



Numeracy Project Plans

POLE TO POLE

These project plans are designed to be used alongside the accompanying resource sheets.
(please note: a CD resource does not accompany this resource pack, all resources are provided below)

Numeracy Project 1: Freezing maths (Key Stage 2/3)

Aims of the lesson: To develop basic numeracy skills (handling data) through investigating polar temperatures.

Activity: Antarctica is the coldest, windiest and driest continent on Earth.

Its harsh weather kept human travellers away until the 19th century and even today no human can survive long there without a sturdy, warm shelter and 'extreme cold weather' clothing.

The Antarctic is colder than the Arctic, where humans have lived since prehistoric times. Antarctica's harsh weather defines the continent that those who work there call 'The Ice'. The Arctic, even though it receives no more sunlight during the course of the year than Antarctica, is warmer.

For this activity, explain to the pupils that they are going to use some polar data (for the Arctic and Antarctic) to create different data charts (bar graphs, scatter graphs etc). The **Numeracy Project 1 folder** on the accompanying CD includes some information on polar climates (Information Sheet: Arctic v Antarctic) and some data tables. The Internet offers a

vast range of data on polar temperatures etc and the pupils could find their own data before presenting it in a mathematical format. The folder also includes a copy of the map of Antarctica, shown opposite. This map shows three weather stations, marked with 'X'. Data for these stations can be found at www.coolantarctica.com – but for your ease of reference data on these stations can also be found in the **Numeracy Project 1** folder. Look at the data supplied (in tables and graphs) – or look at the data sourced by the pupils themselves and ask them to present it in different ways.

Other ideas: The Arctic and the Antarctic are two areas of the world that are full of scientists – all collecting data on a massive range of things. The potential for data handling activities is enormous. One simple idea is to tackle the teaching and learning of probability at the two poles. For example, what is the probability of the seeing a cat at the South Pole (0). What is the probability of surface temperature exceeding 90 degrees at the North Pole (0).

What is the probability of seeing a polar bear in Antarctica?

Numeracy Project 2: Miraculous measurements (Key Stage 2+)

Aims of the lesson: To develop basic numeracy skills (measurements) through investigating Antarctica.

Activity: Antarctica is the fifth largest of the seven continents and the page opposite offers a basic map of Antarctica and a copy of this can be found in the **Numeracy Project 2 folder** on the accompanying CD. The total surface area is about 14.2 million square km (about 5.5 million sq miles) in summer, approximately twice the size of Australia, half as big again as the USA and fifty times the size of the UK. In the winter Antarctica doubles in size due to the sea

ice that forms around the coasts. There is more information on some measurements relating to Antarctica on the Information Sheet in the **Numeracy Project 2 folder** on the accompanying CD.

The measurements involved, and distances travelled by explorers) on Antarctica are staggering. Ask the pupils to investigate some of these measurements and either draw their own map (showing some of the measurements) or plan a journey across Antarctica noting how far they would travel between specific points.



Numeracy Project 3: Icy shapes (Key Stage 1)

Aims of the lesson: To draw a representation of an iceberg using different shapes and create some iceberg fractions.

Activity: The Antarctic ice cap contains over 7 million cubic miles (30 million cubic km) of ice – about 90 per cent of all ice existing in the world and 68 per cent of the world's fresh water. As you approach the continent huge towers of ice (that have split away from the ice cap) can be seen, and these icebergs are truly amazing. The page opposite shows a picture of an iceberg. A copy of this picture can be found in the **Numeracy Project 3 folder** on the accompanying CD.

Iceberg shapes

Icebergs come in all shapes and sizes. As they melt and break up, the small pieces that they shed are given distinctive names such as 'growler', 'bergy bits' and 'brash', depending on their size. Icebergs themselves can also be categorised into tabular, irregular or rounded icebergs and their shape is usually an indication of their age. Antarctica as a rule has much larger icebergs than the Arctic. A large Antarctic iceberg may weigh 400 million tonnes, tower ten stories above the surface of the water and contain enough fresh water to supply a city of three million people for a year. The amazing shapes that irregular and rounded icebergs often acquire is the result of melting under water, so that when the icebergs roll upside down the sculptured forms become visible. This rotation can take place gradually, up to a point. Then when the iceberg becomes top-heavy and unstable, it turns over in a matter of seconds, often breaking into smaller pieces in the process. Such an event can be very dramatic, creating waves and a roar that can be heard for miles.

