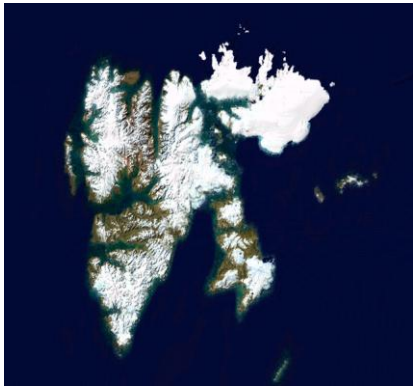
Royal Geographical Society with IBG

Characteristics of an arctic environment and the physical geography of Svalbard - 'geography explained' fact sheet

The Arctic environment is little studied at Key Stage Three yet it is an excellent basis for an all-encompassing study of place or as a case study to illustrate key concepts within a specific theme. Svalbard, an archipelago lying in the Arctic Ocean north of mainland Europe, about midway between Norway and the North Pole, is a place with an awesome landscape and unique geography that includes issues and themes of global, regional and local importance. A study of Svalbard could allow pupils to broaden and deepen their knowledge and understanding of different aspects of the seven geographical concepts that underpin the revised Geography Key Stage Three Programme of Study.

Many pupils will have a mental image of an Arctic landscape, some may have heard of Svalbard. A useful starting point for study is to explore these perceptions using visual prompts and big questions – where is the Arctic/Svalbard? What is it like? What is happening there? Why is it like this? How will it change? Svalbard exemplifies the distinctive physical and human characteristics of the Arctic and yet is also unique amongst Arctic environments. Perceptions and characteristics of the Arctic may be represented in many ways, including art and literature and the pupil's own geographical imagination of the place. Maps and photographs are vital in helping pupils develop spatial understanding of locations, places and processes and the scale at which they occur.

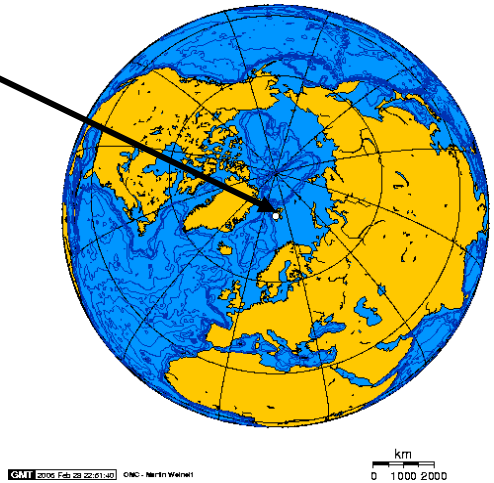


Source: commons.wikimedia.org/wiki/Image:W_W_Svalbard...

Longyearbyen, Svalbard's capital
Source:[*http://www.photos-voyages.com/spitzberg/images/spitzberg06_large.jpg*](http://www.photos-voyages.com/spitzberg/images/spitzberg06_large.jpg)

The landscape of Western Svalbard
Source: [*www.hi.is/~oi/svalbard_photos.htm*](www.hi.is/~oi/svalbard_photos.htm)

Where is Svalbard?



Orthographic map projection centred on Svalbard and showing location relative to UK and EuropeSource: www.answers.com/topic/orthographic-projection...

Royal Geographical Society with IBG

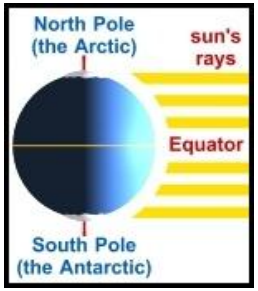
www.capefarewell.com

Source: www.nato.int/ccms/general/countrydb/svalbard.html

Svalbard is an archipelago (group of islands) north of Norway and is part of Norwegian territories. It includes the islands ranging between 74° and 81° of latitude North and between 10° and 35° of longitude East. The largest of the islands is Spitsbergen. The other islands are Nordaustlandet, Edgeøya, Barentsøya, Kong Karls Land, Kvitøya, Hopen and Bjørnøya. Svalbard is bordered by the Arctic Ocean to the North, the sea of Barents to the South and East, and by the sea of Greenland to the West. The name 'Svalbard' means 'the land with the cold coast' or 'cold edge'.

