Western Treatment Plant

From past to present

VELS Level 4

Strand/Domain	**Dimensions**
Discipline-based Learning/English	Reading
	Speaking and listening
Discipline-based Learning/Science	Science knowledge and understanding
Discipline-based Learning/Mathematics	Number
Discipline-based Learning/The Humanities – History	Historical reasoning and interpretation
Discipline-based Learning/The Humanities – Geography	Geographical knowledge and understanding
Physical, Personal and Social Learning/Civics and Citizenship	Community engagement

The pre-visit activities give students the necessary background to make a visit to the Western Treatment Plant more meaningful. These include an introduction to the terms used in the sewage treatment, the processes involved and the importance of treating sewage before discharge into Port Phillip Bay or so it can be recycled for other purposes. Using a historical context students develop an understanding of the events that led to the development of a sewerage system. They model the percentage of water compared to solids that makes up wastewater. They describe what they expect to see prior to visiting the treatment plant.

The post-visit activities elaborate on aspects of the sewage treatment process observed during the visit. These include the creation of a flow chart to demonstrate and explain how waste water is treated at WTP. Students apply their understandings about sustainability and use a set of questions to guide their inquiry about sustainable approaches used at WTP.

Pre-activity 1: Step Back in Time

Focus

- Use an historical perspective to describe the events that led to the development of the Melbourne sewerage system and Western Treatment Plant.

Duration

- Two-hour session

Activity

- Pose the questions:
    - What would Melbourne have been like before European settlement?
    - What was life like growing up in the 1880s?
    - What would people have done with their waste including their rubbish, recycling and sewage?
- Focus students' thinking on housing, transport, food, clothing, streets and buildings, and how these may differ from today.
- Use digital resources to help students gain a sense of what it was like to live in Melbourne during these times. You can find the following digital curriculum resources in your jurisdiction's digital content repository www.thelearningfederation.edu.au/for_teachers/access_information/schools/vic.html:
    - R3347 Collins Street, Melbourne, 1889 (painting)
      The painting Collins Street, Melbourne, 1889 portrays a street filled with activity of the people of that era, the forms of transport used (tram, wagon and horseback) and the street paved with flagstones.
    - R6401 'Your house and mine', 1954 - asset 12 (film clip)
      The film clip 'Your house and mine' provides a look at the backyard lanes and backyard toilets and is a reminder of how things would have been when 'nightmen' collected the nightsoil.
- View clips of early Melbourne to discuss lifestyle and what it might have been like to live in Melbourne in the early 1900s:
    - Marvellous Melbourne: Queen City of the South, circa 1910, Australian Screen website,
      http://aso.gov.au/titles/documentaries/marvellous-melbourne/clip1/
      http://aso.gov.au/titles/documentaries/marvellous-melbourne/clip2/
      http://aso.gov.au/titles/documentaries/marvellous-melbourne/clip3/

    - View maps, images of the people, early works and information about the Board of Works at www.cv.vic.gov.au/stories/melbourne-and-smellbourne-/
    - The video 'The urinal' is an introduction to early Melbourne's human waste problem and the events that lead to the design and building of the sewage system and Western Treatment Plant. See 'The urinal', http://museumvictoria.com.au/learning-federation/video-temp/melbourne-story-videos/urinal/

- Follow up the video with the Student worksheet: Melbourne to Smellbourne and how it cleaned up its act. Organise students to work in pairs, for example pairing up students with differing literacy levels, to read the texts and organise them into a chronological order of events using cues in the text.
- Lead discussion about the following:
    - What 'major problem' did Melbourne have in the 1880s?
    - What did the 'nightman' do?
    - What is the Melbourne Metropolitan Board of Works? Why was it formed? What did it do?
    - What would our life be like if we did not have a sewerage system?
- Students use the following sources to refine the sequence of events that they developed in pairs:
    - the article 'The early years' on the Melbourne Water Education website, http://education.melbournewater.com.au/content/sewage_and_recycling/the_early_years/the_early_years.asp.
    - the timeline provided in the history section of the Western Treatment Plant Explorer on the Melbourne Water Education website (select the History icon – the bottom button beside the map in the main window): http://education.melbournewater.com.au/content/sewage_and_recycling/western_treatment_plant/western_treatment_plant_explorer/western_treatment_plant_explorer.asp.
- After finalising the sequence of events, each pair of students could create a book using the text as a basis and illustrate pages to support it.

