# Micro-organisms at work—at the sewage treatment plant (Years 7 and 8)

Lesson plan

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| Victorian Curriculum F–10[[1]](#footnote-1) links:  **Levels 7 and 8**  **Science**  **Science Understanding**  **Science as a Human Endeavour**  Science and technology contribute to finding solutions to a range of contemporary issues; these solutions may impact on other areas of society and involve ethical considerations  **Biological sciences**  There are differences within and between groups of organisms; classification helps organise this diversity  Cells are the basic units of living things and have specialised structures and functions  Interactions between organisms can be described in terms of food chains and food webs and can be affected by human activity  **Chemical sciences**  Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques  **Earth and space sciences**  Water is an important resource that cycles through the environment  **English**  **Literacy**  **Creating texts**  Plan, draft and publish imaginative, informative and persuasive texts, selecting aspects of subject matter and particular language, visual, and audio features to convey information and ideas to a specific audience |

## Introduction

Micro-organisms play an important role in the biological treatment of sewage at Melbourne’s sewage treatment plants. Students learn how they reduce the harmful nutrients and organic matter in the effluent. Biogas from these processes is converted into renewable energy.

### Activity 1: Mystery laundry powders and detergents

Students investigate the substances that enter the sewerage system (in particular laundry powders and detergents that contain salts and phosphates) by identifying mystery samples through testing.

### Activity 2: Investigating flow rates

Students gain an understanding of how gravity and pumping is used to carry sewage through pipes to the Eastern or Western Treatment Plants. They investigate flow rates by posing scientific questions and designing their own investigations to answer them.

### Activity 3: Helpful, hardworking bacteria wanted

Students elaborate on aspects of the sewage treatment process observed during the visit. Using the context of a job advertisement, students describe what they know about bacteria and their role in s treatment.

### Activity 4: Getting agitated

Students measure the effect of aerating water on dissolved oxygen (DO) levels and relate the increased DO to the aeration stage of sewage treatment and types of bacteria at either the Eastern Treatment Plant or the Western Treatment Plant.

## Activity 1: Mystery laundry powders and detergents

Students identify the main chemicals contained in laundry powders and detergents; measure salt content using an electrical conductivity (EC) meter; measure phosphates using a phosphate test kit or phosphate testing strips; measure the pH of solutions containing laundry powders and detergents.

**Duration**

One period session and one double-period session (practical)

**Equipment**

Selection of empty packaging for laundry powders and detergents

Four laundry powder/detergent solutions (as below)

Containers or beakers for testing solutions of laundry powders and liquids

Teacher tip

Schools that do not have access to an EC meter could contact their local council to enquire about the availability of Melbourne Water Waterwatch kits provided for local groups/schools to borrow.

Universal indicator and scale or data-logging equipment with pH probe

An EC meter, or data-logging equipment with EC probe

Phosphate testing strips or (a phosphate test kit to be conducted by the teacher).

**Preparation**

Mix samples of four laundry powders or detergents labelled samples 1–4:

* regular laundry powder—5 g (1 teaspoon) to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 g per 1 L for top-loading laundry powders.
* regular laundry liquid—5 mL to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 mL per 1 L for top-loading laundry detergents.
* low-sodium/low-phosphate laundry powder—5 g (1 teaspoon) to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 g per 1 L for top-loading laundry powders.
* eco variety of laundry detergent—5 mL to 1 L of water (equates to a standard wash for front loader). Note: Use the rate 15 mL per 1 L for top-loading laundry detergents.

Ensure that all safety requirements are followed.

**Activity steps**

1. Discuss the range of substances and items that might end up in the sewerage system from households and factories. In particular, focus on laundry powders and detergents. Discuss reasons why laundry powders and detergents are of concern in the treatment of sewage. (Refer to **Teacher background** for further information.)
2. Look at a selection of empty packaging for laundry powders and detergents in class or as a take-home task. Have students identify the key chemical constituents. Alert students to look for compounds that include chlorides, sodium, sulphates and phosphates.
3. Students complete the Table 1 using information supplied on the packaging or research using relevant websites (see References on page 6).

