# Activity: Dissolved oxygen and aquatic ecosystems (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 |

Dissolved oxygen is an indicator of the health of aquatic ecosystems. It is a measure of the amount of dissolved oxygen needed by aerobic organisms to break down the organic material present. It is widely used as an indicator of organic pollutants in water and, as such, gives a measure of the effectiveness of the sewage treatment process.

Students conduct an experiment to observe the effects of varying dissolved oxygen levels on the organisms present in pond water. They consider the implications of this for sewage treatment processes.

### Duration

Two period sessions with at least 24 hours between them

### Equipment

Some equipment students may need includes:

fresh water sample from a local stream or pond

beakers

jars

USB or stereo microscope

graduated cylinder

dissolved oxygen meter

petri dishes

pipettes

fish-tank pump, tubing and air stones.

### Activity

1. Students undertake the experiment as outlined in the **Student worksheet: Dissolved oxygen and aquatic ecosystems** to determine the effect of oxygen levels on aquatic organisms. They then analyse their observations and relate them to the use of the measurement of oxygen levels as a viable indicator of water quality. Students present their results in a suitable format. Ensure that all safety requirements are followed.
2. Discuss how the method used by students can determine the biological oxygen demand of the water at various stages in the treatment process and as a measure of the quality of the effluent released from the treatment plants.

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: Dissolved oxygen and aquatic ecosystems experiment

### Introduction

In this activity you will conduct an experiment to observe the effects of varying dissolved oxygen (DO) levels on the organisms present in pond water. You will then consider the implications of this in sewage treatment.

Oxygen enters the water as rooted aquatic plants and algae undergo photosynthesis, or by direct transfer across the air-water interface. The amount of oxygen that can be held by the water, the dissolved oxygen, ranges between 0–18 ppm (parts per million) under normal conditions and depends on the water temperature, salinity and pressure.

DO is an important indicator of a healthy aquatic ecosystem as oxygen is essential for respiration by aquatic animals. To support a diverse population, natural systems generally require DO levels of at least 5–6 ppm. If organic matter such as animal waste or improperly treated sewage is introduced to the system, algae growth can increase. As the algae die off and decompose, oxygen is consumed by aerobic bacterial action which can cause DO levels to fall below those needed to support some aquatic species, upsetting the balance in the ecosystem.

### Hypothesis

How do you think the DO levels of the samples will change over the 24-hour period and how will this affect biodiversity?

### Controls

Consider factors that may affect the DO 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** |
| Temperature | Increased temperature will decrease the solubility of oxygen in water | Measure the DO at the same temperatures |
|  |  |  |
|  |  |  |

### Materials

fresh water sample from a local stream or pond (follow safety procedures)

1,000 mL beaker or large container

3 x 500 mL beakers or jars to set up miniature water ecosystems

USB or stereo microscope

500 mL graduated cylinder

dissolved oxygen meter or test kit

petri dishes

pipettes

fish-tank pump, tubing and air stones set up to provide air to two beakers regulator or paper clip to reduce the air flow to Beaker 2.

### Procedure

1. Take an approximate 1,000 mL sample of the water from a local stream or pond.
2. Pour a portion of the sample into a petri dish and examine it under the microscope.
3. Capture photographs, draw or describe in detail the types and numbers of living organisms you observe.
4. Use the DO meter to measure the DO level of the water sample.
5. Measure three equal samples of the water into three beakers or jars and label as follows:

Beaker 1 – Control. No aeration

Beaker 2 – Slight aeration

Beaker 3 – Increased aeration

1. Place the beakers in an area where they will not be disturbed for 24 hours. Connect Beakers 2 and 3 to the fish-tank pump.
2. Reduce the flow of air to Beaker 2 using the regulator or paper clip so it is about half that going into Beaker 3.
3. Leave the beakers undisturbed for 24 hours, ensuring that the pump keeps running.
4. After 24 hours, place a sample from each beaker into a petri dish and view them under the microscope. Photograph, draw or describe in detail the types and numbers of living organisms you observe.
5. Use the meter to measure the DO level in each beaker and record your results.

### Results and observations

Devise a suitable table to record your observations and measurements.

### Conclusions

Does the data collected support your hypothesis? Why or why not?

Write a short paragraph explaining how each water sample changed based on the DO levels.

What can you conclude about the DO levels and biodiversity?

What implications do your findings have regarding the discharge of effluent from sewage treatment plants?

How does the treatment process at the plant you visited control the DO level of its effluent water?

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