Extension activities

- How did the life of Aboriginal people differ from that of the Europeans who settled Melbourne?
- Find out more about a waterborne disease such as typhoid and diphtheria.

Pre-activity 2: Wastewater: Mainly Solid or Mainly Liquid?

Focus

- Establish that sewage is mostly water.

Duration

- One hour session

Activity

- Show the students a 1 L soft drink bottle filled with water. Explain that the bottle contains 100% water.
- Show a second 1 L soft drink bottle, this time filled with half water and half solids (grass clippings, soil and shredded paper). Lead students to describe the amount of water as a percentage (50% water).
- Ask students to stand on a line marked in the classroom to indicate the percentage of water they think makes up sewage. Identify one end as 0% and the other as 100%. Select several students along the line to give a reason for their position on the continuum. Explain that sewage is 99% water and 1% solid. Discuss where the wastewater comes from, for example, toilet, showers and baths, laundry, kitchen sinks and industrial waste.
- Organise students to work in groups of three or four to create a model showing 99% water and 1% solid. Provide access to a range of containers and measuring cups and materials for use as solids such as sand, soil and shredded paper. Students explain their approach to creating an accurate model.

Teacher background

- Sewage typically contains around 99% water. The impurities in sewage are as follows:
    - micro-organisms – often including disease-causing organisms (pathogens) such as bacteria, viruses, protozoa and parasitic worms
    - phosphorus compounds – these are present in human waste (faeces) and in detergents
    - nitrogen compounds – these are mostly present as ammonia or urea
    - suspended solids – including inert material such as sand and organic solids such as food scraps
    - organic matter – this can include faeces, fats and oils
    - additionally, sewage will contain rags, plastics, sanitary products and other large solids.
- Waste from industry (trade wastes) can provide high levels of:

- fats and oils particularly from food outlets such as take-away shops, meat and fish shops, cafeterias and restaurants
- heavy metals, toxic materials and various organic compounds (e.g. pesticides and herbicides) from some industries can potentially limit the reuse of sludge (biosolids).

Pre-activity 3: What do you think you will see at the Western Treatment Plant?

Focus

- Students draw on their knowledge about removing solids from water and apply those ideas to predict the types of processes they may observe at the Western Treatment Plant and how they might be carried out.

Duration

- One hour session

Activity

- Prior to visiting the Western Treatment Plant ask students what they think they will there.
- Lead discussion about:
    - the types of large solids and suspended solids which may need to be removed and how that might be done
    - how wastewater might be moved around the plant
    - how wastes are removed from wastewater to end up with treated water that can be put back into the environment
    - where the treated water ends up
    - how long the entire process might take.
- List students' ideas and question other students in order to 'piggy back' on someone else's ideas. For example, if a student suggests that bits of plastic and solid objects need to be removed, ask another student to explain what they might see at the Western Treatment Plant that has this function. This type of strategy can be used to include those students reluctant to offer ideas as part of a class discussion.
- Ask students to draw a labelled diagram showing how they think the sewage will be treated, the types of items or substances that need to be removed, what processes might be involved, the machinery that may be used, and where the sewage goes after the treatment process.
- Display completed, labelled diagrams and look for common ideas and key processes to discuss as a class in further detail.

Conclusion

- Complete a class Y chart of what students might see, smell and hear.

Post-activity 1: How is the Western Treatment Plant working towards being sustainable?

Focus

- Describe the sustainable practices used at the Western Treatment Plant and the related benefits and impacts on society and the environment.

