

Stage 6 – HSC Earth and Environmental Science

Wastewater Depth Study Program



Depth Study Inquiry Question - “How does scientific knowledge in an industrial setting (Sydney Water) enable effective treatment of wastewater (sewage) to produce high quality recycled water and biosolids for re-use and to protect the environment?”

Duration:

4 hours excursion
4 hours in-class activities

Sydney Water Depth Study program is designed to complement our free excursion program. Our excursion program includes:

- full syllabus links (reference to module content points, working scientifically outcomes and skills, ideas for practical first-hand investigations, secondary sources investigations, creating fieldwork report/presentation and data analysis)
- delivery by a teacher or science experienced Education Officer, with hands on activities, tour of industry processes and public behaviour insights
- Sydney Water website links to content pages, experiments and resources (PowerPoint presentations, animations and videos).

Suggested Assessment:

1. Fieldwork Report
2. Presentation

Syllabus content

Inquiry question: how can water be managed for use by humans and ecosystems?

- investigate the treatment and potential reuse of different types of water, including but not limited to sewage
- describe ways in which human activity can influence the availability and quality of water both directly (eg over-extraction) or indirectly (eg algal blooms)

Inquiry question: How is waste managed?

- outline the management options for different types of solid waste
- evaluate the sustainability of a named waste management option, for example:
 - environmental impact of waste disposal
 - demand for reused or recycled waste
 - energy used to produce and/or recycle the waste
- investigate human activities that affect sustainability, including but not limited to water pollution
- research and present information about a sustainability initiative in their community

Sydney Water aim for activity

- Students will investigate the importance of wastewater treatment to produce high quality recycled water for human re-use and ecosystems (environmental flows).
- Students will learn the need for water and waste management to mitigate human impacts (water pollution), ensure reliable supply of water (recycled water as an alternative source) and sustainable management of our waste (biosolids an alternative source to chemical fertilisers).
- Our excursion is the starting point for Wastewater Depth Study, looking at how scientific knowledge in an industrial/ real-life setting enables efficient use of water resources for us and to protect the environment.

Syllabus Knowledge and Understanding outcomes

Knowledge and understanding EES11-11 describes human impact on the Earth in relation to hydrological processes, geological processes and biological changes

EES12-15 describes and assesses renewable and non-renewable Earth resources and how their extraction, use, consumption and disposal affect the Earth’s systems

Working Scientifically outcomes

Planning EES11/12-2 Designs and evaluates investigations in order to obtain primary and secondary data and information

- assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation

Analysis and problem solving EES11/12-5 Analyses and evaluates primary and secondary data and information

- assess relevance and reliability of the gathered information
- collate useful and relevant information into water filtration process that relates to acid/base and their uses and applications
- evaluate the effect of buffers in natural systems

Communicating EES11/12-7 Communicates scientific understanding using suitable language and terminology for a specific audience or purpose

Conducting Investigations (Optional) CH11/12-3 Conducts investigation to collect valid and reliable primary and secondary data and information

employ and evaluate safe work practices and manage risks

- use appropriate technologies to ensure and evaluate accuracy
- select and extract information from a wide range of reliable secondary sources and acknowledge them using an accepted referencing style

Teaching learning and assessment	Resources
<p>Lesson 1 – Introduction</p> <p>This Depth Study program plan applies some content from Module 4 and 8 relating to human impacts (water management) and resource management (water and waste). The resources for this study are found on our HSC Earth and Environmental Science and High School webpage.</p> <ol style="list-style-type: none"> 1. Explain details of the task - your expectations, assessment guide and final report/presentation expectations. <ul style="list-style-type: none"> Q. Why is a first-hand investigation important? A. Because it allows you to develop the following skills: <ul style="list-style-type: none"> - fieldwork observations - applying theory to real life - replicating practical activities - communication skills 2. Explain Sydney Water’s role and responsibility in water management. See our Education webpages for more information. <ul style="list-style-type: none"> - Who is Sydney Water and what do they do? See our About us webpage for more information. - Why is managing wastewater so important? See our Wastewater treatment webpage for more information. - Where does my wastewater go? See our Wastewater network webpage for more information. 3. Excursion preparation. <ul style="list-style-type: none"> Q. What will we be doing during the excursion? A. See the High school webpage for the Stage 6 Earth and Environmental Science Depth Study program outline. Q. Where can I find more information about the excursion site? A. See our Penrith Water Recycling Plant webpage for more information. Q. What are the basic safety and risk assessments on industrial sites? A. See Excursion risks and controls for more information. This photo shows you how people dress and work in an industrial site. Various personal protective equipment (PPE) is used to minimise risks. <p>Activity: Students can create a risk assessment table according to the use of PPE.</p> <p>Hints and tips from HSC markers</p> <ul style="list-style-type: none"> - First-hand investigations involve great opportunities to develop essential numeracy skills through practical measurement and the collection, representation and interpretation of data. 	<p>Sydney Water resources</p> <ul style="list-style-type: none"> HSC Earth and Environmental Science High school Education About us Wastewater Treatment Wastewater network Excursion risks and controls Make a simple water filter Wipes out of pipes Clean up not down Wastewater treatment plants Water recycling Protecting the environment Love water, don't waste it <p>Other resources</p> <ul style="list-style-type: none"> Water corporation – Water recycling around the world AWA – Water Recycling Fact Sheet