Table 1 Laundry chemicals

|  |  |
| --- | --- |
| **Chemical/substances identified in laundry powders and detergents** | **Why these chemicals are used in the laundry powders and detergents** |
| sodium polyphosphate | softens water and removes soil |
|  |  |

1. Explain that you have made up solutions of four laundry products and that the students’ task will be to carry out some tests to find out about the products and match each solution to its package using their results. Explain that, in each case, tap water will be measured and used as a reference.

**Test 1: Electrical conductivity**

1. Demonstrate how to measure the salinity of prepared solutions of laundry powders and detergents using an electrical conductivity (EC) meter. Use students from the class to assist in testing the water sample and the mystery laundry powders and detergents. Create a table of results (Table 2) to display the salt content measured in μS/cm (micro-Siemens/centimetre). Interpret the results.

Table 2 Electrical conductivity results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Tap water** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** |
| EC (µS/cm) |  |  |  |  |  |

1. Pose and discuss the following questions:
2. Are there differences in EC measurements from the water sample and the solutions? What does this mean?
3. Is there a difference between EC measurements of mystery solutions? What does this mean?

**Test 2: Phosphates**

1. Demonstrate the use of a phosphate testing kit to roughly indicate phosphorus levels of the mystery solutions. Kits typically have a colour chart showing pre-determined concentrations, which can be used to best match the colour of each mystery solution. The corresponding concentration can be recorded.
2. Phosphate test strips can be used to determine the presence or absence of phosphates. Select a range for measuring at least of 0–100 mg/L. (Up to 500 mg/L would be most suitable for testing laundry product solutions.)

Table 3 Phosphate results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Tap water** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** |
| Phosphates (mg/L)  (mg/L) |  |  |  |  |  |

**Test 3: pH**

1. Demonstrate how to measure the pH of water using a universal indicator, pH meter, or data-logging equipment and pH probe. Students measure the pH of the mystery solutions. Use the universal indicator to determine the alkalinity or acidity of the solutions. Record results in a table.

Table 4 pH results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Tap water** | **Sample 1** | **Sample 2** | **Sample 3** | **Sample 4** |
| pH |  |  |  |  |  |

1. Pose and discuss the questions:

* What does the pH indicate?
* Why is a higher pH preferable for laundry products?

**Results**

1. As a class, have students refer to their tables of results and match the sample to the laundry product. Ask students to provide the reasoning for their suggested matches. Discuss the different claims on the packaging for example ‘Low sodium/low phosphates’.

**Conclusion**

1. Students develop a series of messages about the use of laundry powders and detergents with consideration for the effects on the environment. (These could be refined after their Western Treatment Plant visit). For example:

* Choose washing detergent with a low salt content.
* Concentrated detergents often contain much less salt than powdered varieties.
* Too much salt in the sewerage system means we may not be able to use the recycled water.

1. These messages could be displayed in a place of prominence and linked to raising community awareness about sewage through promoting relevant messages.
2. Students create a list of questions related to sewage treatment and laundry powders and detergents which could be discussed during their Western Treatment Plant visit. For example:

* What happens to salts in the sewage treatment?
* Do phosphates and salts affect the bacteria that help in the treatment process?
* Does a high or low pH affect the treatment process?
* Do the salts in sewage have to be reduced before being released to the environment?
* Does the pH of sewage have to be altered before being released to the environment?

**Teacher background**

Almost half the salt in sewage that flows to the Western Treatment Plant comes from industry located to the west of Melbourne and about one-quarter comes from households.

Laundry powders and detergents may include phosphorus, sodium, boron, chloride and borax. Typically these laundry products contain inorganic compounds (salts) such as sodium tripolyphospate, sodium carbonate, sodium silicate and sodium sulphate. Concentrates generally contain less sodium (salts) than regular laundry products because sodium is used as a filler in powdered laundry detergents. The amount of sodium in laundry detergents needs to be limited when the sewage is to be discharged to vegetation or soil absorption areas, for example if the effluent is used as recycled water.

Phosphates that enter waterways lead to increased nutrient levels which encourage the growth of algae and bacteria.