Duration

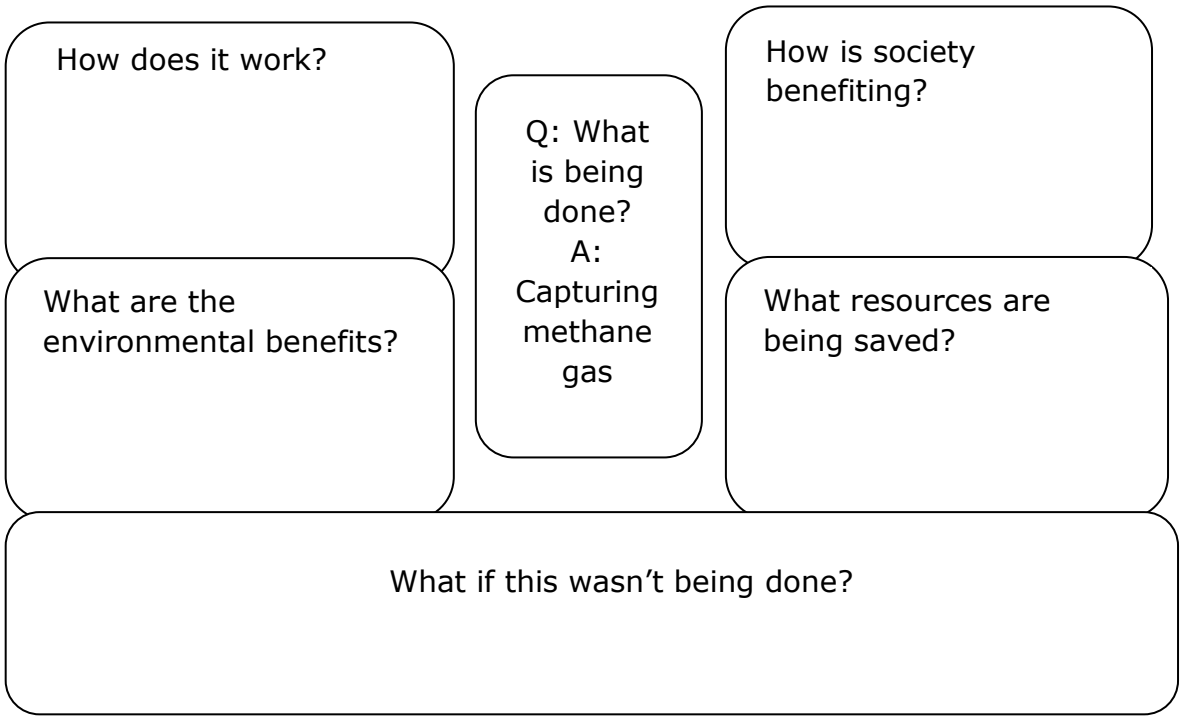
- Two-hour session

Activity

- Discuss the term 'sustainable', which is a complex one for students to understand. Begin with brainstorming words or phrases that relate to being sustainable. Lead students to the understanding that sustainability is the wise use of resources, minimising waste and ensuring resources for future generations.
- Open discussion about ways in which the Western Treatment Plant is working towards being sustainable.
- Students may list ideas such as:
    - methane gas is captured to power the plant
    - dried-out sludge (biosolids) is used as fuel, road beds or soil for landscaping
    - water is recycled in the process of treating the wastewater
    - water enters the atmosphere through evaporation and can return to the ground as rain
    - a natural process is used to treat our wastewater
    - the wetland provides habitat for water birds.
- Ask students to choose an area of interest and find out more about the processes at the Western Treatment Plant that help us to live more sustainably.

Use the following process to find out more about sustainable practices.

For example: 'Capturing methane gas'



- Share students' ideas about the sustainable practices identified and elaborated using the above inquiry method.
- Ask students to reflect on ways that they can become more sustainable with their own water use.

Post-activity 2: How is Effluent Treated?

Focus

- Follow up the visit to the Western Treatment Plant and describe the key processes used to treat wastewater. Develop a flow chart to describe the process.

Duration

- Two-hour session

Activity

- Review the visit to the Western Treatment Plant and ask students to recall their immediate impressions.
- Refer to their diagrams and ask students to describe which of the processes they correctly predicted they would see in action at the Western Treatment Plant. Ask students to describe differences between what they expected to see and what they observed during their visit. Refer to the Y chart of what they thought they would see, hear and smell. Update the chart with new ideas in a different colour.
- Lead discussion to identify and elaborate on the key processes of sedimentation, aeration and evaporation. Refer to the micro-organisms (bacteria) that enable the plant to treat water without chemicals. Key questions may include:
    - How are large solids such as plastics and rags removed from sewage? (Sludge settles; the process is sedimentation.)
    - What happened to the solids in the large pond? (Sludge settles; the process is sedimentation.)
    - Why was one pond covered over with black plastic? (Bacteria in this pond feed on the sludge without oxygen and they produce methane gas when they break down the sludge. Waste gases are captured reducing smells and harmful greenhouse gas to the atmosphere).
    - How is the waste gas used? (Methane is the waste gas captured and used to generate electricity to run the plant.)
    - What happens to the wastewater as it travels through the pond system? (Bacteria continue the process to break down the sewage. The sun evaporates some of the water, which enters the atmosphere as a vapour and becomes part of the water cycle.)
    - What role do the big beaters play? (Provide oxygen; the bacteria in this pond need oxygen to feed on the sewage and break it down to remove nitrogen. The process when oxygen is mixed into the water is called aeration.)