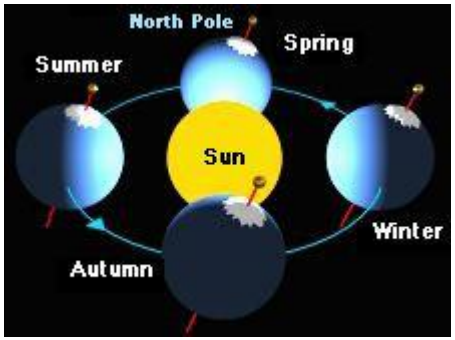
What is Svalbard like?

Svalbard is cold and a dry arctic desert. Its northern location influences the amount of solar radiation it receives and is the main reason for its low temperatures. The curvature of the Earth means that the solar radiation received nearer the poles must heat a larger area than it would nearer the Equator. In the Northern latitudes the sun is at a lower angle in the sky. This lack of radiation helps maintain the low temperatures and allows permanent snow and glaciers to form, and doubles the sea ice area from summer to winter.



Source: http://athropolis.com/arctic-facts/fact-poles-cold.htm

Svalbard experiences a polar night in winter when the capital Longyearbyen is in darkness for 110 days straight as the sun stays below the horizon, and midnight sun throughout the summer when the sun does not sink below the horizon for 123 days. During the winter months (December), the Northern Hemisphere is tilted away from the sun as it orbits the sun and so receives less radiation. The North Pole has no sun for six months but places like Svalbard that are not quite so far North have a few months darkness with very short days either side. In the summer months (June) the Northern Hemisphere faces the sun and the North Pole has 24 hour daylight and Svalbard has a period of midnight sun.



MIDNIGHT SUN: As the Earth orbits around the Sun, its tilt makes the North Pole face towards the Sun in summer (keeping it in sunlight even as the Earth spins) and away from it in winter (keeping it dark). This means that the Sun doesn't shine at all during the winter, but shines continually (yes, even at midnight) during the summer.
Source: www.athropolis.com

The Arctic also has low temperatures due to their high albedo. Albedo means the amount of solar radiation that the Earth's surface reflects instead of absorbing. Different surfaces have different reflectivity - snow and ice can reflect 85% of incoming energy, forests can reflect 20-30% and sandy areas reflect 10%. So, due to the higher reflectivity of ice and snow at higher latitudes a lot of the already limited amount of solar radiation received is reflected back.

However, Svalbard is not as cold as one might expect: average temperatures in the capital Longyearbyen are -5^0C in summer and -8 to -16^0C in winter. This is due to the moderating influence of ocean currents. These are huge flows of water that can be warm or cold depending on their area of origin. They affect the climate and conditions of the places they flow to. The Gulf Stream starts in the Gulf of Mexico and flows north-east across the Atlantic. As the North Atlantic Drift (NAD) it flows past the British Isles, along the coast of Norway and the West side of Spitsbergen. The NAD makes Britain and Norway warmer than they might otherwise be, keeps ports ice free and allows fish to thrive. Near Spitsbergen it starts to sink because it has cooled and has become saltier. This sinking allows more of the NAD to flow to the area, like a conveyor belt, and maintains this thermohaline circulation.

Longyearbyen receives around 200mm precipitation per year. Preceipitation below 250mm is considered a desert. Though little precipitation falls much is stored as snow and ice because of the low temperatures. The ecosystems of Svalbard are finely balanced and span land and sea where they are particularly rich. Food chains are short and vulnerable to environmental change and pollution. Polar Bears are at the top of food chain.

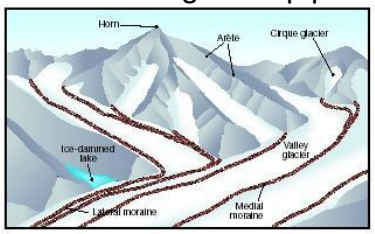
What are the physical processes and landforms of Arctic environments and Svalbard?

The cold climate gives Svalbard a distinct physical landscape and processes. Rock, ice and sea are the main landscape features. There is no tall vegetation and above 1100m only lichen grows. Svalbard is glaciated, 60% of the land is ice covered, and it has small valley glaciers as well as large outlet glaciers draining ice-caps. Glaciers and the rivers issuing from them erode the landscape and then transport and deposit the eroded materials. Weathering and erosion are mainly mechanical processes of frost shatter, freeze-thaw, abrasion and plucking.