The concentration of phosphate in the mystery laundry powder or detergent solution can be estimated by matching the colour produced to a colour wheel or colour chart for pre-determined concentrations which can be found in a kit such as Visicolor Phosphate Testing kit or phosphate test strips. If using phosphate testing strips, select those that have a range up to at least 100 mg/L. Up to 300–400 mg/L is preferable otherwise it will be difficult to distinguish between the mystery solutions.

Acidic solutions have a pH of less than 7, while alkaline solutions have a pH of more than 7. Laundry powders are generally very alkaline with a pH above 8.5. A high pH is required to remove organic matter from clothes such as food stains and sweat. Greywater with a high pH, as a result of laundry products, may be harmful to both plants and the micro-organisms in the soil.

**Safety note: Under no circumstances should students conduct tests on laundry grey water. Grey water can contain pathogens that may transmit disease. All laundry powder and detergent solution samples for testing must be prepared with clean water.**

### Resources

Quality recycled water for the Werribee Plains: Salt-reduction strategy, Melbourne Water <<http://ausvegvic.com.au/pdf/env_Quality_Recycled_Water_for_the_Werribee_Plains.pdf>>

Laundry Products Research, Lanfax Labs

<[www.lanfaxlabs.com.au/laundry.htm](http://www.lanfaxlabs.com.au/laundry.htm)>

Sources of critical contaminants in domestic wastewater, CSIRO

<<https://www.researchgate.net/profile/Magnus_Moglia/publication/242137154_Sources_of_critical_contaminants_in_domestic_wastewater_contaminant_loads_from_household_appliances/links/0046352e1b69294c9c000000.pdf>>

Choosing laundry detergents, City West Water

<[www.citywestwater.com.au/residents/choosing\_laundry\_detergents.aspx](http://www.citywestwater.com.au/residents/choosing_laundry_detergents.aspx)>

Electrical conductivity, Healthy Waterways Waterwatch Program

<<http://www.waterwatchmelbourne.org.au/content/volunteer_monitoring/what_we_monitor/what_we_monitor.asp#2>>

Phosphate test strips: Macherey Nagel phosphate test strips Range 0–100 mg/L phosphate. Gradation 0–3–10–25–50–100, Apps Laboratories website,

<<http://appslabs.com.au/index.php?main_page=index&cPath=410_40_28>>

## Activity 2: Investigating flow rates

Students investigate flow rates of water flowing through tubing connected to a storage container. They relate the investigation to pipes that carry sewage through the sewerage system to the treatment plants.

### Duration

One double-period session

### Equipment

For each group:

One copy of **Student worksheet: Investigating flow rates**

plastic tubing of different diameters: 5 mm, 8 mm and 12 mm;

1L and 2L soft drink plastic bottles

one bucket

graduated measuring jug

measuring device such as a stop watch

a low-melt glue gun to seal joins of tubing to plastic bottle

### Preparation

Teacher requires access to a cordless drill or similar to make a hole in the plastic bottle to fit the tubing. Ensure that all safety requirements are followed.

### Activity steps

1. Explain that the sewerage system uses a combination of gravity and pumping to deliver sewage to the treatment plant. Gravity is the main force used to move the sewage in the sewer pipes but at different points along the pipes pumping stations may be needed to raise the sewage to a level where gravity can again take over.
2. In one sewerage system the sewage is raised 16.5 m from its lowest point at one pumping station; it flows downhill and is then raised 27.5 m at the next pumping station Enable students to get a sense of the height by comparing them to the heights of structures or trees in the school grounds. Using a fish tank pump and plastic tubing, demonstrate a pump in operation and relate this to the way that a sewerage system moves water uphill from a lower container to a higher container. Measure in seconds the time it raise 1 L of water by one metre. Calculate the flow rate in litres/second.
3. Discuss how the water flows once it has been raised to its highest point.
4. Pose the question: What factors affect how fast water flows through pipes?
5. Introduce an investigation of flow rates when moving water from a storage container to another container through tubing. Use a variables grid (Table 5) to brainstorm the aspects of the investigation that can change.