- How are the bacteria removed from the water? (As the treated water passes through the ponds bacteria-filled sludge settles to the bottom and is collected and reused in the activated sludge plant in pond 5. In shallow water, ultraviolet (UV) light from the sun helps control harmful (pathogenic) bacteria. The ultraviolet light affects the bacteria causing them to lose their ability to reproduce and therefore die out.)
- What role do algae and zooplankton play in the treatment process? (Algae are microscopic green plants that use the sun's light to grow. They produce oxygen and take up nutrients such as nitrogen. In turn, algae are eaten by zooplankton (microscopic organisms). Birds also feed on algae and zooplankton.)
- Why is the treatment process considered to be a natural one? (The bacteria are used to remove organic matter from the wastewater rather than harmful and expensive chemicals.)

- Distribute the Student worksheet: Treating Wastewater. Students use the worksheet to create a flow chart of the treatment process. They could complete the activity as a poster adding their own text to describe the processes. Alternatively, the images could be provided electronically for students to use with presentation software.

Conclusion and reflection

- Students compare their completed flow chart with their labelled diagram developed in the pre-activity. They use the two representations to describe their learning.

Note: This task could be used for assessment purposes to assess student understanding of the processes used to treat wastewater. Key processes include sedimentation, evaporation and aeration.

Teacher background

- Sewage treatment is a completely natural process using biological organisms rather than chemicals. The purpose of sewage treatment is to remove:
    - organic matter
    - suspended solids
    - nutrients
    - disease-causing organisms.
- At the completion of the process only liquid effluent remains, which is provided for various land uses or released to the ocean.

References

- Melbourne's Sewerage System – A Brief History, Melbourne Water, www.melbournewater.com.au/content/sewerage/melbournes_sewerage_system/melbournes_sewerage_system_-_a_brief_history.asp
- Melbourne's Sewerage System – Today, Melbourne Water, www.melbournewater.com.au/content/sewerage/melbournes_sewerage_system/melbournes_sewerage_system_-_today.asp
- Night Soil, Kingston Historical Website, http://localhistory.kingston.vic.gov.au/htm/article/30.htm
- World toilet day, Melbourne Museum, http://museumvictoria.com.au/about/mv-blog/nov-2010/world-toilet-day/

Student worksheet: Melbourne to Smell-bourne and how it cleaned up its act (pre-activity 1)

Cut out the text boxes. Put them in order to tell the story of Melbourne's sewerage history.

In 1892 work began on the sewage treatment plant. Underground sewers were built and in 1897 the first homes were connected.	After European settlement began in Melbourne its population steadily grew. The amount of human waste increased; the environment could not keep up. The waste was dumped in large holes in the ground. Open drains carried wastewater into the Yarra River.
The government asked engineer James Mansergh to come up with a solution to Melbourne's waste problem. He proposed a sewage treatment plant be built at Werribee.	By 1846 the Yarra River water was not fit to drink. Drinking water was delivered around the city in handcarts.
By the late 1800s, most homes had a backyard 'dunny' shed. The waste was collected in a pan. The pan was emptied every week by 'nightmen' who took the waste or 'nightsoil' away.	Around 1886 many people had died from the outbreak of waterborne diseases such as typhoid and diphtheria. The government finally decided to deal with the issue of human waste.
The nightsoil was dumped on paddocks, where it was ploughed into the soil. Often the nightmen illegally dumped the nightsoil into drains, the bush or the river.	With the introduction of the new sewerage system, the smelly open drains and street channels were no longer required.
Before European settlement, Aboriginal people living near the Yarra River relied on the environment to recycle their human wastes. Decomposers in the soil, such as fungi and bacteria, soon broke down human waste left in the bush.	More sewers were connected to the system. The network of underground sewers carried sewage via a massive pumping station at Spotswood, to a sewage farm at Werribee.
As the underground sewers spread throughout Melbourne, the backyard dunny and pan system were replaced by inside water-flushed toilets	Waste tipped into holes in the ground and left uncovered began to stink. The flies and the smell were unbearable. Melbourne was known as Smell-bourne.

