North Central Waterwatch

river detectives

part 2 - water science

Water Quality Monitoring

Teacher's Notes

AusVELS Domain and (Level): Science (F-6), Humanities (F-6), Civics and Citizenship (F-6)
Equipment: Water Science Kit, water quality data results sheet, login and password for Waterwatch Data Management System
Duration: Two hours

What you will be doing with your class

Gathering information about our rivers and creeks contributes to a bigger picture of our waterway health and to the community's broad understanding of our natural environment.

By participating in the ***River Detectives*** program, your class is helping to keep our local rivers, streams and creeks healthy. ***River Detectives*** are actually scientists who conduct chemical and physical tests to help determine the health of the local creek or river. To do this, your class will use the equipment supplied in your Water Quality Monitoring Kit.

- every month your class will collect important information on the water quality of a chosen local waterway
- results are added to the Victorian Waterwatch Data Management System (WDMS) which can be accessed online
- a comparison of the monthly results will provide you and your class with a picture of water quality and how it changes in your local waterway
- your class will not only conduct real science experiments but also contribute meaningful data which helps assist in decision making about managing your local waterway

What you are testing for

Your class will be testing a range of parameters including Electrical Conductivity, Turbidity, pH, Reactive Phosphorus, Water and Air temperature. The equipment needed to complete these tests is supplied in your Water Quality Monitoring Kit.

Each month your class will complete these tests and fill in a **Water Quality Results** sheet within your ***River Detectives*** manual. These results are then entered into the online database, which is found at https://vicdata.waterwatch.org.au

River Health Fish

'Water quality fish' are shown as representative indicators in the rating charts for each parameter in the student manual which help students rate the health of the water for the particular parameter (test) they are completing. Encourage students to use the information contained in the parameter descriptions (Electrical Conductivity, Turbidity, pH, Reactive Phosphorus and Temperature) to make an assessment of the health of the water using the *Excellent, Good, Okay* and *Not so good* 'water quality fish'. They can choose to either write the descriptive word in their results sheet or draw the fish that matches.

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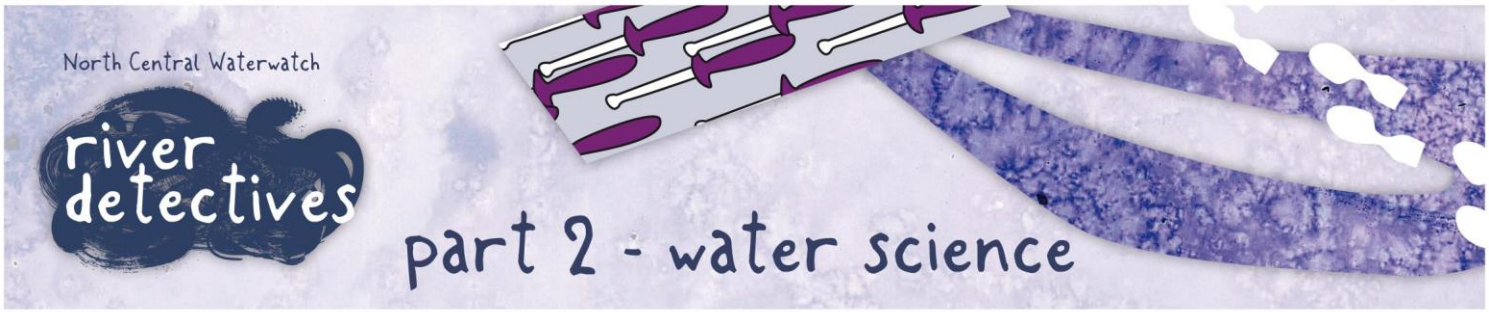

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To assess student learning and to provide Waterwatch with baseline data, it would be valuable for you to brainstorm with your students before beginning a Waterwatch unit to identify and clarify what they already know about water in their region and what else they would like to know.

Some of the questions you could ask before doing some of the units include (record the answers):

What do you know about water quality and river health? Why do we need healthy rivers?
Do you know of any tests we can do to determine the health of the water? What equipment would we need?
What do you know about the animals that live in rivers and creeks? Why are they important?
What do you know about salinity? How can it impact on rivers, catchments, plants, animals and people?
What do you know about the Aboriginal connections to and their use of rivers in our region?
What do you know about the life cycles of frogs? How can we help animals that depend on our rivers?