Table 5 Variables grid for flow rate investigation

|  |  |  |
| --- | --- | --- |
| shape of storage container holding the water | quantity of water in the storage container | diameter of the tube |
| length of the tube | position of the tube on the storage container | inclination of the tube |
| flow rate |  |  |

1. Identify the variable to be measured (flow rate in litres/second).
2. Explain that to ensure a fair test they should change one variable and keep all others the same. Use an example of changing the diameter of the tube, keeping all other variables the same and measuring any change in flow rate litres/second.
3. Encourage students to come up with their own questions to investigate such as:

* Does the inclination of the tube affect flow rate?
* Does the diameter of the tube affect flow rate?
* Does the quantity of water affect the flow rate?
* Does the shape of the container affect flow rate?

1. Guide students to turn their question into a hypothesis by making it an ‘If, then’ statement. As an example, if a question is ‘Does the diameter of the tube affect flow rate’, then the hypothesis would look something like: ‘If the diameter of the tube affects flow rate, then the flow rate should be faster for a tube with a larger diameter than that of a smaller diameter’.
2. Provide students with Student worksheet: flow rate to design their investigation and record their results.
3. Provide assistance to make holes in the plastic bottles to fit the plastic tubing.
4. Supervise the use of the low-melt glue gun to seal the joins to prevent leakage.
5. Discuss each group’s investigation and results. Develop generalisations from the evidence gathered, for example, pipes of a larger diameter enable sewage to flow faster than pipes of a smaller diameter under the same pressure. Students could develop questions about flow rate and the diameter of pipes used around the treatment plant.

### Extension activities

Students research Bernoulli’s Principle, the Venturi effect and the effect of pipe dimensions on flow rates.

Research the location of the treatment plant. Use topographic maps or Google Earth to compare the elevation with that of central Melbourne. Pose the question: Why do you think the elevation of the sewage treatment plant was a consideration when the site was chosen?

### Teacher background

In a container of water, all the water pushes downwards causing pressure on the water at the bottom. A greater quantity of water will cause a greater quantity of pressure pushing downwards; less water will result in less pressure.

### Western Treatment Plant

A system of pipes, sewers and drains built underground carry sewage from homes and factories to the sewage treatment plant. At the Western Treatment Plant a combination of gravity and pumping is used to move the sewage to the treatment plant. For most of the way it flows downwards but two pumping stations are used to pump the sewage upwards. The Brooklyn pumping station, which can pump 17,600 L of sewage a second, raises the sewage 16.5 m to the head of the trunk sewer, from where it runs downwards towards Hoppers Crossing. Another pumping station pumps the sewage 27.5 m upwards and from there it runs down to Werribee.

**Eastern Treatment Plant**

A system of pipes, sewers and drains built underground carry sewage from homes and factories to the sewage treatment plant. The Eastern Treatment Plant has many small pumping stations that move sewage along and transfer it between systems within the plant. The pumps raise the sewage 17 metres from below ground to the highest point at the treatment plant.

Generally the Eastern Treatment Plant is lower in elevation than the locations which are the source of the sewage, however some suburbs near the Eastern Treatment Plant are at the same or a slightly lower elevation.

## Activity 3: Helpful, hardworking bacteria wanted

Students create a job advertisement for bacteria using what they know about bacteria and their role in sewage treatment.

## Equipment

Per student: one copy of **Student worksheet: Job advertisement—Sewage treatment**

### Activity steps

1. Explain that bacteria are tiny organisms (micro-organisms) that are not visible to the naked eye and can only be seen with the aid of a microscope. Use the analogy that if you laid 1,000 bacteria end-to-end they would be equal to 1 mm.
2. Students research the role of bacteria at the Western and Eastern Treatment Plant processes and information about the stages in the treatments that use bacteria.

