Melting ice and sea level change 2 – ice caps
Does sea level change when ice caps melt?

The Antarctic continent and Greenland are largely covered in ice, up to 3 km thick. The ice sheets are often referred to as ice caps.

This activity investigates what will happen to sea level across the world when these ice caps melt.

The ice cap on top of the Antarctic Peninsula, with glaciers in the foreground flowing down to the Larsen Ice Shelf

To demonstrate the principle of ice-cap melting, carefully place solid objects in the bottom of a large beaker, e.g. 500ml. In the photograph below two small slabs of rock have been used, to represent a continent, but in a laboratory situation several 100g masses may be used instead.

1. Coloured water up to about 280 ml.

2. Ice cubes added and water level marked.

3. Water level rises to 450ml when all the ice has melted.

The activity set up, using slabs of rock to represent a continent

Add enough warm water to surround the masses, but not to flood across the top of them (leave about 2cm clear). Now carefully add a few ice cubes to the top of the masses, ensuring that they do not fall into the water. These represent the ice cap. Measure the depth of water from the base of the beaker, using a ruler placed alongside (or using the marked scale on the beaker), and also mark the level of the meniscus of the water on the glass of the beaker, using a permanent marker pen. Ask the class to predict what will happen to the water level as the ice cubes melt. Either speed up the rate of melting using a hair dryer (with due regard to electrical safety), or carry out another activity, e.g. *Melting ice and sea level change 1 – sea ice*, while the ice is melting

When all the ice has melted, measure the height of the meniscus from the base of the beaker again and mark the new level with the marker pen. Ask the class to explain what has happened. If they have also seen the sea ice model, ask them to explain the differences in outcome.

The back up

Title: Melting ice and sea level change 2 – ice caps

Subtitle: Does sea level change when ice caps melt?

Topic: Investigate the impact on water levels when 'ice caps' melt.

Age range of pupils: 7 years upwards

Time needed to complete activity: 10 minutes

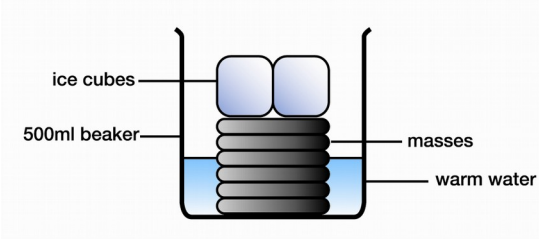
Pupil learning outcomes: Pupils can:
- read the meniscus of a liquid in a container accurately;
- understand why land-based ice increases overall water levels when it melts;
- apply their classroom observations to the topic of world sea level rise.

Context: The outcome of this activity is rather obvious: when continental ice sheets melt, sea level rises, and could rise by several metres if all the world's land-based ice sheets and glaciers melt. However, taken with the work on the 'sea ice' in the *Melting ice and sea level change 1 – sea ice* Earthlearningidea activity (where melting does not cause sea level rise) it will remind pupils of what happens and should enable them to handle press reports more critically.

When the ice cover was at its maximum during the 'Ice Age', ice caps covered much of Britain, northern Europe**,** Asia and America and world sea levels were about 200m lower than at present. It is possible that we are now returning to Earth's more 'normal' state, with no major ice and generally higher sea levels.

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

The diagram shows the same method, using 100gm masses for the 'continents'.



Following up the activity:
- Ensure that pupils have seen the activity *Melting ice and sea level change 1 – sea ice,* and discuss the difference in outcome.
- Show the two photographs below and ask what would happen to sea levels if the ice in the foreground of each photo were to melt. (*1. Starbuck Glacier: Melting ice from the glacier will eventually drain into the sea and contribute to raised sea levels. 2. Larsen Ice Shelf: As the shelf ice melts it will displace its own mass in water and will not cause a rise in sea level. In 2002, most of the Larsen B Ice Shelf, to the north of Cape Disappointment collapsed, producing floating tabular icebergs and much broken ice. As these melt, they will not affect sea level. However, the loss of the 'protection' from the Larsen A and B has led to a threefold increase in the rate of flow of the glaciers coming off the Antarctic Peninsula, which will affect sea level.)*

Travelling up the Starbuck Glacier. The bed of the glacier rests on rock and the ice is up to 700m thick at this point.

A 'rift valley' in the Larsen B Ice Shelf, near Cape Disappointment in 1963. The ice shelf is afloat in sea water and is about 300m thick in this area.

Underlying principles:
- Land-based ice, such as ice caps and glaciers, runs into the sea when it melts and results in raised sea levels.

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.

Useful links:
https://earthlearningidea.com/PDF/322_Melting_ice and sea level change_1- sea ice.pdf"
https://earthobservatory.nasa.gov/world-of-change/LarsenB
https://en.wikipedia.org/wiki/Larsen_Ice_Shelf

Resource list:
- 500 ml transparent beaker or similar
- flat non-floating objects, e.g. 100g masses
- water
- ice cubes
- ruler

- permanent marker pen (water-soluble ink runs in the condensation)
- (optional) hair dryer
- (optional) food colouring

Source: Earth Science Education Unit *Teaching Science in an Earth context.* All photographs by P. Kennett.