Activity 5: Experimenting with water

Let's investigate how water moves in an estuary and how salt water and fresh water mix

CURRICULUM LINKS

Learning areas	Learning intentions	Success criteria
Science: Levels 1–4 ▪ Material World: Properties and changes of matter (levels 1–4). ▪ Planet Earth and Beyond: Earth systems (levels 1–2). ▪ Planet Earth and Beyond: Interacting systems (levels 3–4). ▪ Nature of Science: Investigating in Science. **Science capabilities** ▪ Interpret representations. ▪ Engage with science. **Te Marautanga o Aotearoa** **Pūtaiao:** The natural world.	**Students are learning to:** ▪ investigate how water moves and behaves in estuaries ▪ compare physical changes and buoyancy in salt water and fresh water.	**Students can:** ▪ observe water moving through the catchment and estuary and/or make a model of an estuary and describe how water moves through it ▪ observe and describe how salt water and fresh water mix and have different densities, which affect buoyancy.

CONTENTS

BACKGROUND NOTES

THINKING LIKE SCIENTISTS

The experiments and models in this activity encourage students to thnk and act like scientists. Scientists make predictions and then test their predictions by making observations, gathering and interpreting data, looking for patterns and trends, and critiquing their evidence. Students should be encouraged to engage in these science capabilities before, during and after their visit to an estuary, as part of their inquiry.

For further information, see the Te Kete Ipurangi (TKI) *Science Online website*.

Introducing five science capabilities

ESTUARIES: WHERE SALT WATER AND FRESH WATER MIX

Saltwater wedge. *Photo: Shan Walker, EfS Initiatives*

Salt water and fresh water are constantly mixing and interacting in estuaries. As the tide goes in and out and the river flows change, the salinity of the water (amount of dissolved salts) also changes. Salt water is more dense and heavier than fresh water as it contains more mineral salts and organic matter. Therefore, the fresh water will often sit on top of the salt water where the two meet, with the salt water forming a layer underneath, sometimes in a wedge shape.

In the photograph on the left, blue fresh water has been added to yellow salt water, causing the areas of water mixing to turn green. The saltwater wedge is visible in the middle of the container.

Saltwater wedges are important places in estuaries, as fishes such as īnanga lay their eggs there. For more information about saltwater wedges and īnanga, see Whitebait Connections *Inanga/whitebait* resource.

Inanga/Whitebait Finding the saltwater wedge

The saltwater wedge that is produced in an experiment will be shorter lived than that which occurs in nature, where the water usually mixes more slowly. As mixing of the salt water and fresh water increases, they will combine to become 'brackish' (salt water and fresh water mixed together).

BUOYANCY IN SALT WATER AND FRESH WATER

Buoyancy is the ability of an object to float. Objects and living things are able to float more easily in salt water than in fresh water, ie they are more buoyant in salt water – and the saltier the water (the higher the salinity), the more buoyant an object will become. However, buoyancy also depends on the density of the object – a very dense object will sink in both fresh water and salt water.

ESTUARY ANIMALS AND CHANGES IN SALINITY

Estuary animals need to cope with changes in the salinity of the water in the estuary as the tides change, and must also adjust to the different amounts of mineral salts, oxygen and organic matter, as well as their different buoyancies.

Animals have many physical and behavioural features/adaptations that allow them to cope with these conditions.

How do cockles behave in different salinities?

Cockles feed by filtering the water (see *Activity 4: Life in an estuary*). They will close in fresh water and open in salt water.

Note: If cockles are kept in salt water, they will keep filtering the water until they run out of oxygen.

Adult cockle opening up. *Photo: Helen Kettles, DOC*

LEARNING EXPERIENCE 5:

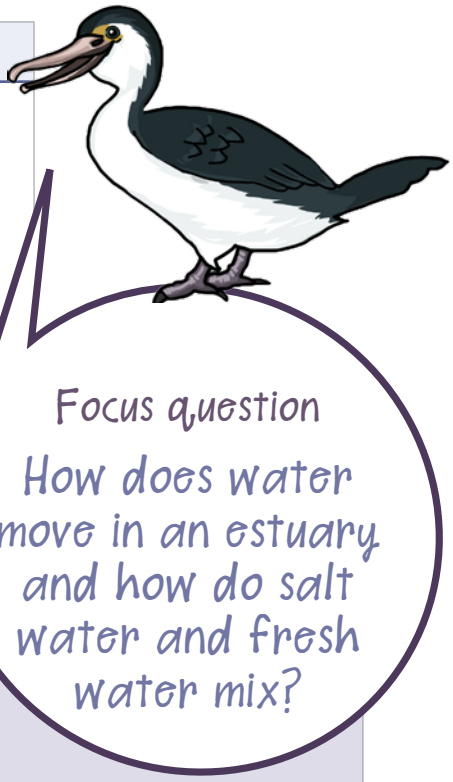
EXPERIMENTING WITH WATER

Resources for this activity

- Student worksheet Experimenting with fresh water and salt water (page 10).
- DOC's Fresh water and salt water mixing video.
  Fresh water and salt water mixing
- The following materials: fresh water, salt water (or fresh water + sea salt), several containers, jugs or jars, food colouring, camera or device for filming, and pieces of fruit/vegetable (eg celery, peas or berries).

Vocabulary

Prediction, experiment, method, buoyancy, mixing, density, float, observe.



Links

To open the links throughout this resource without losing your place in the document, follow either of these steps:

- Right click on the link and click **Open Hyperlink**. Now the link will be opened in new tab.
- Hit the **Ctrl** key while you left click the link. This will also force the browser to open the page in a new tab.

Either of these methods will open the link in a new tab leaving the teaching resource open.

INTRODUCING STUDENTS TO EXPERIMENTING WITH WATER

Note: These learning experiences are suggestions only. Teachers are encouraged to adapt and change the material to suit their students' needs and interests.

Inquiry stage 3: Investigate

Investigating estuaries

- Look back at the inquiry questions and prior knowledge of students in *Activity 2: The importance of estuaries*.
- Could any of these inquiry questions be answered using an experiment? Use concept cartoons to share thoughts about how you could test students' ideas about water and estuaries. See the Science Learning Hub's concept cartoons activity.

  Using concept cartoons to explore students' scientific thinking

Observing water moving in your catchment and estuary

- If possible, go for a walk around your catchment area and see where fresh water is moving towards the salty water of the sea. (*Notice that the water always flows downhill, towards the sea.*)
- Identify areas where you can see fresh water and salt water mixing. These areas are part of your estuary. What do you notice about the part of the estuary where the river/stream/fresh water enters the saltier estuarine water? What do you notice when the tide comes in and more salt water mixes in with the fresh water?

Modelling water movement in an estuary

- Make a model of an estuary in your school sandpit or at your local beach. Include rivers, streams, the wider catchment, the estuary and the sea in your model. Streams and rivers are higher in the catchment than estuaries and the ocean. Pour water on the model to see where it goes. Notice that water always moves downhill (with the force of gravity) and will sink down into the sand. Explore students' questions and test ideas about water movement using your model.

Sand model of a catchment.
Photo: Shan Walker, EfS Initiatives

Experimenting with the mixing of salt water and fresh water

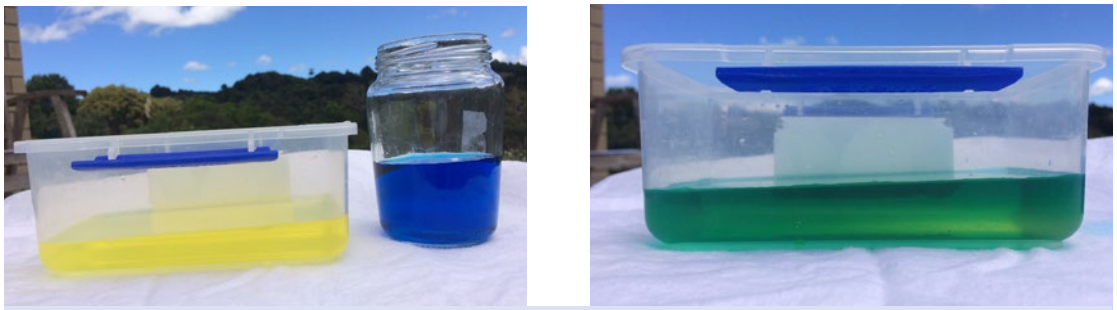
- Experiment with salt water and fresh water. How do your students think salt water and fresh water will mix? Make predictions.
- Test the students' predictions with an experiment. For example, you could collect salt water or make some by mixing a few tablespoons of sea salt with tap water, and colour the salt water and some fresh water with distinctive colours, eg blue for the fresh water and yellow for the salt water.
- Students could investigate how salt water and fresh water mix by pouring the water samples into separate containers and observing what happens when they mix (see examples on the following page). Try to simulate natural situations that may occur, eg the tide coming into the estuary (salt water mixing into fresh water) or the river flowing into the estuary/sea (fresh water flowing into salt water).