<ul style="list-style-type: none"> - Fieldwork reports and engagement with community experts involve systematic scientific inquiry of real-life application promote students to achieve top marks in the HSC. <p>Further investigations and extension options:</p> <ul style="list-style-type: none"> • First-hand practical investigations at school <ul style="list-style-type: none"> - Conduct a wastewater audit – understand the individual and community impact to wastewater quality that can disrupt treatment. See our High School webpage for wastewater audit resources. - Conduct a stormwater audit - understand the individual and community impact on urban run-off into local waterways. See our High School webpage for stormwater audit resources - Compare filtration techniques – particle filtration, distillation, and membrane filtration such as syringe or straw filter. Think about the advantages and disadvantages of each. See our Make a simple water filter activity as a source of inspiration. - Test a claim – find out whether wipes are flushable (breakdown when shake in jar or mixed in bowl), check whether break-down in other conditions such as whether they are biodegradable in soil. See our Wipes out of pipes and Clean up not down webpages for more information. • Secondary sourced investigations <ul style="list-style-type: none"> - Comparative study of the different wastewater treatment techniques at different plants and the water quality requirements of each. See our Wastewater treatment plants pages for more information. - Comparative study of water treatment and recycling in another country. See our Water recycling webpage and other resources for more information. • Communication surveys – What do people think about their wastewater and recycled water? <ul style="list-style-type: none"> - Investigate the perceptions and environmental impact of using recycled water and biosolid on the community. - Research and present information about a sustainability initiative by Sydney Water, create their own. See the Protecting the environment, Wipes out of Pipes, Clean up not Down and Love water don't waste it webpages or for inspiration. 	
<p>Lesson 2 – Secondary research</p> <p>Q. Have you thought about where your water comes from and where it goes?</p> <p>A. Probably not daily. Here in Sydney, we have some of the best drinking water in the world, it's clean, safe, reliable and affordable. But where does it come from and where does it go? See our Urban water management webpage and the Urban water cycle diagram and video for more information</p> <p>Activity: Students can investigate our network using the Urban water cycle diagram on our Urban water management webpage.</p> <p>Q. How do you use your water?</p> <p>A. The average breakdown in Sydneysider is ~200L per day. See our Water use and conservation for more information.</p> <p>Q. Have you ever wondered what happens to water after you've used it?</p>	<p>Sydney Water Resources</p> <p>HSC Earth and Environmental Science</p> <p>Urban water management</p> <p>Urban water cycle</p> <p>Urban water cycle video</p> <p>Water use and conservation</p> <p>Water recycling</p> <p>Glossary</p>

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 as you've used it. See our Water use and conservation page for a list of what we put down our drains. Sydney Water takes this wastewater and treats it to discharge into the environment or re-use as recycled water.

Did you know: We call it wastewater, but your syllabus uses sewage. See our Glossary for more information about the terms and definitions we use in the water industry.

Activity: Look at the wastewater network map and see which plant your wastewater goes to.

Q. What is in that one percent? How do you think we treat a mixture like wastewater, make recycled water?

A. The remaining 1% is made up of things you've added to water as you've used it, such as toilet paper and human waste. To protect public health and environment, treated wastewater has been treated to separate and remove pollutants before being released into the environment or reused (recycled water). See our Wastewater Treatment webpage for more information.

Q. How can we use our understanding of science to help remove the waste from the wastewater?

A. Based on the properties of matter (heterogeneous mixture), we can apply different techniques to separate substances. For example, we could use physical separation methods such as sedimentation, filtering or decanting.

Q. After the water has been treated, how do we use the recycled water?

A. Recycled water is an alternate source of water saving drinking water from being used. We can use it for purposes like irrigation, flushing toilets, washing cars and in manufacturing processes. Some places use it as part of their drinking water supply, such as Singapore and San Diego. See PUB Singapore and San Diego Public Utilities for more information.

Another use of recycled water is for environmental flows, to keep creeks and rivers running. Keeping the water captured in the dams as a source of drinking water. Using high-quality recycled water, we can also have a positive influence on the water quality of the Hawkesbury Nepean-River. See our Water recycling webpage for more information.

Q. What do you think happens to all the waste removed from the wastewater?

A. 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 webpage for more information, this could be a Depth study extension option.