Where does wastewater go? ABC Splash video [3:43]

<<http://splash.abc.net.au/home#!/media/524873/>>

Western Treatment Plant Sewage treatment process <<http://www.melbournewater.com.au/whatwedo/treatsewage/wtp/Pages/Sewage-treatment-process.aspx>>

Primary treatment of sewage and anaerobic treatment of sludge

<<https://www.youtube.com/watch?v=--GS_djOzcg&list=PL1zDcvEb76G6FdTMg-_VRmAE4jMoarrKr&index=1>>

Secondary treatment of sewage

<<https://www.youtube.com/watch?v=yF9hQUebDNA&index=2&list=PL1zDcvEb76G6FdTMg-_VRmAE4jMoarrKr> >

Eastern Treatment Plant Sewage treatment process <<http://melbournewater.com.au/whatwedo/treatsewage/etp/Pages/Sewage-treatment-process.aspx>>

1. Share the information provided in the **Teacher background** about the role of other micro-organisms such as algae, protozoa and zooplankton in the treatment process.
2. Students share what they found out about bacteria used in the sewage treatment process. Add any key information that may have been missed:

* there are two key types of bacteria; those that require oxygen and those that do not
* one type of bacteria produces methane gas as it breaks down organic matter under anaerobic conditions (no oxygen)
* another type of bacteria requires oxygen for respiration (aerobic conditions) as it breaks down organic matter
* oxygen is added to the sewage using mechanical beaters that mix together the sewage and bacteria to form ‘activated sludge’ (Western Treatment Plant)
* adding oxygen and mixing speeds up the treatment process as the oxygen-loving bacteria grow and reproduce and break down organic matter
* bad odours are produced by anaerobic bacteria in the form of the gas hydrogen sulphide; these bacteria also produce methane and carbon dioxide
* given a suitable environment and sufficient food, bacteria reproduce and multiply at a great rate
* anaerobic bacteria take longer to break down organic matter than aerobic bacteria as they have a slower metabolism and get their energy from sulphates and nitrates
* several different types of bacteria are used to remove nutrients from sewage before it can be released back into the environment.

1. Explain that the science ideas about bacteria that are incorporated into the job description must be accurate.
2. Show examples of several job advertisements so that students are familiar with the format. List relevant headings to prompt students, such as employer, location, work environment, working conditions, job description and their role, skills required, work as a team/individually. Provide students with the **Student worksheet: Job advertisement sewage treatment**.
3. Share students’ completed job advertisements and discuss the science ideas presented.

Note: This task could be used for assessment purposes to assess student understanding of the role bacteria plays in the treatment of sewage.

### Extension activities

Organise half the class to write the job advertisement and the other half of the class (after the advertisements have been completed) to respond to a job advertisement from the point of view of the bacteria.

Use the context of a job advertisement to describe the role of algae and zooplankton in the sewage treatment process.

### Teacher background

There are two main types of environments used in sewage treatment—anaerobic (without oxygen) and aerobic (with oxygen). Anaerobic and aerobic environments suit different types of bacteria and the treatment plant needs both types of bacteria to break down the sewage.

At the Eastern Treatment Plant, the primary treated effluent is moved to secondary treatment tanks where it is aerated to encourage the growth of oxygen-loving bacteria. The amount of oxygen supplied to the tanks is automatically controlled based on the level of dissolved oxygen in the tanks. There are six rectangular tanks approximately 4.5 m deep. Diffusers mounted on the tank floors release bubbles of air which provide agitation to maintain the bacteria in suspension and give them the oxygen they require for the aerobic breakdown of the sludge. Not all the tank floors are covered with diffusers (15–25% are not covered). This creates alternate areas of aeration and non-aeration. Different types of bacteria exist side by side in aerobic (with oxygen) and anaerobic (without oxygen) environments, breaking down organic material and removing nutrients in the plant's aeration tanks. This results in a significant reduction in ammonia load.

The activated sludge contains micro-organisms; mainly bacteria and protozoa.

Under anaerobic conditions, bacteria produce strong, unpleasant smells and release greenhouse gases (methane).

As part of the secondary sedimentation process, algae feed on nutrients in the sewage stored in the holding basin. Algae are eaten by zooplankton, waterbugs and water birds. Zooplankton also feed on bacteria and protozoa.

## Activity 4: Getting agitated

Students measure the effect of aerating water on dissolved oxygen (DO) levels. They relate the increased DO to the aeration stage of sewage treatment and types of bacteria involved.