Ask the pupils to look at picture of icebergs, and then draw their own representation of an iceberg using different regular (square, circle, triangle etc) and irregular shapes. Ask the pupils to note the different shapes used in their representation and note the number(s) of different shapes used. The representations produced by the pupils will most likely be 2-dimensional, and icebergs are (of course) 3-dimensional. As an extension to this activity, you could ask the pupils to try and produce some 3-dimensional models of icebergs.

Iceberg monitoring

Icebergs are monitored worldwide by the US National Ice Center (NIC). More than 95 per cent of the data used in its sea ice analyses are derived from the remote sensors on polar-orbiting satellites that survey these remote regions of the Earth. The NIC is

the only organization that names and tracks all Antarctic Icebergs. It assigns each iceberg larger than 10 nautical miles (18 km) along at least one axis a name composed of a letter indicating its point of origin and a running number. The letters used are as follows:

- A** – longitude 0° to 90° W (Bellingshausen Sea, Weddell Sea)
- B** – longitude 90° W to 180° (Amundsen Sea, Eastern Ross Sea)
- C** – longitude 90° E to 180° (Western Ross Sea, Wilkesland)
- D** – longitude 0° to 90° E (Amery Ice Shelf, Eastern Weddell Sea)



As an extension for more-able pupils, ask them to look at satellite images of icebergs and see if they can spot these letters in the naming of the bergs. The NASA website offers lots of satellite images of icebergs and the **Numeracy Project 3 folder** on the accompanying CD includes an image taken of iceberg B-15a in 2005. Using the Internet, ask the pupils to track some icebergs and note the distances travelled.

Other ideas: It is commonly accepted that nine tenths of an iceberg is always under water. With this mind, show the pupils some pictures of icebergs and ask them to how much of the iceberg they think is underwater as a fraction. Then get the pupils to draw pictures of icebergs to match their fractions (showing the parts of the ice bergs under and above the water line. As a fun conclusion to this activity, ask the pupils to think about how they could tow an iceberg. Some scientists have suggested that icebergs could be towed to parts of the world that desperately need water (although this has never been done!).



Pole to Pole

Numeracy Project 1:
Freezing maths

Key Stages 2 & 3





Information sheet: Arctic v Antarctic

The Antarctic is much colder than the Arctic. On average temperatures in the Antarctic are 50–80 degrees Fahrenheit lower than the Arctic. Although both areas receive the same amount of sunlight, the ice and snow in Antarctica reflect much of the heat away, causing it to be so cold. The winds also play a large factor in the temperature. Every increase of 1.2 mph in wind speed drops the temperature a further 1.8 degrees Fahrenheit. Even in summer a person's breath freezes as soon as it leaves the body.

The Antarctic is also a desert, even though it contains 70 per cent of the world's fresh water. The interior of Antarctica receives less than the equivalent of two inches of rain each year. Of course, it doesn't come in the form of rain, but as snow. This makes inland Antarctica one of the world's driest deserts. The air is too cold to hold moisture, which is why there is so little rain. Even on the coast, where the temperatures are higher, there is less than the equivalent of 15 inches of rain per year.

The Antarctic Peninsula, in West Antarctica, directly south of South America has the highest temperatures. During a really hot summer there, the temperatures can reach as high as 59 degrees Fahrenheit, but the summer average is around 50 degrees. You can compare that to the winter in Arizona. The average summer temperatures in the warmest place in Antarctica are much the same as the average winter temperatures in the warmest place in Arizona!

The cold in Antarctica makes it almost impossible for humans to live there. Although the temperatures are so low, a person wearing dark clothing can actually feel quite warm, as the clothes absorb the heat of the sun. Any exposed skin, though, freezes. When it is frozen blood cannot reach it and it dies. This is known as frostbite. The sun reflecting off the ice also causes problems, and people must wear dark glasses outside or they may become blind, from the ultra-violet rays. Add to the problem of the cold and sun, the wind. Walking against such strong winds is very tiring. The combination of all these factors is what caused so many explorers to fail to reach the South Pole when they tried. In such cold climates humans must consume a lot of food to maintain their energy. Early explorers often had to give up because they were too cold, too exhausted and too hungry to go on. They had to carry or pull all the food and clothing they needed on sleds. That meant spending more energy. It was extremely difficult to make a balance between the energy needed to pull the food (so requiring more food) and taking just enough food to give enough energy.



