Stage 6 Earth and Environmental Science Lesson Plan – Module 4
How do we treat wastewater?

Sydney WATER

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

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.

Working scientifically
- Questioning and Predicting EES11/12-1
- Planning Investigations EES11/12-2
- Conducting Investigations EES11/12-3
- Communicating EES11/12-7

Sydney Water aim for activity
Students will conduct secondary research using Sydney Water's website to investigate how we at Sydney Water apply scientific knowledge to treat wastewater. They will discuss why wastewater treatment helps to minimise human impacts. This includes how recycled water is an alternative source of water that can supplement some drinking water and can be used as environmental flows to help keep rivers and creeks healthy.

Teaching and learning	Resources
Lesson 1 – Introduction **Q.** Have you heard of Sydney Water? Who are they? What do they do? **A.** To Find out who we are and what we do, see our About us webpages for more information. **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 discharge into the environment. See our Wastewater treatment webpage for more information **Activity:** You can find out where your wastewater goes using our map on the Wastewater network webpage. **Q.** What is in that one percent of waste? **A**. It's made up of a lot of different items. Can you name a few? **Activity:** Do a brainstorm of everything that gets flushed, washed or drained down sinks, toilets, from machines (dishwater or laundry) or toilets in your home…. Be honest!	**Sydney Water Resources** About us Wastewater network Wastewater treatment What's in wastewater

Q. Look at some of the items in wastewater. It's Sydney Waters responsibility to remove all this waste from the water. What do you think could happen to our environment if we didn't have wastewater treatment plants? **A.** They might say it could pollute the environment, it will be detrimental to plants and animals. Ask them why and how this occurs? Can they describe the cause and effect of specific water pollutants? See our Wastewater treatment webpage and What's in wastewater factsheet for more information. **Activity**: Create a summary table of the ways that various pollutants can have an impact on the environment. For example, nutrients can cause eutrophication, fine particles (sediment) can block waterways, light and carry nutrients and exacerbate eutrophication, metals and chemicals may be toxic, bioaccumulate and/or biomagnify. **Q.** So how do you think they treat wastewater? **A.** Students know we may filter the water, but to produce high quality recycled water it takes quite a few more steps! To work this out we are going to look at: • the application of science and technology to treat wastewater and make sure it's safe for re-use. • how is treated wastewater is reused (recycled water) by us. • how recycled water can be re-used to improve the water quality for ecosystems (Hawkesbury-Nepean River).	
Body **Part 1: How do we treat wastewater** **Activity**: Go to our Penrith Water Recycling Plant webpage and explore the virtual tour. Complete the following research". 1. Define primary, secondary and tertiary treatment. 2. Annotate on the Penrith Water Recycling Plant Treatment flow chart, identifying what is being removed at each stage. **Activity:** Crunch the numbers on the *What's in wastewater* factsheet and do the following: 1. Calculate the effectiveness of the wastewater treatment. 2. Discuss as a class: Do you think these numbers are good, bad or are you still unsure. What additional information would you need to tell? Why do you think scientific skills and monitoring pollutants are important? **Part 2: How is treated wastewater reused for humans and ecosystems** **Activity:** Continue to explore the Penrith Water Recycling Plant webpage and then the Water Recycling webpage. Complete the following: 1. List the ways that recycled water is used specifically from Penrith Water Recycling Plant. 2. Describe other ways recycled water can be used. **Activity:** Explore the St Marys Advanced Water Recycling Plant Page and watch the video located under replacement flows project: 1. Define advanced treatment. 2. Describe how high-quality recycled water used as environmental flow, improves water quality of the Hawkesbury-Nepean river.	**Sydney Water Resources** Penrith Water Recycling Plant Penrith Water Recycling Plant – Virtual tour Penrith Water Recycling Plant – Flow chart What's in wastewater Water recycling St Marys Advanced Water Recycling Plant St Marys Recycling Plant – Replacement Flows video

Class discussion or debate: Consider these topics. • What do you think are future uses of recycled water? • Should we use more recycled water? What are the pros and cons? • Who do you think has more responsibility to protect waterways? Individuals, communities, organisations or governments?	
Extension Investigate the technology (membranes) used in advanced water treatment to create high quality recycled water. Students may want to investigate how scientific knowledge has been applied to create these amazing filters. Filters that can remove even the tiniest dissolved substances like salts and nutrients!	**Sydney Water Resources** Make a model membrane
Conclusion **Evaluation questions** • What are your thoughts on wastewater treatment and re-use? • How do you think you could do to reduce your human impact on wastewater networks and the waterways? • How are working scientifically skills used every day in water management? **Reflection Activity** - Students finish these statements 1. I used to think (at the start of these lessons) 2. 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. **Do your students have questions?** • Join our Sydney Water Talk chemistry forum. • This forum is where you can ask your questions relating to Stage 6 Science. We will share answers with you, other students and teachers on this forum. **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 deliver our **free** programs • 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** HSC Earth and Environmental Science Careers Reports & publications Sydney Water Talk Excursion requests **Contact us** Email us at: education@sydneywater.com.au or share on our social media channels: • facebook.com/SydneyWater • instagram.com/sydneywater • twitter.com/SydneyWaterNews

