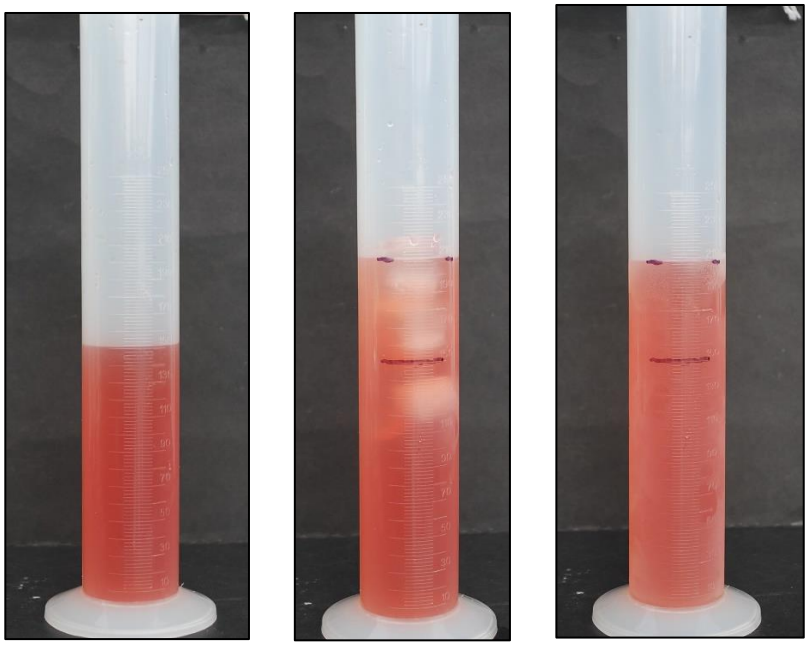
Melting ice and sea level change 1 – sea ice
Does sea level change when floating sea ice melts?

Investigate the effects of the melting of floating sea ice on water levels, linking to discussions about rising world sea levels. Use a large measuring cylinder (or similar container) of tap water to represent the sea, and a mass of crushed ice to imitate floating sea ice, which forms in the winter when the sea surface freezes in polar regions.

A sledge party camped on sea ice in the Antarctic. The ice formed during the previous winter and has not yet melted or broken up. (*All photos: P. Kennett*)

For a 250ml measuring cylinder add warmish water up to about the 150ml mark. Add some crushed ice to the water and write down the new level of the water (measure the base of the meniscus and not the top of the ice). Predict what will happen to the water level as the ice melts. When it has all melted, measure the height of the meniscus again and note any difference from the original reading. Discuss the outcome, which may surprise some pupils.

Sledging over the winter's sea ice in early Spring.



1. 150 ml of coloured water 2. 210 ml after adding ice, 3. where the level remained after it had all melted

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The back up

Title: Melting ice and sea level change 1 – sea ice

Subtitle: Does sea level change when floating sea ice melts?

Topic: Investigate the impact on water levels of allowing floating ice to melt.

Age range of pupils: 7 years upwards

Time needed to complete activity: 10 minutes

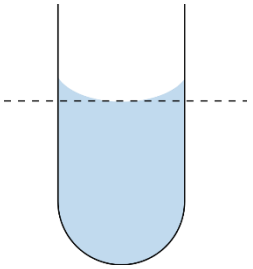
Pupil learning outcomes: Pupils can:

- read the height of the meniscus of a liquid in a container accurately;
- understand why floating ice does not change overall water levels when it melts;
- apply their classroom observations to the topic of world sea level rise.

Context: There is much misunderstanding of the impact on world sea level of melting sea ice, which this simple activity should dispel.

Adding food colouring to the water makes the demonstration more visible to pupils.

The method of measuring the base of the meniscus is shown in the diagram below.



The photograph below shows how new sea ice forms at the beginning of winter.

Pancake ice forming.

Following up the activity:

- It can be demonstrated that the total mass of the water plus floating ice does not change as the ice melts. After adding the water to the measuring cylinder, weigh it and note the reading. Weigh the ice separately and calculate the total mass of measuring cylinder, water and ice. Add the ice to the water in the measuring cylinder. Whilst it is melting, ask the class what changes, if any, they expect to see in the total mass. When the ice has all melted, weigh the measuring cylinder and its contents again and compare with the initial total mass, which should, of course, be the same.
- Carry out the related Earthlearningidea activity, *Melting ice and sea level change 2 – ice caps,* which simulates the melting of land-based ice caps and glaciers, and compare the results.

Underlying principles:

- Water is one of very few liquids which expand, rather than contract, on freezing.
- Ice has a lower density than water, so equal masses have different volumes.
- It is because ice has a lower density than water that it floats.
- A 'large' volume of ice melts to give a smaller volume of water.
- The melting of sea ice does not explain rising sea levels
- However, when water warms, there is a very small increase in the volume of the water due to thermal expansion.
- The above principles also apply to floating ice on the edge of a continent, called shelf ice. Shelf ice is often several hundred metres thick and forms over centuries, not just one or two winters.

Thinking skill development: Thought processes of construction are involved when observing the outcomes of the demonstration. Bridging skills are needed to relate the observations to the real world.

Resource list:

- large measuring cylinder (e.g. 250ml or 500ml), or similar transparent container
- water
- crushed ice
- (optional) food colouring
- (optional) hair dryer to speed up melting rate [with due regard to electrical safety]
- (optional) electronic balance

Useful links:
https://www.earthlearningidea.com/PDF/180_Ice_power.pdf
https://earthlearningidea.com/PDF/323_Melting_ice_2.pdf"

Source: Earth Science Education Unit *Teaching Science in an Earth context.*