The foot of a glacier on Spitsbergen
source: www.capefarewell.com

Physical process	How it works
Frost shatter	Rocks are weakened and break up as a result of weakening due to the stresses of extreme low temperatures.
Freeze thaw	Occurs in rocks that have joints and cracks and in places where temperatures fluctuate about freezing. Water gets into cracks, freezes and expands and puts pressure on the rock. On thawing the pressure is released. Repeated freezing and thawing weakens and breaks rock down.
Plucking	Occurs when glacial ice freezes onto solid rock, as the glacier moves it pulls with it large pieces of rock.
Abrasion	Occurs when material carried by a glacier rubs against the valley floor and sides like sandpaper and rubs it away.

Glacial landforms include include fjords, glacial valleys, arêtes and nunataks (formed by erosion), outwash plains, alluvial fans, moraines and braided streams (depositional). Svalbard also has periglacial features associated with cold areas, such as pingos which are small hills created by ice lenses underground, and patterned ground resulting from frost and ice heaving materials up from the ground. The ground is permanently frozen and impermeable nearly everywhere above 100m altitude. This is called permafrost and varies from 10m to 45m thickness. Only the very top layer thaws in summer enabling some plant growth. It causes problems for constructing and heating buildings and explains why some buildings and pipes are on short stilts.



Block diagram of selected glacial landforms

Patterned ground, a periglacial feature on Svalbard

Glaciated landscape of Svalbard
Source: **www.hi.is/~oi/svalbard_photos.htm**

What are the human activities and processes occurring in Svalbard?

Human activities are influenced by the climate, landscape and processes of Svalbard:

- Settlement and population
    - There is no indigenous population on Svalbard and only 2600 people live there. People stay for an average of 7 years and they are employed mainly in mining, tourism and transport. There are few settlements, of which Longyearbyen is the largest and associated with mining and growing tourism.

- Economic Activities
    - There is some coal mining, with mainly Russian workers, which supplies Svalbard's own needs.
    - The fishing industry very important to Norway and includes limited whaling.
    - Tourism is increasingly important and depends on the unique landscape.
    - Oil is now more important to the Norwegian economy than fishing. There is a real prospect of oil development on Svalbard, and future decisions will have to be made between the economic value of oil and the value of the environment.

- Scientific exploration
    - Svalbard provides an important environment for research as it is relatively untouched, accessible and may demonstrate evidence of climate change.


Mining in Longyearbyen
Source: rabbit.eng.miami.edu/.../svalbard/index.html


The permanent science base at NyAlesund
http://folk.uio.no/olehum/NyAlesundJuly2000.jpg


Tourists visiting Svalbard locations, bird watching at the cliffs
Source: europeforvisitors.com/europe/countries/norway...


Tourists ski in Svalbard
Source: http://ski.svalbard.co/frastart_small.jpg

Svalbard exemplifies the dynamic relationship between people and the natural environment. The distinct environment enables a range of human activities and these in turn impact upon the Arctic environment and influence planning and development decisions. The human activities affecting Svalbard may be local to the area or distant and demonstrate the interdependence of places. Most of the gases that are believed to be contributing to the climate changes that may be responsible for measurable losses in sea ice are not produced in the Arctic but by industry and transport taking place across the planet. Climate change may be causing Svalbard's glaciers to retreat and land ice to melt and reduce albedo. The run-off could make sea less salty, less dense and less likely to sink in the thermohaline circulation and so slow down the NAD. The British Isles and Norway could get cooler in a warmer world! However, human activities may also involve sustainable management decisions. Norway's fishing is sustainable and it is investing in sustainable tourism and developing conservation strategies for the environment such that 60% of the Svalbard land area is under some form of protection. An understanding of the values and attitudes of different groups of people involved in affecting the Svalbard environment, including those of pupils, is an important dimension of study in the revised National Curriculum.

Glacier retreat in the Arctic, a result of climate change triggered by pollution generated across the globe?
Source: http://www.igreens.org.uk/boat.jpg

Royal Geographical Society with IBG

USEFUL SOURCES

Visit www.nilu.no/niluweb/services/zeppelin/ for web cam views of locations on Svalbard at different times of the year.

www.capefarewell.com for wide range of resources and expedition information

'The High Arctic Cape Farewell Expedition Teacher Guide', with accompanying CD and pupil booklet, were written for the OCR pilot GCSE, and they are excellent comprehensive sources for KS3 teachers
and available from the Geographical Association

Philip Pullman's 'His Dark Materials' trilogy of novels is partly set much in Svalbard, home of the armoured bears, pupils may find this an interesting entry point.

Visit http://www.cru.uea.ac.uk/cru/info/thc/ for a useful animation of ocean currents

www.aber.ac.uk/~glawww/arctic.shtml Aberystwyth University has links with Svalbard and this website is a good source for teachers