Set up to go on the excursion.

Lesson 3 to lesson 6 – Field trip

Students will visit a working water recycling plant to explore how scientific knowledge helps us in sustainable water management. They'll see how we treat and manage wastewater for re-use to protect public health and the environment. We'll also discuss our sustainability initiatives and how they can help us protect the environment.

Refer to our program outline and excursion itineraries on our High school webpage for more information.

[Wastewater network map](#)

[Wastewater treatment](#)

[Penrith Water Recycling Plant](#)

[St Marys Advanced Water Recycling Plant](#)

[Solid Recycling](#)

[Water Recycling](#)

Other Resources

[PUB - Singapore's National Water Agency](#)

[San Diego – Recycled Water](#)

Sydney Water resources

[High school](#)

<p>Lesson 7 – Analysing Data and Information</p> <p>Activity: Students can use secondary sourced data (lessons 1-2) to compare with excursion observations. Students can also investigate the following sources of information and data:</p> <ul style="list-style-type: none"> • Penrith Water Recycling Plant webpage provides additional details for the excursion site • What’s in wastewater? Factsheet to identify what we deal with at the plants • EPA pollution monitoring data reports for all our wastewater systems. These reports measure concentration limits of pollutants such as nutrients, organic matter and other elements after wastewater has been treated. See our EPA pollution monitoring data reports for more information. <p>Optional or extension:</p> <ul style="list-style-type: none"> • Sydney Water’s drinking water analysis results provide drinking water quality report for up to 70 different characteristics. This is the source water of wastewater. Students may want to compare wastewater, recycled water and drinking water and can assess the relevance and reliability of the gathered information. See Drinking water analysis results for more information. • EPA webpage also provide information on the regulation of water pollution and quality. Students can assess the relevance and reliability of the gathered information. WaterNSW, Beachwatch and Water Quality Australia webpage provides information on water quality in natural systems. Students can evaluate the importance and assess the relevance and reliability of the gathered information. See other resources for more information. <p>Activity: After students gathered all the relevant data and information, they can analyse and create a scientific report or presentation. Think about:</p> <p>Q. Why was it valuable to learn about the greater context of wastewater treatment and water recycling?</p> <p>A. To understand the application of science in real-life are essential to maintaining public health and protecting the environment. We also get to understand the role of individuals and how we all contribute to sustainable water management.</p>	<p>Sydney Water resources</p> <p>Penrith Water Recycling Plant</p> <p>St Marys Advanced Water Recycling Plant</p> <p>What’s in wastewater?</p> <p>EPA pollution monitoring data reports</p> <p>Drinking water analysis results</p> <p>Other resources</p> <p>EPA Water</p> <p>WaterNSW</p> <p>Beachwatch</p> <p>Water Quality Australia</p>
<p>Lesson 8</p> <p>Example: Depth Study – Fieldwork Report /Presentation</p> <p>A report may require students to:</p> <ul style="list-style-type: none"> • describe the context of the site <ul style="list-style-type: none"> - How does wastewater treatment and recycling work? - How does the application of science form predictable outcomes require for recycled water (and biosolid waste)? - How did the procedure of the separation activity affect its efficiency and function? • describe and justify methods used during the investigation <ul style="list-style-type: none"> - What were some of the flaws? - How valid, accurate and reliable were the results? - What needed improvements? • assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation • process and analyse first-hand lab activities, fieldwork and secondary data <ul style="list-style-type: none"> - Did the theory fit the results observed on the day? - What tables and graphs can you compile? - How could this be information be useful, for example, testing the efficiency of water recycling? Designing a new wastewater treatment system? • communicate the results and conclusions of the fieldwork, lab and research investigations. 	<p>Sydney Water resources</p> <p>HSC Earth and Environmental Science</p> <p>Other resources</p> <p>NESA - The scientific research report</p>

Conclusion

Evaluation questions

- What role do you play in helping manage our water for the future?
- How is science applied in sustainable water management?
- Why are working scientifically, collaboration and communication skills important?
- What could you do to help manage our water for the future?

Reflection activity - students finish these statements:

- I used to think (at the start of these lessons) ...
- but now I think (at the end of these lessons).

Got students interested in a career with Sydney Water or research and development? See our Sydney Water careers webpage for more information on working here. Find out about the latest research from Sydney Water on our Reports and publications webpage.

Would you like to book an excursion?

- Come behind the scenes and see how we protect public health, the environment and manage water sustainably.
- Our qualified teachers and industry professionals will help you discover your role in sustainable water management and give you tips to improve our city's livability.
- All our programs are **free of charge** and most are syllabus linked.
- See our Excursion Request webpage for more information.

Proud of your students? We'd love to hear from you. We welcome feedback, example work and any new ideas you want to share with us.

Sydney Water resources

[Careers](#)

[Reports & publications](#)

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