### Equipment

Teacher tip

Schools that do not have access to a DO meter could contact their local council to enquire about the availability of Melbourne Water Waterwatch kits provided for local groups/schools to borrow.

A sample of tap water

Thermometer or temperature probe

DO meter or datalogger with a DO probe

### Preparation

Ensure that all safety requirements are followed.

### Activity steps

1. Show a sample of tap water, measure its temperature and use a DO meter, or data-logging equipment with a DO probe to measure the level of DO. Explain that it is useful to measure temperature as the temperature affects the DO levels.
2. Depending on the available resources, demonstrate or enable students to investigate the effect of aerating a sample of water. Two methods of aerating water are:

* a pump and aquarium aerator stone
* mechanically agitating the water, for example with a whisk or hand beater.

1. Relate the two types of aeration used at Melbourne’s two main treatment plants. The aerated sludge plants at the Eastern Treatment Plant and the 25W pond at Western Treatment Plant use aerators like the aerator stone; 55E at the Western Treatment Plant uses aerators similar to the hand beater.
2. Highlight the stage of aeration in the overall process in the treatment of sewage at the Western Treatment Plant <<http://www.melbournewater.com.au/whatwedo/treatsewage/wtp/Pages/Sewage-treatment-process.aspx>>
3. Measure the DO levels and temperature before and after aeration and record data in a table.
4. Discuss the following:

* What happens to the DO levels in the water as a result of the two methods of aeration?
* What type of bacteria benefits from the aeration of sewage?
* Why is aeration a step in sewage treatment?

1. Students write a brief report about their investigation including their results and responses to questions, including images of the relevant section of the treatment plant to indicate where the process takes place.

### Extended investigation

Students design an investigation that measures the effect of adding dead plant material such as grass clippings or the leaves of an aquatic plant to a sample of water. Ideally the investigation can be carried over at least 1–2 weeks.

Students set up a control for comparison. Students take measurements of temperature and DO levels.

### Teacher background

DO is the amount of oxygen gas that is dissolved in the water. DO is measured in milligrams per litre (mg/L). Aquatic organisms such as fish require at least 6 mg/L of DO in the water to survive.

Organic wastes are the remains of any living or once-living organism. Organic waste is decomposed by bacteria; these bacteria remove DO from the water when they breathe. If more food (organic waste) is available for the bacteria, more bacteria will grow and use oxygen and the DO concentration will drop.

## Student worksheet: Investigating flow rates (Activity 2)

### Introduction

A system of pipes, sewers and drains built underground carries sewage from homes and factories to the sewage treatment plant. A combination of gravity and pumping is used to move the sewage to the treatment plant. For most of the way it flows downhill through these pipes.

Consider the questions: What factors affect how fast water flows through the pipes?

Does the inclination of a pipe affect the flow? What about the diameter of the pipe, does that make a difference?

Use a plastic soft drink bottle and plastic tubing as a starting point to design your own investigation.

Ensure you design a fair test by only changing one variable.

### Materials and equipment

plastic tubing of different diameters: 5 mm, 8 mm and 12 mm

1 L and 2 L plastic soft drink bottles, and a bucket

graduated measuring jug

timing device such as a stopwatch

a low-melt glue gun to seal joins of tubing to plastic bottle.

### Hypothesis

My question to investigate:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Turn this into a hypothesis:

If \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Controls

List the variables that may change in your investigation in the grid below:

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |

Variable being measured is

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Variable being changed is

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Variables kept the same are

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Procedure

Draw a labelled diagram of your investigation.

### Observation and results

Create a table for your results.

### Conclusion

Explain your findings based on your evidence.

## Student worksheet: Job advertisement—Sewage treatment (Activity 3)

### Introduction

Bacteria are an important part of sewage treatment.

Create a job advertisement that describes the role of bacteria in the sewage treatment process.



### Conclusion

In what ways are bacteria important in the sewage treatment process?

1. Creative Commons Licence Victorian Curriculum and Assessment Authority (VCAA) <<http://victoriancurriculum.vcaa.vic.edu.au/>> Accessed 14 August 2016. [↑](#footnote-ref-1)