Weather conditions at Antarctic weather stations

Current weather conditions at McMurdo (30 November 2006)

McMurdo is a coastal station and so is influenced by the sea. Once the winter pack ice starts to form and the sun disappears beyond the horizon, the temperature really starts to drop. The reappearance of the sun causes the temperature to rise rapidly again.

*Rainfall figures – precipitation is given as rainfall equivalent, i.e. the amount that would have fallen had it fallen as rain and not snow. Actual liquid rain is very rare in Antarctica.

Current weather conditions at the South Pole (30 November 2006)

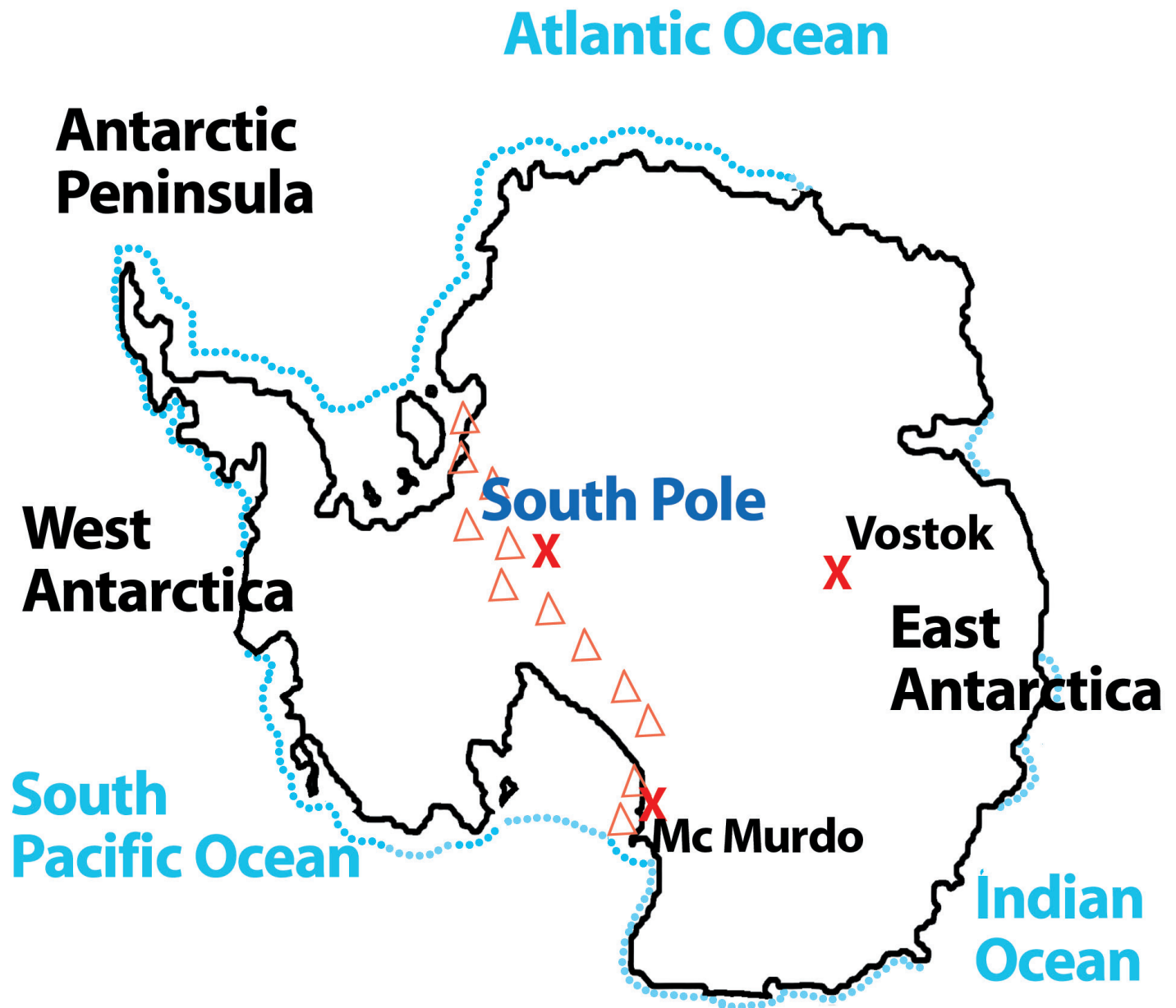
The temperature at the South Pole station consists of six months when it is fairly stable from April to September. After this, there is a three-month period where the temperature rises to a peak and then drops again. This corresponds to light and dark. When it is permanently dark, the temperature is very stable. As the sun rises higher in the sky and has more heating power, so the temperature rises. After the longest day, 21 December, the sun falls again and so does the temperature.

