

Why does the sea level not change when the ice on the North Pole melts?

When the Greenland ice sheet melts the sea level will rise. The sea level will actually rise by about 7.4 metres if the entire ice sheet melted – luckily this will not happen for thousands of years. However, the ice on the North Pole is melting quite fast. The ice on the North Pole is sea ice. Will the sea level rise when sea ice melts? In this experiment we will test what happens to the sea level when ice melts.

Structure of the experiment:

1. Hypothesis
2. Experiment
3. Evaluation
4. The principle of Archimedes

1. Hypothesis

Have a look at the two pictures below and answer the following questions:

- Do you think water will spill on the table when the ice cubes melts?
- What do you think will happen to the water level when the iceberg melts?

Based on you answers, write down what you think will happen to the sea level when the sea ice on the North Pole melts.



Figure 1: A glass of water with ice cubes, and an iceberg at the coast of Greenland.

2. Experiment

You will need:

- 2 large lumps of ice (leave them in the freezer until you are completely ready to start the experiment)
- 2 flat rocks
- 2 flat rocks
- A measuring tape

Instructions:

- a) Put the two plastic containers on the table and put a rock in each container. Take your two lumps of ice and put one in each container, placing one lump on top of the rock in one container and the other next to the rock in the second container.
- b) Fill water in the containers, but not the same amount in both:
 - In the container where the ice lump is on top of the rock, you fill it with water until it just touches the bottom of the ice. We will call this container A.
 - In the container where the ice is next to the rock, you will fill up water until the ice floats, but don't fill it completely. This is container B.
- c) Measure the water depth in both containers and write it down.
- d) Now you just wait until the ice is melted... it can take several hours depending on the size of the ice lumps.
- e) When the ice is melted in both containers, you will melt the water level again.

Imagine that the ice in container A is the Greenland ice sheet and the ice in container B is the sea ice at the North Pole.



3. Evaluation

What is the difference between the water-level rise in container A and B? Can you from this tell what happens to the sea level when the sea ice melts? Was your hypothesis correct? And do you still believe that the water will spill in the glass in figure 1?

4. The principle of Archimedes

That the water does not rise in the container where the ice is floating is due to what is called Archimedes' principle. An object fully or partly submerged in water will feel lighter than on land. You have probably noticed how it feels when you are swimming. The principle of Archimedes says that the object will feel the exact amount of kilogrammes lighter as the kilogrammes of water that it has replaced. So if a lump of ice of 1 kg is floating, it will replace exactly 1 kg of water. 1 kg of water takes up less space than 1 kg of ice, as water expands when it freezes, and the ice will therefore float. When the ice melts it will become 1 kg of water and take up the same amount of space of the water as the ice did. The water level will therefore not rise as the lump of ice melts.