**ACTIVITY: Water temperature**

**Activity idea**

In this activity, students look at what happens when hot and cold water meet.

By the end of this activity, students should be able to:

* discuss how temperature affects the density of water
* discuss how temperature and density affect ocean currents
* discuss how wind can mix up the layers of warm and cold water.

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**Introduction/background**

This activity looks at what happens when hot and cold water meet.

Each water molecule is made up of two hydrogen (H) atoms and one oxygen (O) atom. The bonds between water molecules are called hydrogen bonds.

Water density changes with temperature. Water is densest at 3.98°C and is least dense at 0°C (freezing point). When water is cooled to 3.98°C, its mass stays the same but its volume decreases – the same mass fits into a smaller space so it is more compact.

When water freezes at 0°C, the mass stays the same but its volume expands by 9%. In liquid water, molecules are attracted to each other and temporarily held together by hydrogen bonds.

When water freezes at 0°C, a rigid open lattice (like a web) of hydrogen-bonded molecules is formed. It is this open structure that makes ice less dense than liquid water. This is why icebergs float.

The temperature of seawater varies all over the world. The ocean waters near the Arctic and Antarctic will be considerably colder than the water near the equator. Because water temperature affects its density, it also affects how water moves in the ocean and the way deep ocean currents move. The articles [Ocean motion](https://www.sciencelearn.org.nz/resources/691-ocean-motion) and [Ocean temperature](https://www.sciencelearn.org.nz/resources/707-ocean-temperature) explain this occurrence in greater detail.

This activity has been adapted from the SEREAD Programme developed in conjunction with NIWA.

**What you need**

* Access to the articles [Ocean motion](https://www.sciencelearn.org.nz/resources/691-ocean-motion) and [Ocean temperature](https://www.sciencelearn.org.nz/resources/707-ocean-temperature)
* Copies of the student handout [What happens when hot and cold water meet?](#handout)
* Iced water
* Hot water
* 500 ml beaker
* 2 x 30 ml beakers
* Red and blue food colouring
* Dropper
* Red and blue coloured pencils
* Straw

**What to do**

1. Introduce this activity by viewing the articles [Ocean motion](https://www.sciencelearn.org.nz/resources/691-ocean-motion) and [Ocean temperature](https://www.sciencelearn.org.nz/resources/707-ocean-temperature) with the class.
2. Hand out copies of the student handout [What happens when hot and cold water meet?](#handout) and assist small groups to gather the materials they need and conduct the experiment. Discuss the results and the questions on the student worksheet.

**Extension idea**

* The article [Ocean motion](https://www.sciencelearn.org.nz/resources/691-ocean-motion) has map images of ocean gyres and New Zealand surface currents. Students may enjoy viewing these maps and the video [Big ocean currents](https://www.sciencelearn.org.nz/videos/347-big-ocean-currents) to learn more about water temperature, salinity and density and the ways in which they influence ocean currents and weather.

**Student handout: What happens when hot and cold water meet?**

1. ¾ fill the 500 ml beaker with tap water and leave to adjust to room temperature.
2. ½ fill one of the 30 ml beakers with hot water and add some red food colouring.
3. Repeat with the other beaker, adding iced water and blue food colouring.
4. Gently add a few drops of red hot water to the room temperature water.
5. Then add some blue cold water.
6. Hold a straw at the edge of the top of the beaker so that it is parallel to the water surface. Blow gently through the straw.
7. Draw pictures using red and blue coloured pencils to show what happens to the water. You may need to do several pictures over a period of time.
8. Discuss these questions in your group:

* What happens to the hot and cold water? Do they mix?
* What would happen when the polar cold water meets the tropical hot water?
* What do you think the density of seawater would be like compared to freshwater?
* What happens to the water when you blow on it?