Current weather conditions at Vostok Station (30 November 2006)

Vostok is at the Southern Geomagnetic Pole. It is close to the Pole of Inaccessibility, the point on the Antarctic continent that is the furthest from any other and so the most difficult or inaccessible place to get to. It is inland and on the high Antarctic ice plateau making it the coldest and most inhospitable place in the world.



Antarctica



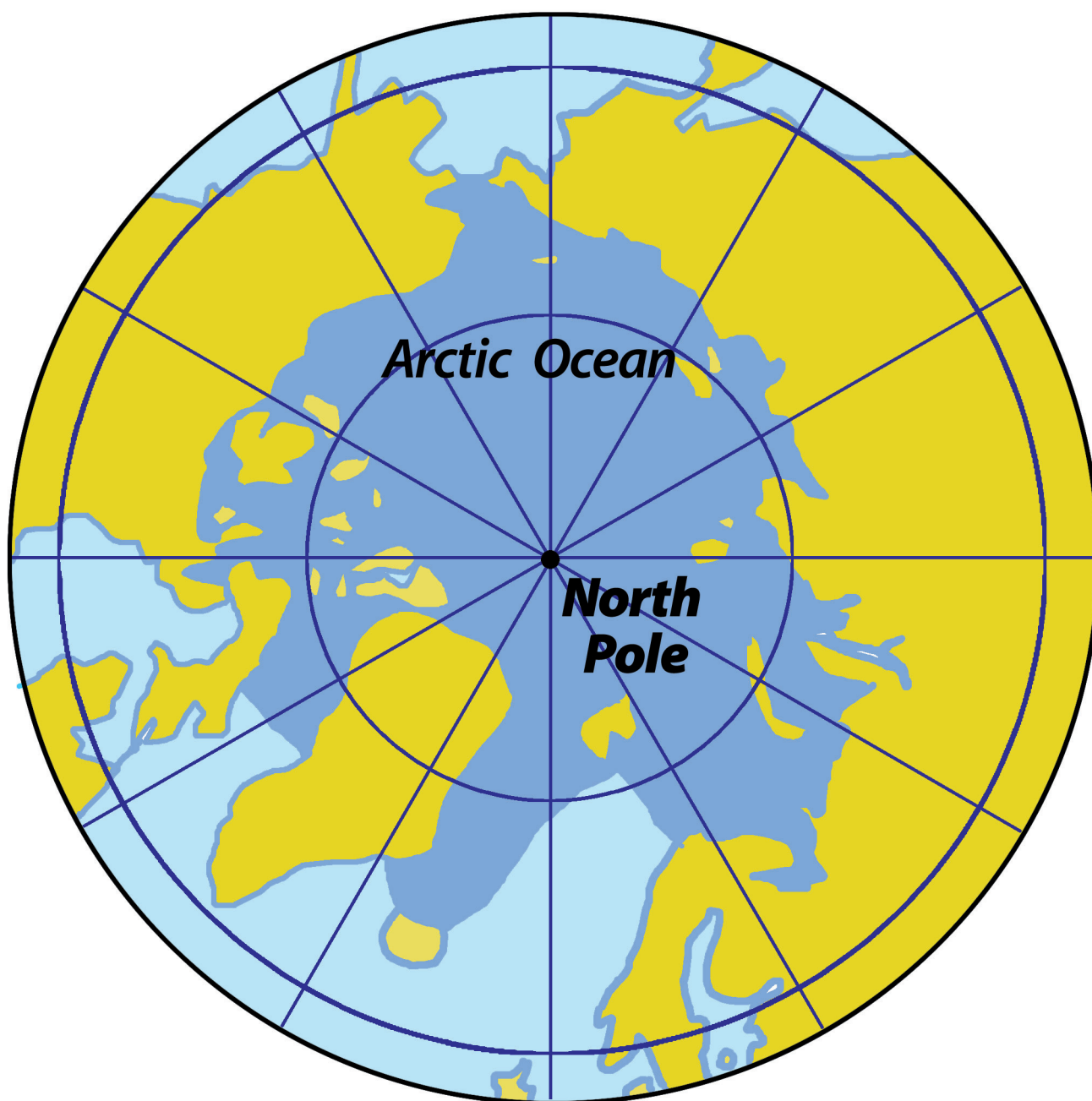


Arctic – map 1





Arctic – map 2





Amundsen-Scott station – data

Location: 90°00'S, 0°00', South Pole, East Antarctica.

This table offers the annual, seasonal and monthly surface temperature statistics for the Amundsen-Scott station. These data are updated monthly. With regard to summer (DJF) the year refers to the December.

Annual/ Season/ Month	Mean (°C)	σ (°C)	Min. (°C)	$q_{0.25}$ (°C)	$q_{0.75}$ (°C)	Max. (°C)	Period (°C)	n