To help determine what students are interested in learning about, explore what they want to know about the topic. This information is invaluable to the Waterwatch program as it helps develop and refine the program and its activities into the future.

At the end of the unit – rephrase the original questions asking students what they have learnt about the topics. This is useful in determining whether the sequence of learning was effective, and the extent to which it engaged the students.

If you are able to, take photos or electronically record this data and send it to Waterwatch during the year to further assist the North Central CMA to continually improve the usefulness and relevance of the *River Detectives* program into the future.

What do I know about…?	What do I want to know about…?	What did I learn about…?

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Electrical Conductivity

What is Electrical Conductivity?

Electrical Conductivity is a measure of salinity; the concentration of salt in the water and soil across the landscape.

How do we measure EC?

Salt conducts electricity and is measured using an Electrical Conductivity (EC) meter which measures electricity between two electrodes. Many different units can be used to report salinity; however micro-Siemens per centimetre (µS/cm) is most widely used and accepted.

What causes high EC?

Salt in our local environment comes mainly from the natural process of weathering rocks and as a result of inland seas that retreated 10 million years ago, leaving sediments containing large quantities of salt.

When it rains, some rain runs off into water bodies, such as creeks and rivers, some rain is used by plants where it falls and the surplus soaks through to watertable. Groundwater is water that is found deep below the earth's surface. The 'watertable' is used to describe the upper surface of the groundwater. Deep-rooted vegetation, such as trees, maintain the watertable at a stable level by absorbing and using water, which has often fallen as rain, through to their roots. When deep-rooted vegetation is removed and replaced with shallow-rooted pastures and annual crops, water seeps through the soil and into the groundwater. When this land is irrigated (the application of water to pasture) more water is added to the groundwater. If this happens over a long period of time the watertable can rise and bring the natural salts in the soil profile with it.

In badly affected areas the watertable can rise to within a metre of the land's surface and the water can be evaporated by the sun and leave salt behind as a crust. Salinity occurs both naturally and a result of land management practices and is found in both irrigation and dryland (non-irrigated) areas across Victoria.

What impact does it have?

The acceptable level of salinity in freshwater, for the health of aquatic plants and animals, is <500 µS/cm (rated as 'good'). Anything lower is classed as 'excellent' and any higher falls to the category of okay or 'not so good'. Salinity can severely limit the growth of vegetation, reduce the capacity and productivity of the land, degrade natural resources, contribute to habitat loss and decrease in species diversity of flora and fauna. Salinity decreases water quality affecting river health and contributes to erosion. Urban areas can also be impacted by salinity where it can affect infrastructure such as houses and roads. Salinity problems are increasing in severity across our region.

Is there a solution?

Commonly accepted techniques employed to reduce the impact of salinity include; planting deep-rooted native trees in high recharge areas (areas where water is entering the groundwater) to lower the watertable and discharge areas (where water is returning to the surface), improved land management practices e.g. whole farm planning; and monitoring of groundwater and surface water to determine changes in salinity levels.

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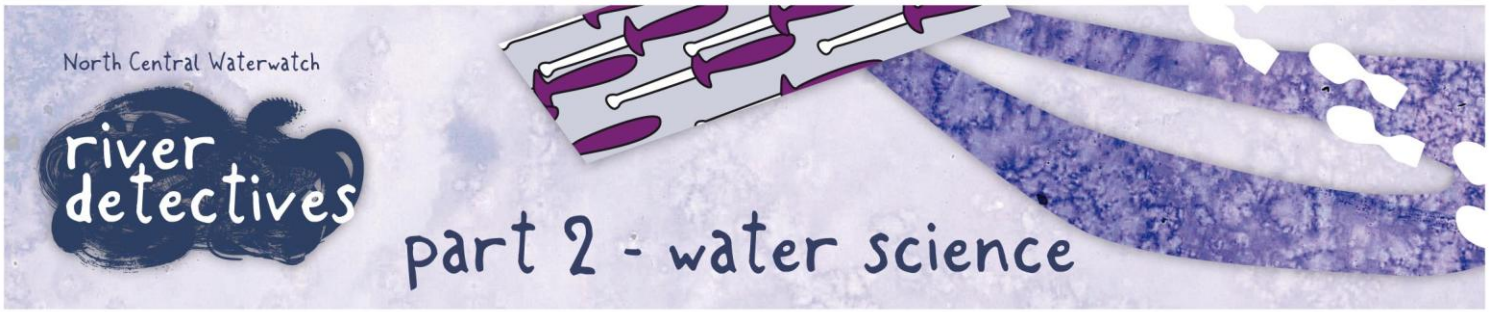

