

Stage 6 Earth and Environmental Science Lesson Plan – Module 4
 Make a simple filter



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 and indirectly

Time: 45 - 60 min

Outcomes

- develops and evaluates questions and hypotheses for scientific investigation EES11/12-1
- designs and evaluates investigations in order to obtain primary and secondary data and information EES11/12-2
- conducts investigations to collect valid and reliable primary and secondary data and information EES11/12-3
- communicates scientific understanding using suitable language and terminology for a specific audience or purpose EES11/12-7
- describes human impact on the Earth in relation to hydrological processes, geological processes, and biological changes EES11-11

Working scientifically

- Questioning and Predicting EES11/12-1
- develop and evaluate inquiry questions and hypotheses to identify a concept that can be investigated scientifically, involving primary and secondary data
- Planning Investigations EES11/12-2
- assess risks, consider ethical issues and select appropriate materials and technologies when designing and planning an investigation
 - justify and evaluate the use of variables and experimental controls to ensure that a valid procedure is developed that allows for the reliable collection of data
 - evaluate and modify an investigation in response to new evidence
- Conducting Investigations EES11/12-3
- employ and evaluate safe work practices and manage risks
- Communicating EES11/12-7
- select and use suitable forms of digital, visual, written and/or oral forms of communication
 - select and apply appropriate scientific notations, nomenclature and scientific language to communicate in a variety of contexts
 - construct evidence-based arguments and engage in peer feedback to evaluate an argument or conclusion

Syllabus Content

- Humans use the Earth's resources to maintain life and provide infrastructure.
- Natural resources are not infinite. Renewable resources such as water can be managed sustainably using scientific knowledge.
- Incomplete information or failure to consider the impact of resources use may cause environmental damage.

Sydney Water aim for activity

- This activity is designed to be a practical investigation looking at how scientific knowledge is applied to manage our water sustainably.
- Students will look how scientific skills and knowledge can help us in managing wastewater quality.
- Students will carry out a practical investigation looking out how we can use scientific knowledge to improve wastewater treatment and management.

Teaching and learning

Introduction

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 and went down the drains from the bathroom, laundry and kitchen. We take this wastewater and treat it to re-use as recycled water or discharge into the environment. See our Wastewater treatment webpage for more information.

Q. How do you treat wastewater to turn it to recycled water?

Resources

Sydney Water resources

[Wastewater treatment](#)

[HSC Earth and Environmental Science](#)

[Drinking water filtration](#)

<p>A. We use a combination of physical, biological and chemical techniques to remove unwanted items in the wastewater and turn it into recycled water. This takes quite a few steps and energy to make it both clean and safe. See our Wastewater treatment webpage for more information.</p> <p>Did you know? You can accompany this lesson with the <i>How do we treat wastewater?</i> lesson plan exploring methods of wastewater treatment in more detail. See our HSC Earth and Environmental Science webpage for more information.</p> <p>Q. What water treatment techniques do you know of?</p> <p>A. Students may know about physical techniques like sedimentation or screening. Most people are familiar with particle filtration. This is when we physically block and remove suspended solids and microorganisms, cleaning the water. The technique of particle filtration has been used by humans for thousands of years, filtering through materials like sand, gravel and coal, which we still use today! This also happens naturally in the environment, where water infiltrates and percolates through rocks, sediment, and crevices. See our <i>Drinking water filtration</i> factsheet which describes filters that are similar to ones we use to make recycled water.</p> <p>Q. How do you think we can use science and working scientifically skills to manage wastewater sustainably to help protect the environment?</p> <p>A. Students may go for hard science skills such as:</p> <ul style="list-style-type: none"> • testing to quantify water quality, • find new materials to make it cheaper, safer, easier and more energy efficient to treat wastewater. <p>Students may also like to consider working scientifically skills such as:</p> <ul style="list-style-type: none"> • predicting • data analysis • communicating to target community initiatives to the public to help in managing water more sustainably. See our Clean up not down webpage for an example of our community campaigns. 	
<p>Body</p> <p>Activity: Make the best model particle filter we can, discussing the skills and considerations we need to make to succeed. Students will be using their scientific skills and knowledge to improve wastewater treatment.</p> <p>Q. What is a model? Why do we use models in wastewater treatment?</p> <p>A. Using models or replicating processes is an important tool in science to make a prediction. Raw wastewater coming into our treatment plants change every day, and every day our staff and scientist must ensure a consistent and predictable outcome – recycled water safe for re-use and the environment. In fact, we test, and replicate processes on a small scale every day to ensure that our processes are working, whether we need to change settings on equipment or chemicals we use. By using a small sample means we don't have to run a giant experiment on an entire plant, getting it wrong could mean millions of litres being mistreated!</p> <p>Scenario: You are a graduate engineer and have been tasked by Sydney Water to create a proposal for the design of a new gravitational particle filter. These filters are cheap to run and build, requiring less energy. You've been asked to find which materials will create the best filter in 30 minutes!</p> <p>Students will:</p> <ol style="list-style-type: none"> 1. Discuss as a class what the risk and hazards are looking at the equipment they have. Decide the appropriate controls. <p>Q. What would the risks and controls be if the wastewater were real?</p> <p>A. A real sample would have human waste including urine, faecal matter and potentially harmful pathogens. At Sydney water we manage this by wearing the personal protective equipment (PPE) you can see in below image.</p>	<p>Sydney Water Resources</p> <p>Make a simple filter</p> <p>Clean up not down</p> <p>What's in wastewater?</p> <p>Other resources</p> <p>Mock wastewater sample, pre-prepared with the same volume and quality for each group – including water, dirt, food scraps, oils, cotton buds, wipes, soap, and household items you may flush. See our <i>What's in wastewater?</i> fact sheet to help make a wastewater sample.</p> <p>Optional –</p> <ul style="list-style-type: none"> • nitrogen and/or phosphorus (if you have additional water quality testing equipment). Note: this filtration

