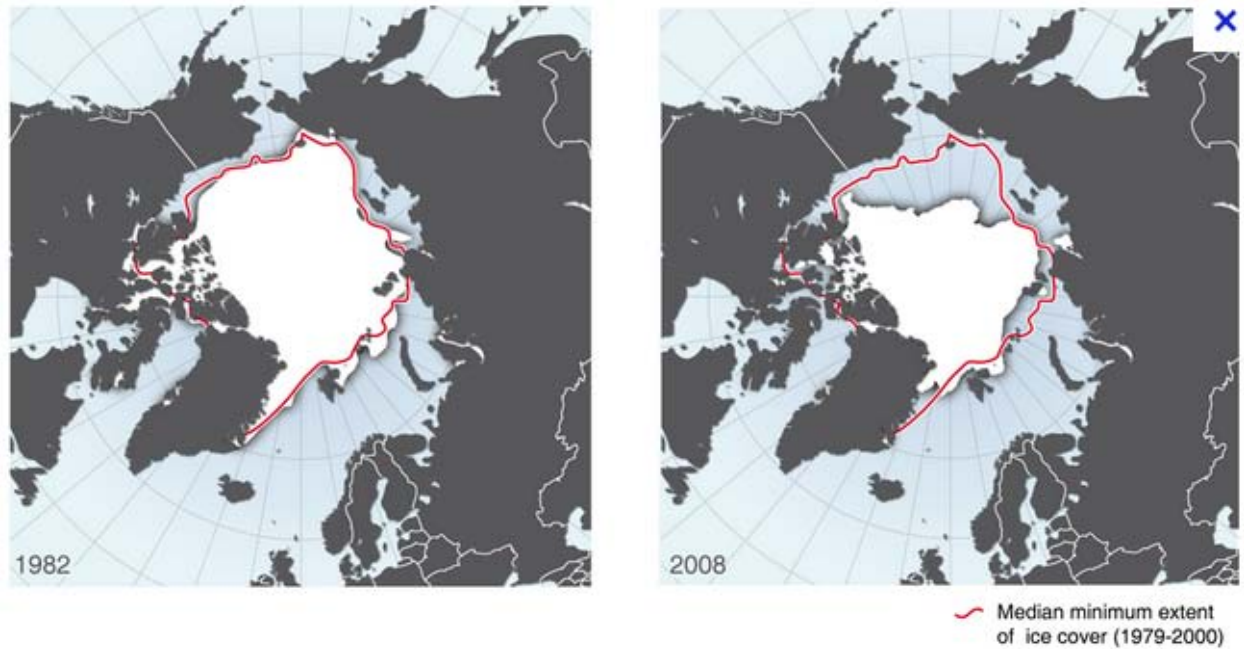


The Hydrosphere's Cryosphere:

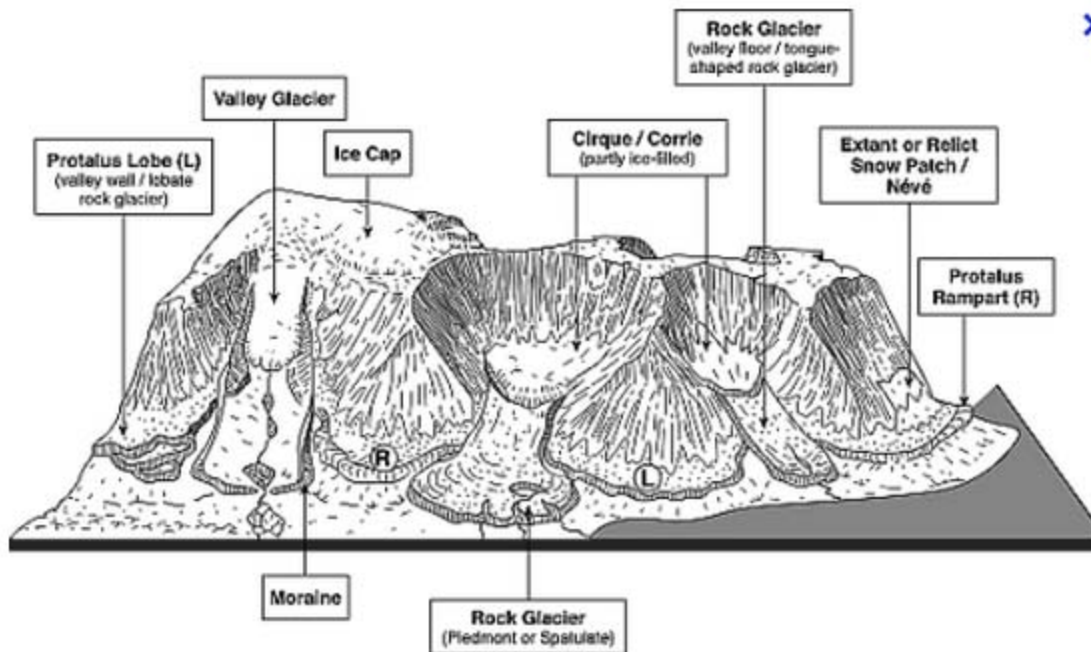
A-Pack Ice: (Sea Ice) They are large sheets of ice found in the oceans around Antarctica and in the Arctic Ocean. Smaller ones are called *ice floes*.