Calendar year	-49.5	0.7	°51.0	°49.8	°49.0	°48.0	1958–2005	48
Autumn	-56.5	1.3	-59.1	-57.4	-55.5	-52.8	1957–2006	50
Winter	-59.5	1.7	-63.3	-60.7	-58.2	-56.1	1957–2006	50
Spring	-49.6	1.6	-53.3	-50.8	-48.4	-46.8	1957–2005	49
Summer	-32.3	1.4	-35.5	-33.2	-31.5	-28.5	1957–2005	49
January	-28.1	1.7	-32.0	-29.3	-27.3	-24.7	1958–2006	49
February	-40.7	1.9	-44.4	-41.8	-39.6	-35.3	1957–2006	50
March	-54.0	1.9	-58.0	-54.9	-52.9	-48.6	1957–2006	50
April	-57.3	2.8	-62.6	-59.2	-55.0	-50.4	1957–2006	50
May	-58.0	2.0	-62.4	-59.4	-56.4	-53.5	1957–2006	50
June	-58.6	2.9	-64.4	-61.0	-56.4	-52.6	1957–2006	50
July	-60.1	3.0	-67.0	-62.3	-58.2	-53.3	1957–2006	50
August	-59.7	2.9	-66.8	-61.4	-57.7	-53.5	1957–2006	50
September	-59.3	2.9	-65.4	-61.6	-57.3	-52.6	1957–2006	50
October	-51.4	2.4	-55.8	-53.0	-49.8	-46.2	1957–2006	50
November	-38.4	2.2	-43.1	-39.5	-37.5	-32.3	1957–2005	49
December	-27.9	2.0	-32.3	-29.4	-26.5	-24.0	1957–2005	49



