

Stage 6 Chemistry– Module 1

Teacher lesson plan - Wastewater audit

Inquiry question: How do the properties of substances help us to classify and separate them?

- explore homogeneous mixtures and heterogeneous mixtures through practical investigations – using separation techniques based on physical properties

Time:
2 x 45 to 60 min**Outcomes**

- conducts investigations to collect valid and reliable primary and secondary data and information CH11/12-3
- analyses and evaluates primary and secondary data and information CH11/12-5
- communicates scientific understanding using suitable language and terminology for a specific audience or purpose CH11/12-7
- explores the properties and trends in the physical, structural and chemical aspects of matter CH11-8

Working scientifically

- Questioning and Predicting CH11/12-1
- Conducting Investigations CH11/12-3
- Communicating CH11/12-7

Sydney Water aim for activity

This lesson is designed as a practical investigation using primary and secondary research. Students will learn how separation techniques are applied every day in an industrial context – wastewater treatment. Students will be asked to identify the items they put into drinking water, a homogenous mixture, to turn into a heterogeneous mixture that is wastewater. They will then investigate how chemical ideas such as the properties of substances are used in wastewater treatment. They will also reflect on cross-curriculum outcomes and look at their individual responsibilities in sustainable water management.

Syllabus content

Properties and Structure of Matter

- Students analyse trends and patterns in relation to the properties of substances.
- Determine the ways in which substances can be separated from each other and those that allow them to remain together.
- Matter can be either pure substances with distinct measurable properties (eg melting and boiling points, reactivity, strength, density) or mixtures with properties that are dependent on the identity and relative amounts of the substances that make up the mixture.

Teaching and learning**Lesson 1 – Introduction**

Students conduct secondary research using Sydney Water’s website to gather context for their wastewater audit. They will then conduct primary research - wastewater audit at home.

Q. Have you thought about where your water comes from?

A. Probably not! It is often taken for granted. In Sydney, we have some of the best drinking water in the world, it’s clean, safe, reliable and affordable. You can see our Water sources and Water quality and filtration webpages for more information about where your water comes from to get to your tap.

Activity: Students can investigate our urban water cycle PowerPoint or animation on our Urban water management webpage.

Q. How do you use your water?

Resources**Sydney Water resources**

[Water sources](#)

[Water quality & filtration](#)

[Water use & conservation](#)

[Urban water management](#)

[Wastewater treatment](#)

[Penrith Water Recycling Plant](#)

A. The average breakdown in Sydney is about 200L per person per day. Did you know that all water coming into your home is treated to a drinking water standard? Yet, we use very little of it for drinking.

Activity: Use the infographic below to start a discussion about how much water you think you use in your home. Also consider how much drinking quality water you use in your home for drinking.

Hint: The infographic can be found on the Water use and conservation webpage.



Q. Have you ever wondered what happens to water after you've used it?

A. The water you used becomes wastewater which is 99% water. The remaining one per cent is made up of things you've added to water. We take this wastewater and treat it to re-use as recycled water or release into the environment. See our Wastewater treatment web page for more information.

Activity: You can find out where your wastewater goes on our map on the Wastewater network page.

Q. What is in that one percent?

A. It's made up of a lot of different items. Can you name a few? See our Wastewater treatment webpage for more information.

Q. Look at some of the items in wastewater. Discuss their physical and chemical properties.

Are these substances pure or mixtures? Are they solids or liquids? What properties do they have that we can use to separate them?

A. Most of these items are mixtures. We use a combination of their physical properties, for example, their size and density, to separate them. We also use their chemical properties such as their reactivity with other chemicals in water.

Q. How do you think we treat a complex mixture like wastewater to make recycled water? What separation techniques would you use?

A. Students may mention we filter water. It's only one part of the process. Think about the variety of things that enter wastewater that must be removed in stages, we can't just put everything straight through a filter!

You can use the Treatment process flow diagram to show there are multiple stages in removing waste.



Use Penrith Water Recycling Plant webpage for more information.

