waterways present hazards such as pathogens that can cause human disease, and slippery banks make it possible to accidentally fall in. You must be accompanied by a responsible adult when collecting the samples and take safety precautions such as wearing safety gloves, hat and gumboots.*



## Air pollution

Forests are also important biological filters of atmospheric air pollutants including the greenhouse gas carbon dioxide. Carbon dioxide is taken in through spaces between plant cells called stomata whereby it is fixed through chemical and enzymatic photosynthesis reactions into sugars and stored in the tree. While ever the tree is alive, carbon dioxide is being taken in and oxygen, a product of photosynthesis, is being released.

Trees work as biofilters for environmental and air pollutants such as organic nitrates, nitrogen dioxide, carbon monoxide and sulphur dioxide by turning them into amino acids that are stored in the tree. Benzene is another major air pollutant in Australia produced mainly through the extraction of crude oil and gas, which can also be taken out of the environment through absorption by trees.

### Who set standards for air quality?

The Ambient Air Quality National Environment Protection Measure (AAQ NEPM) set standard thresholds. A measure of the amount and size of particulate matter is just one ambient air quality indicator (outside air). Other indicators include carbon monoxide levels, nitrogen dioxide, sulphur dioxide, lead and ozone.

## Particulate Matter

Particulate matter is commonly produced by diesel vehicle emissions. The particulate matter is small and can create breathing problems, particularly asthma and bronchitis.

Particulates are classified according to size in microns (one micron is one millionth of a metre); particulate matter (PM) 10 is 10 microns or smaller; PM 2.5 is 2.5 microns or smaller. The threshold set for human ambient air quality is  $50 \mu\text{g}/\text{m}^3$  of PM 10 for 5 days/year – higher levels and incidence indicate unsafe air.

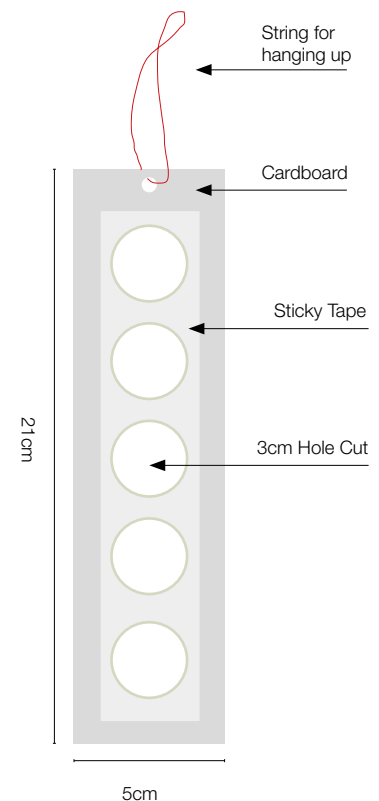
Trees remove particulate matter from the air when the particles land on the leaves and are either absorbed into the tree along with the air or are washed into the soil when it rains. By providing an enormous surface area on which to capture the particles, forests act like giant filters to clean the air.



## Activity 2

The following test will allow students to gather particulate matter samples however only PM 10 particles will be visible to the eye using standard microscopes.

1. In groups, students can make a basic air quality test strip tool using cardboard, sticky tape and string. Take a strip of cardboard, approximate size 5cm x 21cm, and cut five 3cm holes in it. Cover the holes with sticky tape with the sticky side exposed on one side (see diagram at right).
2. Place air quality test strips at two selected sites for comparison (e.g. forest vs car park). These tools can be placed or hung in these locations overnight, then examined the following day using a microscope. Draw enlarged field of view diagrams and label with number and size of particulates found. Interpret findings.



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## Data sheet

SITE INFORMATION	Site 1	Site 2
Date		
Collector/s		
Location		
Current land use surrounding		
GPS locator		
Environment problems; such as weeds, erosion, fire damage, feral animals, siltation, algae bloom		
Type of water body; river, reservoir, dam, stream, wetland, waterhole		
Water bugs present; dragonflies, mayflies, beetles, snails, leech, flatworms, flies, mussels, prawns, larvae, shrimps, mites		
<b>WATER QUALITY ANALYSIS</b>		
pH (units 0 -14)		
Turbidity (NTU)		
Salinity (µS/cm)		
Dissolved oxygen (mg/L)		
Biochemical oxygen demand (mg/L)		
Phosphorus (mg/L)		
Faecal coliform (colonies/100mL)		
Surface conditions e.g. oil slick, scum, foam		
<b>AIR QUALITY</b>		
Particulates (average no./strip & size microns)		
Odours		





## Questions

1. What is your assessment of the water quality of the two sites tested?  
(Excellent / Good / Average / Poor / Very poor)

Site 1

Site 2

2. What do you think is making the water healthy or unhealthy (i.e. sources of contaminants?)

Site 1

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Site 2

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3. How do you assess the air quality at the two sample locations?  
(Excellent / Good / Average / Poor / Very poor)

Site 1

Site 2

4. In groups discuss and then write down what surrounding land management practices or human activities could be changed to improve the quality of water and/or air in the two site locations.

Site 1

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Site 2

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5. How do trees act as biofilters to remove environmental pollutants?

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Biofiltration