Climate data for the Russian Vostok station at the southern geomagnetic pole 1

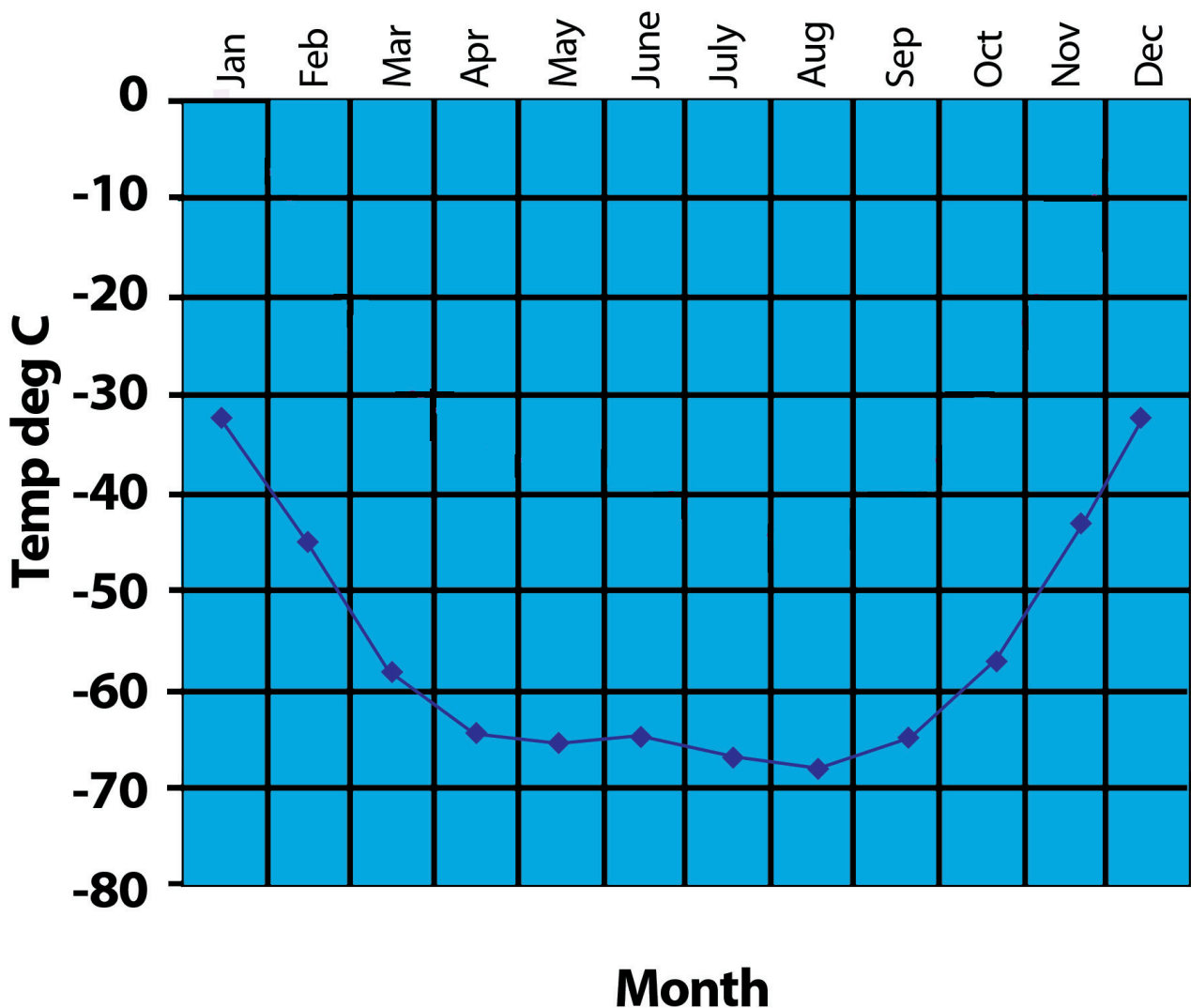
Data range from 1957 to 1988; Latitude: 78.45°S; Longitude: 106.80°E

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average daily temperature °C	- 32.1	- 44.3	- 57.9	- 64.7	- 65.6	- 65.2	- 66.9	- 67.6	- 66	- 57.1	- 43.3	- 32.1	- 55.1
Mean monthly rainfall mm	0.1	0	0.7	0.5	0.4	0.5	0.6	0.7	0.3	0.2	0.1	0	Annual total 4.5