<p>2. Think scientifically:</p> <ul style="list-style-type: none"> • What are some control variable(s)? • What are some independent and dependent variable(s)? • How will you make a quick plan for your experiment? A laboratory protocol flow charts are a quick way to read and write a method in a lab notebook. <p>3. Gather resources.</p> <p>4. Create the filter using the <i>Make a simple filter</i> fact sheet instruction.</p> <p>5. Filter the mock wastewater leaving a small amount to compare the before and after.</p> <p>6. Record results</p> <p>7. Choose the “best filter” as a class. What criteria do they consider when selecting “the best filter”? Is it:</p> <ul style="list-style-type: none"> • Water quality (how clean the water is)? • Water quantity, can the filter recover the most recycled water? • Efficiency (retention time), how fast should the filter work? • Cost of materials? Are the materials easy to source? Easy to replace, recycle or re-use? 	<p>process will not remove dissolved nutrients, which is a good discussion point.</p> <ul style="list-style-type: none"> • additional range of filtering material
<p>Did you know? At Sydney Water must consider all the above and weigh our options.</p> <p>Assessment Using the practical investigation performed in class students can write a scientific report, poster, or proposal of which they thought was the best filter. In their report they should include:</p> <ul style="list-style-type: none"> • the method of how to <i>Make a simple filter</i> • experiment results • discussion about reliability and validity • recommendations for the best filter, based on the criteria discussed as a class. 	
<p>Conclusion Evaluation questions</p> <ul style="list-style-type: none"> • What are your thoughts on wastewater treatment and re-use? • How are working scientifically skills used every day in water management? • How do you think you could do to reduce your human impact on wastewater networks and the waterways? <p>Reflection Activity - Students finish these statements</p> <ol style="list-style-type: none"> 1. I used to think (at the start of these lessons) 2. But now I think (at the end of these lessons) <p>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.</p> <p>Would you like to book an excursion?</p> <ul style="list-style-type: none"> • Come behind the scenes and see how we protect public health, the environment and manage water sustainably. • Our qualified teachers and industry professionals deliver our free programs • See our Excursion Request webpage for more information. <p>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.</p>	<p>Sydney Water resources HSC Earth and Environmental Science</p> <p>Careers</p> <p>Reports & publications</p> <p>Excursion requests</p> <p>Contact us Email us at: education@sydneywater.com.au or share on our social media channels:</p> <ul style="list-style-type: none"> • facebook.com/SydneyWater  • instagram.com/sydneywater  • twitter.com/SydneyWaterNews 