Turbidity

What is Turbidity?

Turbidity is a measure of water clarity. Highly turbid water appears cloudy or murky because of a large amount of suspended particles. Suspended particles can include organic and inorganic materials such as algae, soil particles and contaminants such as oils and fertilisers.

How do we measure Turbidity?

Turbidity levels are commonly measured with a turbidity tube or meter, whereby the depth of water that can be viewed through clearly determines the score. The standard unit of measurement is the Nephelometric Turbidity Unit (NTU). Highly saline water usually has low turbidity due to its high ionic strength, which forces soil and other particles to settle out of the water.

What causes high Turbidity?

Many events can lead to an increase of suspended material in a waterway including: erosion, storm events, or an increase in the number of bottom feeding animals or fish, such as carp. Urban stormwater can be laden with nutrients which can run off after rain. This can lead to increased turbidity level and also increases algal growth. Bank erosion contributes soil particles to waterways and is often a direct result of stock having unrestricted access into waterways, especially when combined with the removal of protective streamside vegetation. This erosion can also increase turbidity.

What impact does it have?

The acceptable level of turbidity in freshwater, for the health of aquatic plants and animals, is <20 NTU (rated as 'good'). Anything lower is classed as 'excellent' and any higher falls to the category of okay or 'not so good'. High turbidity levels limit the amount of light able to penetrate the water surface. This affects plant growth by reducing their ability to photosynthesise and grow. Reduced plant growth leads to reduced amounts of oxygen in the water and the loss of vital habitat and water quality for aquatic animals. Fine particles settling out from the water column may also reduce habitat availability by smothering plants, rocks and logs. Fish can suffer from clogged gills, and eggs and larvae can also be smothered by fine particles.

Is there a solution?

Soil erosion is a major contributor to sediment loads in our waterways. Limiting stock access to waterways by fencing streams is an effective way to reduce erosion. Revegetation of indigenous trees, shrubs and grasses to hold banks together and decrease erosion is another solution. Grasses and groundcovers act as a physical filter, trapping sediments as water drains through, while larger shrub and tree roots stabilise banks and protect against erosion. Managing urban stormwater inputs is also an effective way to reduce turbidity levels.

pH

What is pH?

pH measures the acidity or alkalinity of water and is measured on a scale that ranges from 0 to 14, with 7 being neutral.

How do we measure pH?

A pH meter or pH strips can be used to measure this parameter. There are no units for pH; it is simply stated as a number, e.g. 8. A value of less than 7 is becoming more acidic and contains more H+ ions than OH- ions, while a value of greater than 7 is becoming more alkaline and contains more OH- ions than H+ ions. An increase or decrease in pH of one unit equals a tenfold increase or decrease in concentration e.g. an increase from 8 to 9 is 10 times more alkaline, while an increase from 8 to 10 is 100 times more alkaline and so on.

What causes pH to change?

pH can change in response to a range of factors. Some of these factors include increases in carbon dioxide levels as a result of respiration of plants, or decreases due to photosynthetic consumption of carbon dioxide; chemicals introduced through stormwater; pollutants such as fertilisers, exhaust fumes, and sewage; increases or decreases in salinity; soil type and disturbance.

What impact does it have?