Example 1: What are the consequences of melting pack ice?

It affects polar bears but does not cause a rise in sea level if the ice was already floating . Only if ice slips from land into water does it cause the water level to move up.

B-Glaciers: These persistent sheets of ice at least 50 m thick are found on land, on mountaintops at mid or high latitudes and elsewhere on continents. Large glaciers are known as ice sheets or ice caps.



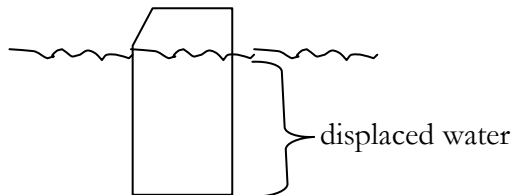
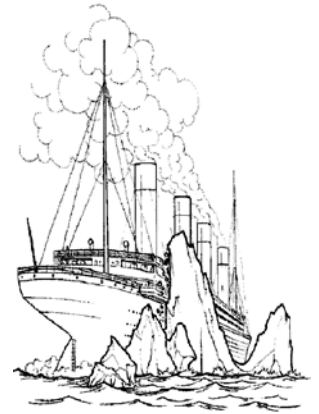
Example 1 How do glaciers form?

They form from the continuous accumulation of snow and ice season after season in areas where ice does not completely melt in the summer. Eventually enough pressure builds up from the weight of ice above that the underneath layer becomes wet ice and causes the glacier to move.

Example 2 a) How are glaciers related to icebergs?

It's a piece of a glacier that slides to the ocean and breaks off.

b) **STE only** Prove that over 90% of an iceberg is submerged. The density of ice is 0.917 g/cm^3 . Use the idea that the buoyant force is the product of g and the **mass of water displaced** by a floating object. The buoyant force balances the weight of the floating object. Assume 1.00 g/cm^3 for water's density. (STE diversion)



$$m_{\text{displaced water}} * g = m_{\text{iceberg}} * g$$

$$m_{\text{displaced water}} = m_{\text{iceberg}}$$

$$V_{\text{displaced water}} * d_{\text{water}} = V_{\text{iceberg}} * d_{\text{iceberg}}$$

$$\frac{V_{dw}}{V_{ice}} = \frac{d_{ice}}{d_{dw}} = \frac{0.917}{1.00} = 0.917 =$$

91.7% of the iceberg is under water

Example 3 When does sea level rise?

When ice slides from land and ends up in the sea.

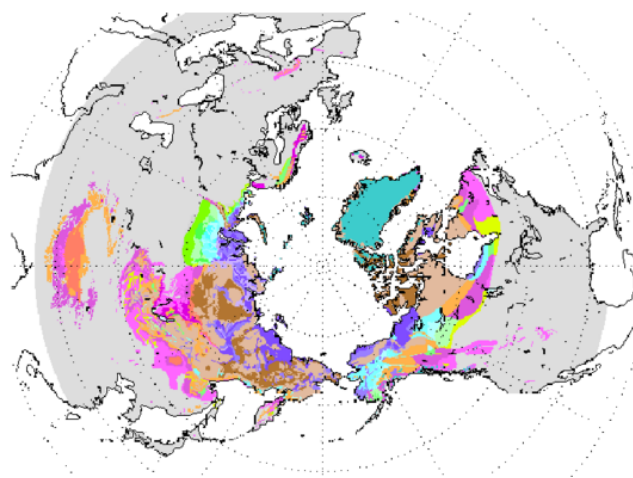


C-Permafrost

1. What is permafrost?

It's permanently frozen ground found in polar areas

and on high mountains.