Student worksheet: Treating Wastewater (post-activity 2)

Use these images to create a flow chart to describe how wastewater is treated at the Western Treatment Plant.

Note: Provide images in random order

Effluent entering Western Treatment Plant

Pumping station

Ponds where water is exposed to sunlight

Ponds where sedimentation takes place

Ponds covered with black plastic to capture methane

Mechanical beaters

Conservation lagoon

Excess methane gas being burned

Weir where water flows from one pond to another via gravity flow

Open channel leading out to Port Phillip Bay

Recycled water standpipe

Outfall at Port Phillip Bay

Curriculum mapping

Strand/ Domain	Dimensions	Level	Standard
Discipline-based Learning/English	Reading	4	Interpret and respond to a wide range of literary, everyday and media texts in print and in multimodal formats. Use strategies such as reading on, using contextual cues, and drawing on knowledge of text organisation when interpreting texts containing unfamiliar ideas and information.
	Speaking and listening	4	Listen to spoken texts, identify the main idea and supporting details and summarise them for others. Identify opinions offered by others, propose other relevant viewpoints and extend ideas in a constructive manner.
Discipline-based Learning/Science	Science knowledge and understanding	4	Apply the terms relationships, models and systems appropriately as ways of representing complex structures.
Discipline-based Learning/Mathematics	Number	4	Use decimals, ratios and percentages to find equivalent representations of common fractions (for example, 3/4 = 9/12 = 0.75 = 75% = 3:4 = 6:8).
Discipline-based Learning/ The Humanities – Geography	Geographical knowledge and understanding	4	Compare the various ways humans have used and affected the Australian environment. Recommend ways of protecting environmentally sensitive areas in a sustainable way.
Discipline-based Learning/ The Humanities – History	Historical reasoning and interpretation	4	Use a range of primary and secondary sources to investigate the past. With support, frame research questions and plan independent inquiries.
Physical, Personal and Social Learning/Civics and Citizenship	Community engagement	4	Present a point of view on a significant current issue or issues and include recommendations about the actions that individuals and governments can take to resolve

			issues.

Connections to the Australian Curriculum

Australian Curriculum	**Content strands/ sub-strand**	**Content descriptions**
English	Literacy/ Texts in context	Year 6 Compare texts including media texts that represent ideas and events in different ways, explaining the effects of the different approaches (ACELY1708)
	Literacy/ Interacting with others	Year 5 Clarify understanding of content as it unfolds in formal and informal situations, connecting ideas to students' own experiences and present and justify a point of view (ACELY1699) Year 6 Participate in and contribute to discussions, clarifying and interrogating ideas, developing and supporting arguments, sharing and evaluating information, experiences and opinions (ACELY1709)
	Literacy/ Interpreting, analysing, evaluating	Year5 Use comprehension strategies to interpret and analyse information, integrating and linking ideas from a variety of print and digital sources (ACELY1703) Year 6 Use comprehension strategies to interpret and analyse information and ideas, comparing content from a variety of textual sources including media and digital texts (ACELY1713)
History	Historical skills/ Chronology, terms and concepts	Years 5 and 6 Sequence historical people and events (ACHHS098)/ (ACHHS117)

	Historical skills/ Analysis and use of sources	Years 5 and 6 Compare information from a range of sources (ACHHS103)/ (ACHHS122)
Geography	Geographical knowledge and understanding	Not available at this time
Mathematics	Number and Algebra/ Fractions and decimals	Year 5 Compare, order and represent decimals (ACMNA105) Year 6 Make connections between equivalent fractions, decimals and percentages (ACMNA131)
Science/	Science Understanding/ Chemical sciences	Year 5 Solids, liquids and gases have different observable properties and behave in different ways (ACSSU077) Year 6 Changes to materials can be reversible, such as melting, freezing, evaporating; or irreversible, such as burning and rusting (ACSSU095)
	Science Understanding/ Biological sciences	Year 5 Living things have structural features and adaptations that help them to survive in their environment (ACSSU043) Year 6 The growth and survival of living things are affected by the physical conditions of their environment (ACSSU094)