The acceptable pH level in freshwater, for the health of aquatic plants and animals, is 6.5 to 8.5 (rated as 'good'). Marine systems are slightly more alkaline than this. A large increase or decrease in pH, outside of the normal range of a stream, can have a dramatic affect on the abundance or diversity of species found within a waterway. Some animals are very sensitive to changes and will migrate out of the system, while others are quite tolerant. The affects on aquatic life of altered pH levels include interruptions to breeding cycles; altered development; decreased health or death. One way this can occur is through acidic water conditions burning the skin of aquatic creatures.

Is there a solution?

There is a limited amount that we can do to manage the pH of a waterway. What we can do is reduce the primary source of pollution. Effective stormwater and sewage management, reduced soil disturbance and improved farming techniques are effective methods to maintain a stable and healthy pH.

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Reactive Phosphorus

What is Phosphorus?

Phosphorus is a nutrient that occurs naturally at low concentrations in the environment and is essential for life. It is derived from the weathering of rocks and through the decomposition of organic material, such as decaying plant and animal matter.

How do we measure Phosphorus?

There are different forms of phosphorus found in water and these determine the method of measurement. In ***River Detectives*** we test for 'reactive phosphorus', which is phosphorus that is readily available and biologically active. Reactive phosphorus is measured using a colour comparator test kit, or a colorimeter. The unit of measurement is milligrams per litre (mg/L).

What causes high Phosphorus levels?

Elevated phosphorus levels may result from erosion and the subsequent introduction of sediment containing phosphorus; accidental sewage discharge; detergents; input from urban stormwater drains; animal waste; industrial waste; and rural runoff containing fertilisers, animal or plant matter.

What impact does it have?

The acceptable level of reactive phosphorus in freshwater, for the health of aquatic plants and animals, is 0.008 – 0.03 mg/L (rated as 'good').

When phosphorus is in large supply it can lead to excessive plant growth or algal blooms. These can then choke waterways and dramatically lower oxygen levels, which impacts on the survival of fauna and flora. Certain species of blue-green algae produce extremely toxic chemicals that are harmful to humans and livestock.

Is there a solution?

A reduction in phosphorus can be achieved by determining and reducing the primary source of phosphorus. Effective stormwater and sewage management, improved farming techniques and reduced animal and industrial waste entering the waterway are effective methods to reduce raised phosphorus levels.

In the home, responsible decisions can be made by choosing washing detergents low in phosphorus.

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Temperature

What is Temperature?

Temperature is the measure of how hot or cold something is. In terms of the ***River Detectives*** program, we are interested in the temperature of the air and the water at the time of testing.

How do we measure Temperature?

Water temperature is measured in degrees Celsius (°C), with a thermometer or a digital meter; it must always be measured within the same area of your local waterway. Air temperature is measured the same way.

What causes high Temperatures?

Water temperature varies in response to a range of factors including air temperature; exposure to sunlight; turbidity of the water; groundwater inflows to the waterway; discharge of warmed water from industry or cold water from dams; surrounding and aquatic vegetation; depth and flow of the waterway. The temperature of a waterway can vary across the river and from the top to the bottom of the water column. Riparian vegetation provides shade and traps sediment particles that would otherwise enter the waterway and absorb heat from sunlight. The shade provided, and also the clarity of the water, helps to keep the water cool and well oxygenated.

What impacts does it have?

The temperature of a waterway directly affects many physical, biological and chemical characteristics. Warm waters are more susceptible to eutrophication (nutrient build-up) because photosynthesis and bacterial decomposition work faster at higher temperatures. Oxygen is less soluble in warmer water and this can affect aquatic life as they find it difficult to gain sufficient oxygen levels. Salts are more soluble in warmer water, so temperature can affect the salinity of the water.

Temperature directly affects the metabolic rate of plants and animals. Aquatic species have evolved to live in water of specific temperatures. If the water becomes colder or warmer, the organisms do not function as effectively and become more susceptible to pollution and disease. With extreme temperature change, many aquatic organisms will die. Changes in long-term temperature average may change the species present in the waterway.

Is there a solution?

Temperature maintenance can be assisted through the replacement of vegetation on riverbanks; through tree planting, which also reduces turbidity of the water by reducing runoff from both urban and rural areas; and by the exclusion of stock from riverbanks and waterways.

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