2. Large parts of northeastern Russia and almost 50% of Canada's land can be frozen up to a depth of 0.5 km.

Where else is this permafrost found?

Greenland, Alaska, mountainous regions of BC

3. What can happen to the top part (active layer) of permafrost during summer?

It can partially melt.

4. a) How could climate change lead to large amounts of methane being produced?

With more melting, decomposers get activated and in the absence of oxygen, they will produce methane.

- b) What's wrong with releasing methane into the atmosphere?

It's a stronger greenhouse gas than CO₂, so it could spur more warming and more melting of permafrost and icecaps.

EXERCISES

1. Why do parts of British Columbia have permafrost even though its northern boundaries are south of the Arctic Circle?

The mountain peaks of Northern BC have a cold climate.

2. a) How is methane released from permafrost?
In a warmer climate, microorganisms(decomposers) become active again and break down organic material in the absence of oxygen. (otherwise you would get carbon dioxide)
b) What actually produces it?
Microorganisms
c) What do the microorganisms act as? Think of trophic levels.
decomposers

3. a) What is the active layer of permafrost?

It's the top layer which is the only one that defrosts in the summer and supports life.

b) Is it possible for the active layer not to exist in certain areas?

Yes. There's no active layer where it's too cold.

4. Is a sandy area less likely to be flooded? Why or why not?

Yes. Water seeps down very easily and does not accumulate on the surface and does not runoff to rivers or increase their volume.

5. a) How do storm drains help during heavy rainfall?

They prevent water from accumulating on the streets.

b) What can act as a natural storm drain?

If there are rocky depressions in a landscape, the water can escape.

c) How does deforestation affect the amount of water that ends up in a river?

Trees help absorb water. Without them, more water and soil is lost from the land.

6. What is the difference between a glacier and an iceberg?

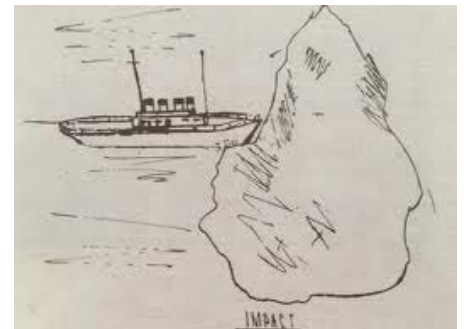
A glacier is a large persistent body of ice that forms with the accumulation of snow. It's found on land. An iceberg which floats in the sea forms by breaking off a glacier or ice shelf.

7. If sea water has a density of 1.027 g/cm^3 , what percentage of an iceberg will be submerged if ice's density = 0.917 g/cm^3 .

$$m_{\text{displaced water}} * g = m_{\text{iceberg}} * g$$

$$m_{\text{displaced water}} = m_{\text{iceberg}}$$

$$V_{\text{displaced water}} * d_{\text{water}} = V_{\text{iceberg}} * d_{\text{iceberg}}$$



$$\frac{V_{dw}}{V_{ice}} = \frac{d_{ice}}{d_{dw}} = \frac{0.917}{1.027} = 0.893 = 89.3\%$$

8. What can cause ice sheets to leave land? What will subsequently happen to sea level?
Climate change. Sea level will rise.
9. a) What happens to the volume of water if an already submerged ice cube melts?
Nothing.
- b) In what way does this not contradict the answer from #8?

The ice experiment is equivalent to what happens to sea levels when icebergs melt: nothing. But the sea level rises when ice moves off the land and ends up in the sea. That's like placing an ice cube in a full glass of water. It will cause the water to overflow before melting.

10. What is the difference between pack ice and a glacier?

Pack ice is *not* really a large glacier, which is usually on land. Pack ice consists of a large mass of salt-water ice.

In the original answer I was confusing it with an *ice sheet* or *ice cap*, which is a large glacier.

Pack ice is a large floe. Too much vocabulary for a chemist!---That's what non-chemists say about our subject.