- Record your predictions, what you did and your conclusions in a format that suits your students, eg by using the template provided on page 10.
- How could changes in the tides, water depth, water flow and salinity affect estuary animals? For example, what do animals do when the tide goes out? (Bury themselves, crabs go into holes, birds come to feed.)

Example experiment

- *Prediction:* Students predicted that the salt water and fresh water would mix easily and become a less salty combined solution.
- *What we did:* To test this idea, we slowly poured fresh water into a container of salt water and observed what happened. We also filmed this in slow motion to detect any subtle changes.
- To see this experiment in action, watch DOC's video.

  Fresh water and salt water mixing



Before (left) and after (right) the mixing of yellow salt water with blue fresh water. Notice the green-yellow band of salt water at the bottom of the container after mixing. *Photos: Shan Walker, EfS Initiatives*

- *Observations/results:* We noticed that when we poured the fresh water into the salt water very slowly, it stayed towards the side of the container we poured it into. Then, as more fresh water was poured in, it crept over to the other side, forming a layer on top of the salt water. There was a wedge shape of salt water on that side. As we kept pouring, the fresh water kept flowing over the salt water. After leaving the experiment for 20 min, the fresh water had mixed with the salt water. Some more yellowish green water was left at the bottom of the container.
- *Conclusions:* We decided that the fresh water seemed to be lighter or less dense than the salt water, as it stayed towards the top of the container. The salt water seems to be more dense/ heavier than the fresh water because it stayed at the bottom of the container.

Examining buoyancy in salt water and fresh water

Experiment with buoyancy by trying to float objects in salt water and fresh water.

- Try using different types of fruits and vegetables. We found that celery, snow peas and blueberries had different buoyancies, floating in the salt water and sinking in the fresh water. Why would this be the case? (Salt water is more dense than fresh water; see teacher notes.)
- How could this difference in buoyancy affect estuary animals?

Fruits and vegetables placed in salt water (yellow) and fresh water (blue). *Photo: Shan Walker, EfS Initiatives*

REFLECTING ON LEARNING

Animal behaviours in salt water and fresh water: cockles

- Cockles are commonly found in estuaries around New Zealand. This keystone species is very important in the food chain, with its disappearance from an ecosystem potentially having devastating effects.
- For more information about cockles, see the Science Learning Hub's *Cockles* article.

  Cockles
- To learn about how cockles deal with changes to their habitat (eg how mud affects them), view the following Living Waters video.

  How does mud affect cockles
- Also see the shellfish observation activity in *Activity 4: Life in an estuary*.

Cockles provide a hard surface for plants and small animals such as limpets and anemones to live on. *Photo: Helen Kettles, DOC*

EXTENDING LEARNING

- Find out what lives in your estuary and regularly monitor its biodiversity by joining the University of Otago's New Zealand Marine Studies Centre's Marine Metre Squared project.

  Mm2 survey on a rocky shore
- Investigate your estuary further or regularly monitor changes over time. To find out which monitoring options and equipment are available, contact your local council or Whitebait Connection.

  Waterway monitoring

OTHER RESOURCES RELATING TO EXPERIMENTING WITH WATER

- Aveley Lab Science Guys' salt water density science experiment video:

  Quick salt water density science experiment
- Whitebait Connection resources:

  Waterway monitoring

  Instream workshops
- Science Learning Hub's *Temperature, salinity and water density* activity:

  Temperature, salinity and water density
- Science Learning Hub's *Ocean salinity* article:

  Ocean salinity

- Science Learning Hub's *Buoyancy in water* activity:

  Buoyancy in water
- Science Learning Hub's *Marine organisms and adaptations* article:

  Marine organisms and adaptations
- University of Otago New Zealand Marine Studies Centre's Marine Metre Squared project website:

  Mm2 survey on a rock shore

Experimenting with salt water and fresh water

Predictions and ideas (what we think might happen)	Steps (what we did)	Observations/results (what we saw)

How can we explain these results?

Conclusions:

Google Docs version: Experimenting with salt water and fresh water.