# Activity: The nitrogen cycle at the sewage treatment plant (Years 9 and 10)

Cleaning up sewage

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| Victorian Curriculum F–10[[1]](#footnote-1) links:  **Levels 9 and 10**  **Science**  **Science Understanding**  **Science as a Human Endeavour**  The values and needs of contemporary society can influence the focus of scientific research  **Biological sciences**  Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems  **Earth and space sciences**  Global systems, including the carbon cycle, rely on interactions involving the atmosphere, biosphere, hydrosphere and lithosphere  **Geography**  **Geographical Knowledge**  **Environmental change and management**  Different types and distribution of environmental changes and the forms it takes in different places  Environmental, economic and technological factors that influence environmental change and human responses to its management |

Students investigate the nitrogen cycle in the real-world context of a sewage treatment plant. They design an experimental investigation to test the effect of different nitrogen compounds on plant growth and draw conclusions about the importance of minimising nutrient levels in sewage treatment discharge into Port Phillip Bay and Bass Strait.

### Duration

Two period sessions for research. One period session for design and set up of experiment. Allow about one to two weeks for plants to grow and students to make measurements. One period session for analysis of results.

### Equipment

Some equipment students may need includes:

petri dishes or saucers

thermometers

hygrometers

growing lamps

time-lapse cameras/software/applications

data loggers.

### Activity steps

**The nitrogen cycle**

1. In small groups, students use the internet to research the nitrogen cycle and its importance for life on Earth. Ask them to also research the sources of nitrogen in sewage. Students use ICTs (e.g. PowerPoint, Keynote) to prepare a simple animation depicting the nitrogen cycle including sewage processes.
2. Discuss as a class how nitrogen compounds might get into sewage and why it is necessary to control the nitrogen levels in effluent before the effluent is released.

**Nitrates in the environment**

1. Review students’ ideas about the nitrogen cycle. Discuss the fact that plants need nitrogen to make proteins and nucleic acids to grow and be healthy. However, if nitrogen levels get too high in waterways this can promote rapid plant growth. This rapid growth can, in turn, result in reduced dissolved oxygen levels because, as the plants die, the aerobic bacteria that decompose them use up the oxygen in the water. Reduced oxygen levels can cause the death of other aquatic life that requires oxygen.
2. Students work in groups to design an experiment that investigates the effect that different nitrogen compounds have on the growth of wheat, alfalfa, watercress or other fast-growing seeds. They need to consider necessary controls and how they will determine the rate of growth before commencing the experiment. Students are to consider factors that may affect the dissolved oxygen levels in the samples and how they will be controlled in their experiment. Further details of the activity can be found in **Student worksheet: Nitrogen and plant growth**. Ensure that all safety requirements are followed.
3. Allow about one to two weeks for plant growth.
4. When students have drawn conclusions from their observations and related them to the need to control nitrogen levels in the effluent released from the sewage treatment plants into the sea. Discuss how high nitrogen levels could have a detrimental effect on the marine environment.

Note: This task could be used for assessment purposes to assess student understanding of the selection of appropriate equipment and measurement procedures that will ensure a high degree of reliability in data collected and enable valid conclusions to be drawn.

## Student worksheet: Nitrogen and plant growth

## Introduction

Plants need nitrogen to make proteins and nucleic acids to grow and be healthy. Nitrogen is found naturally in the atmosphere and in the soil, but even though there is an abundance of nitrogen available, the most common form of nitrogen (N2) cannot be used by plants. Nitrogen can be combined chemically with oxygen or hydrogen to form nitrogen compounds that plants can use. These nitrogen compounds can be added to the soil in the form of ammonium (NH4+) and nitrate (NO3–) fertilisers.

If nitrogen levels get too high in waterways, this can promote rapid plant growth. This can result in the reduction of dissolved oxygen levels because, as the plants die, the aerobic bacteria that decompose them use up the oxygen in the water. Reduced oxygen levels can cause the death of other aquatic life that requires oxygen.

In this activity you are to design an experiment to demonstrate how different nitrogen compounds affect plant growth.

### Hypothesis

What do you think you are going to find out?

### Controls

Consider factors that may affect the dissolved oxygen levels in the samples and how they will be controlled in your experiment. Record them in a table like the one below.

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| --- | --- | --- |
| **Control factor** | **Effect** | **Method of control** |
| Amount of light | Amount of light will affect rate of growth | Keep all plants under the same lighting conditions |
|  |  |  |
|  |  |  |

### Equipment

quick-growing seeds (e.g. wheat, alfalfa, water cress, radish)

solutions of nitrate and ammonium compounds of different concentrations

list any other materials or equipment you may need (refer to outline for Post-activity 1 Nitrates in the environment).

### Procedure

Describe what you will do, considering the necessary controls, and how you will measure the growth of the plants.

### Observations and results

Use tables and graphs to record and display your observations.

### Conclusions

What has this experiment shown about the role of nitrogen in plant growth?

Why is it necessary to limit the number of nitrogen compounds in effluent before it is released into Port Phillip Bay or Bass Strait?

How are nitrogen levels in the effluent reduced during the sewage treatment process?

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