[Wastewater network](#)

[Solids recycling](#)

[Wastewater audit](#)

<p>Activity: Students identify if physical, biological and/or chemical properties are at work, for example:</p> <ul style="list-style-type: none"> • screens and filters use physical property – size • sedimentation tank and clarifier use physical properties - insolubility and density • bioreactor uses biological and chemical properties - biodegradability, REDOX reactions • chemical mixing –precipitation and coagulation are chemical and flocculation a physical process • disinfection uses chemical properties - chlorine toxicity (acid, oxidation), before being removed. <p>Q. How can we minimise litter and pollution that damages the wastewater network and impacts waterway health?</p> <p>A. We are going to do a wastewater audit! You may have done a school waste audit for solid waste in your bins, which can help reduce landfill and recover more recyclables. Similarly, a wastewater audit can:</p> <ol style="list-style-type: none"> identify how our behaviour creates a heterogeneous mixture that is wastewater and identify the separation techniques used help you reduce pollutants that can cause blockages in our wastewater network and interrupt processes that allow us to recycled water and waste. <p>Activity: Provide students the wastewater audit web content and recording sheets to do the wastewater audit at home before the next lesson. See our Wastewater audit webpage for more information.</p>	
<p>Lesson 2 - Body Students will:</p> <ol style="list-style-type: none"> compile the information they acquired from the wastewater audit using a suitable format such as a spreadsheet discuss their initial findings analyse their data and use calculations Make recommendations based on the findings discuss how they will communicate their research and results in an appropriate format. <p>Hint: See our HSC Chemistry and Wastewater audit webpage for more ideas and information.</p>	<p>Sydney Water resources High school see HSC Chemistry</p> <p>Wastewater audit</p>
<p>Assessment Report or presentation.</p> <ol style="list-style-type: none"> Introduction – a literature review of gathered from primary (excursion and/or wastewater audit) and secondary (website) resources. <ul style="list-style-type: none"> - How is wastewater treated at Penrith Water Recycling Plant and re-used? - What would happen if we were not here to manage this wastewater? - Why is it necessary to monitor and manage pollutants? - What are some challenges in the industry? How can individuals like you help? Method and results – students record how they conducted and analysed their wastewater audit results. Compare results in What’s in wastewater at Penrith Water Recycling Plant to see the effectiveness of wastewater treatment. Discussion and conclusion – discuss the limitations of their results and make recommendations on how to: <ol style="list-style-type: none"> change our behaviour 	<p>Sydney Water resources Penrith Water Recycling Plant <i>What’s in wastewater?</i> factsheet</p> <p>Other resources CSIRO - Sources of contaminants in domestic wastewater</p>

<p>b. separate the mixture - applications of chemistry that can be used to reduce impacts on our wastewater systems and waterways.</p> <p>Hint: See our Penrith Water Recycling Plant web page and <i>What's in wastewater?</i> fact sheet for more information.</p>	
<p>Extension</p> <ol style="list-style-type: none"> 1. Practical investigation - students can recreate wastewater treatment and 'Make a simple filter' instructions are on our High school webpage. Get them to think about what a filter can and can't remove. Create a mock wastewater sample by using food scraps, oils, cotton buds, wipes, nitrogen and phosphorus solution made from aquarium or plant supplements. They could change the design of their wastewater treatment with a controlled wastewater sample or have a single filter design and look at the impact of changing wastewater quality. 2. Research investigation - what do you think happens to all the waste from wastewater? We recycle waste from wastewater to minimise the impact on the environment. Waste, minus litter such as plastics, can make a great fertiliser and even energy. See our Solids recycling web page for more information. 	<p>Sydney Water resources</p> <p>High school</p> <p><i>Practical investigation - Make a simple water filter</i></p> <p><i>Make mock water samples</i></p> <p>Solids recycling</p>
<p>Conclusion</p> <p>Reflection Activity for students on how and why their thinking has changed.</p> <p>Q. I used to think (at the start of these lessons) ...</p> <p>Get students to finish this statement (orally or written)</p> <p>A. But now I think (at the end of these lessons) ...</p> <p>Evaluation questions</p> <ul style="list-style-type: none"> • What role do you play in helping manage our water for the future? • How can chemistry and more generally STEM be applied in the sustainable water management? • Why are working scientifically, collaboration and communication skills important? <p>Got kids interested in a career with Sydney Water or R&D? See our Sydney Water careers web page for more information on working here. Find out about the latest research from Sydney Water on our Reports and publications web page.</p>	<p>Sydney Water resources</p> <p>Careers</p> <p>Reports and publications</p> <p>Find out more</p> <ul style="list-style-type: none"> • sydneywater.com.au/education • facebook.com/SydneyWater  • instagram.com/sydneywater  • twitter.com/SydneyWaterNews 