**ACTIVITY: Nutrient impact experiment**

**Activity idea**

In this activity, plastic bottles are used to simulate the link between land and sea. Students investigate some of the potential impacts increased nutrient use on land can have on the marine environment.

By the end of this activity, students should:

* understand some of the possible impacts on the marine ecosystem of agricultural nutrient run-off and leaching
* discuss human impacts on life in the sea and understand that land and coastal ecosystems are not discrete
* understand what is meant by the term ‘fair testing’.

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**Introduction/background**

Many people think of land and coastal systems as discrete or separate from each other. However, they are intricately linked – what we do on land can have a significant impact on life in the sea.

Water is the most important link between the 2 ecosystems. As water makes its way via groundwater, drains, streams and rivers into our oceans, it picks up sediments, nutrients and contaminants along the way. In New Zealand the impact of agricultural run-off, in particular of nutrients, is a major concern.

Eutrophication is the result of a particular type of marine pollution. It is caused by the release of excess nutrients into coastal areas via streams and rivers. These nutrients, such as nitrates and phosphates, come from fertilisers and animal wastes from intensive farming practices on land. Additional nutrients in the sea can lead to excessive phytoplankton growth that results in ‘blooms’. When these large numbers of organisms die, the sharp increase in decomposition of the dead organisms by oxygen-using bacteria depletes oxygen levels. In some cases, this can result in the death by oxygen-starvation of large numbers of other organisms such as fish.

With careful management, it is possible to reduce the amount of agricultural run-off into coastal areas. For example, applying smaller amounts of fertiliser, ensuring there are buffer zones of nutrient-hungry plants between farmland and surface water (such as lakes and rivers) and preventing the discharge of effluent into surface water.

**What you need**

* 2 clear soft drink bottles of equal size (choose bottles with easy-to-remove labels) for growing
* Sharp scissors or craft knife
* Electric drill or nail and candle
* Stapler
* Aquatic plants, for example oxygen plant or duck weed
* 200mls of water (if possible, let this sit in an open container for 24 hours first)
* Approximately 2 cups of sand
* 2 potted, sun tolerant plants, for example small houseplants approximately 7–10cm high
* Liquid plant food
* 2 empty bottles for feeding, for example, milk bottles
* 100ml measuring container
* Permanent marker

**What to do**

1. Prepare the experiment (see [experiment photos](#photos)):
* Clean the 2 growing bottles and remove the labels.
* Cut the top off each bottle about 8-10cm from the top of the lid. (Mark where you want to cut the bottle. Lay the bottle in an open drawer. Rest the pen on the top of the drawer, with the point touching the bottle. Rotate the bottle, creating a cutting line.)
* Drill 3-5 small holes in the lids of the bottles (use an electric drill or a nail heated over a candle flame) and screw them back on,
* Irrigate the sand to remove any traces of nutrients by placing it in a sieve and running water through (outside with a hose is best).
* Wash the soil off the plant roots to remove any traces of nutrients
1. Before you run the experiment, as a class:
* Watch the video clip [Farmland run-off into estuaries](http://link.sciencelearn.org.nz/videos/34-farmland-run-off-into-estuaries).
* Read the article [Estuaries and farmland run-off](http://link.sciencelearn.org.nz/resources/138-estuaries-and-farmland-run-off).
1. Explain the experiment. Discuss what the term fair testing means and why this is important in science. (It is important to keep all variables identical except for the solution used to water the plants (for example, weighing the plants, using the same amount of sand and so on.) Discuss with students the importance of having a control.
2. Conduct the experiment (involve students in these steps as much as possible – see [experiment photos](#photos)):
* Place 100mls of water in the bottom of each bottle.
* If possible, weigh the aquatic plants and place an equal amount in the bottom of each bottle.
* Place the tops of the bottles upside down inside the bottom sections
* Staple the tops to the bottoms (4–5 staples around the edge).
* Add sand and 1 small plant to the top part of each bottle
* Label the growing bottles ‘control’ and ‘experiment’.
* Mix up 2 solutions:
	+ 1 litre of tap water
	+ 1 litre liquid plant food solution made according to product instructions.
* Label each feeding bottle ‘Water’ and ‘Plant food (Do not drink)’,
* Add 50ml of water to the control bottle and 50ml of plant food to the experiment bottle.
* Keep the plants in moderate sunlight.
* Feed the plants as above 3 times per week (for example, Monday, Wednesday and Friday) for about 4 weeks.
1. Ask students to record their observations and include sketches and/or digital photographs. (Results will depend on the type of plant food used and frequency of watering.) What they might observe:
* Increased growth of the aquatic plants in the experiment bottle due to the increased nutrients from the plant food.
* Die-off off the aquatic plants in the experiment bottle due to too many added nutrients.
* Initial growth increase in the experiment bottle and then a die-off.

**Extension ideas**

Students could investigate different nutrient concentrations, different types of soil instead of sand or different types of plant.

**Discussion questions**

* What does the top section of the bottle represent?
* What does the bottom section of the bottle represent?
* What does the plant food represent?
* What differences do you observe between the two bottles?
* What has happened to the plants in the sand?
* What has happened to the aquatic plants?
* What do you think would happen if we added more/less nutrients to the experiment bottle?
* How do you think nutrients end up in the coastal environment?
* Is there anything that can be done to minimise or prevent nutrient run-off?

**Experiment photos**

