Sea Ice Thickness -Teacher Notes

Sea ice regulates exchanges of heat, moisture and salinity in Polar Regions. It insulates the relatively warm underlying seawater except where cracks (leads) permit loss. In the Arctic sea ice can build up over many years and be well over 3m thick whereas in the Antarctic sea ice melts and reforms every year. Ice in the Antarctic Ocean averages only 0.5m thick and varies greatly with the seasons.

Aim **To observe if the thickness of ice affects the rate of its melt**

Materials per student

- Two containers. One tall and narrow (plastic drinking cup) and another wide and flat (fast food container or meat tray)
- Water
- Freezer
- Timer/watch
- Basin or pneumatic trough

Method

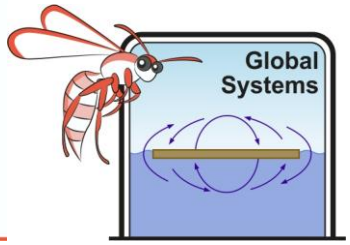
1. Place the same volume of water in each container and freeze until solid.
2. Remove both blocks of ice and float in water at room temperature.
3. Measure how long it takes the blocks to melt.
   To curb student impatience if this is a teacher demonstration, placing the blocks in direct sunlight through a window or using a radiant heater can increase the rate of melting or using heat generated microscope lamps (least effective). My experiment at 32^{o}C indoors had the thinner ice sheet melted in 5 minutes while the four times thicker block took 8 minutes. I selected a container, which would produce one sheet four times thicker than the other to reflect the difference between Arctic and Antarctic sea ice.

Which units shall you use to measure time to ensure precision? Minutes and seconds.

Observations

The thick block (Arctic ice) took _____

The thin block (Antarctic ice took _____



Sea Ice Thickness -Teacher Notes

Conclusion

Did the thickness of the ice affect its rate of melting? Yes. Thin ice melts faster than thick.
Why would this be? The thin ice had a greater surface area to absorb radiant heat. Conduction is a slow process but the thinner the ice the less time it would take. Thin ice contains less air and thus less insulation.

Discussion

How could this activity be improved? Float ice on a 3.6% saline solution to represent seawater. Ensure one sheet was four times thicker than the other to reflect difference between Arctic and Antarctic sea ice. Repeat and average results.

How does this activity relate to penguins?

1. Most penguins live in the Southern Oceans on thinner (Antarctic) ice.
2. Penguins have to cross shelf ice to travel from their rookeries (nesting places) to reach open sea where they can forage for food.
3. Early ice break up may cause some penguins to float away from their rookeries leaving their young to perish
4. They also rest and recover from hunting fish on sea ice.
5. If ice is too thick they may have to travel too far to reach open water.
6. If ice melts too quickly they will have no resting areas.

An Adélie penguin

Melting of sea ice and snow will result in ocean warming. The effect is called "polar amplification"

Extension

Design an experiment to find out the effect that increasing air temperature and water temperature will have on rate of melt.
Some climate change modelling suggests that temperatures will increase by 4°C in the next one hundred years. Design an experiment to find out the effect that increasing air temperature one degree every 25 years will have on rate of sea ice melt.

Students may wish to use the headings below to rough out their experiments.

Aim To observe how four increases of 1°C affect sea ice thickness_____(1 mark)
Dependant Variable Thickness of ice_____(1 mark)
Independent variable Increments of 1°C _____(1 mark)
Which variables will be controlled? Same ice thickness, same water, no wind etc. ____(3 marks)

Materials (Selected for accuracy and precision) _____(4 marks)
Method _____(4 marks)
Results/observations Should readings be represented as a graph or a table? If a graph is chosen, which style of graph should it be? Remember to include units. _____(4 marks)

Remember to include your rough draft with your final copy. Total /18 marks