Climate data for the Russian Vostok station at the southern geomagnetic pole 2

Vostok, Annual Temperature



—◆— Average daily temperature °C



Climate data for the American Amundsen-Scott station at the South Pole 1

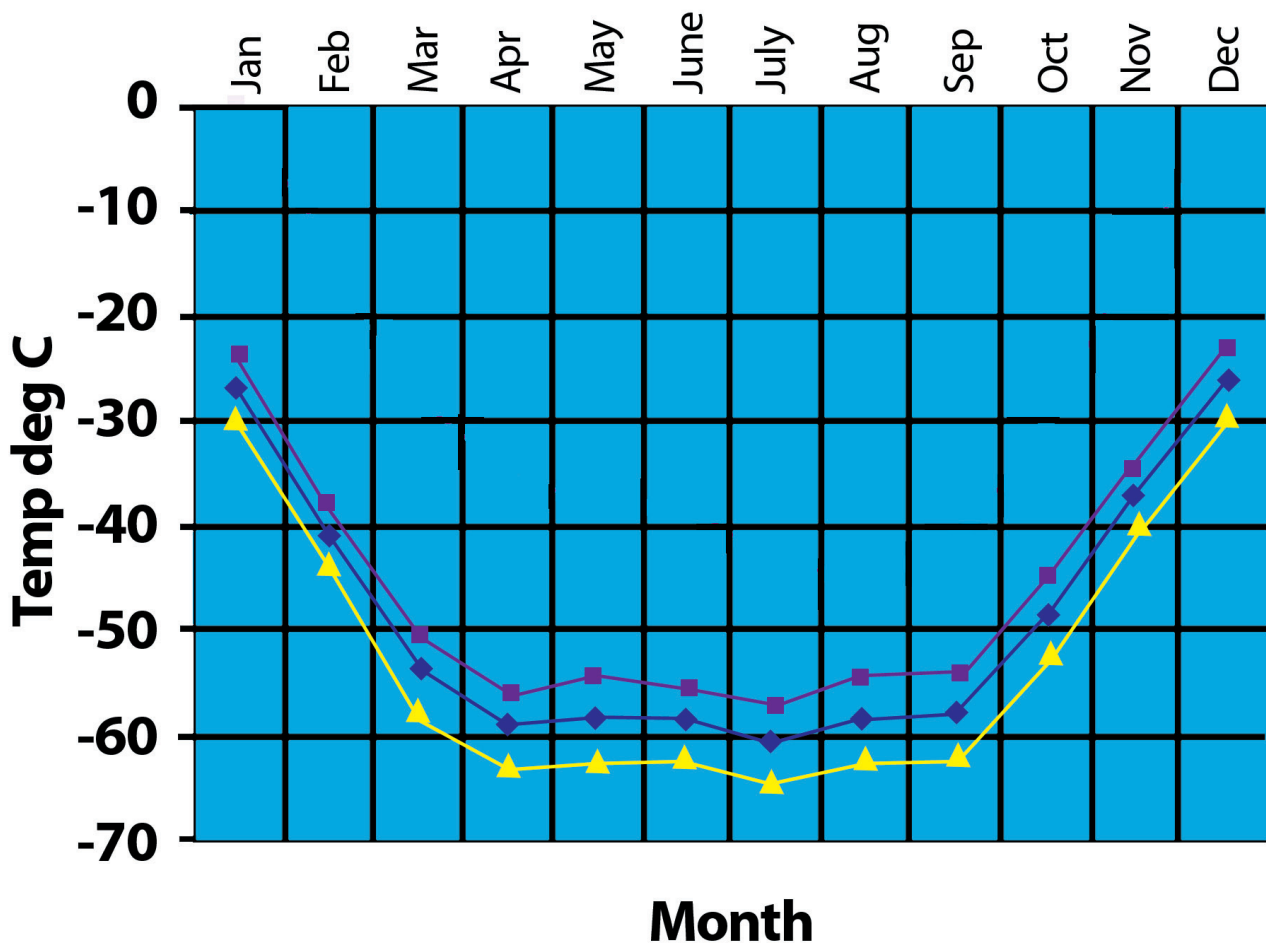
Data range from 1957 to 1988; Latitude: 90°S; Longitude: 0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average daily temperature °C	- 28.2	- 40.9	- 54	- 57.3	- 57	- 58	- 59.7	- 60	- 59.4	- 51.1	- 38.3	- 27.5	- 49.4
Mean daily max °C	- 25.9	- 38.1	- 50.3	- 54.2	- 53.9	- 54.4	- 55.9	- 55.6	- 55.1	- 48.4	- 36.9	- 26.5	- 45.4
Mean daily °C	- 29.4	- 42.7	- 57	- 61.2	- 61.7	- 61.2	- 62.8	- 62.5	- 62.4	- 53.8	- 40.4	- 29.3	- 49.3



Climate data for the American Amundsen-Scott station at the South Pole 2

South-Pole, Annual Temperature



- ◆— Average daily temperature °C
- Mean daily maximum temperature °C
- ▲— Mean daily minimum temperature °C



Climate data for the American McMurdo station 1

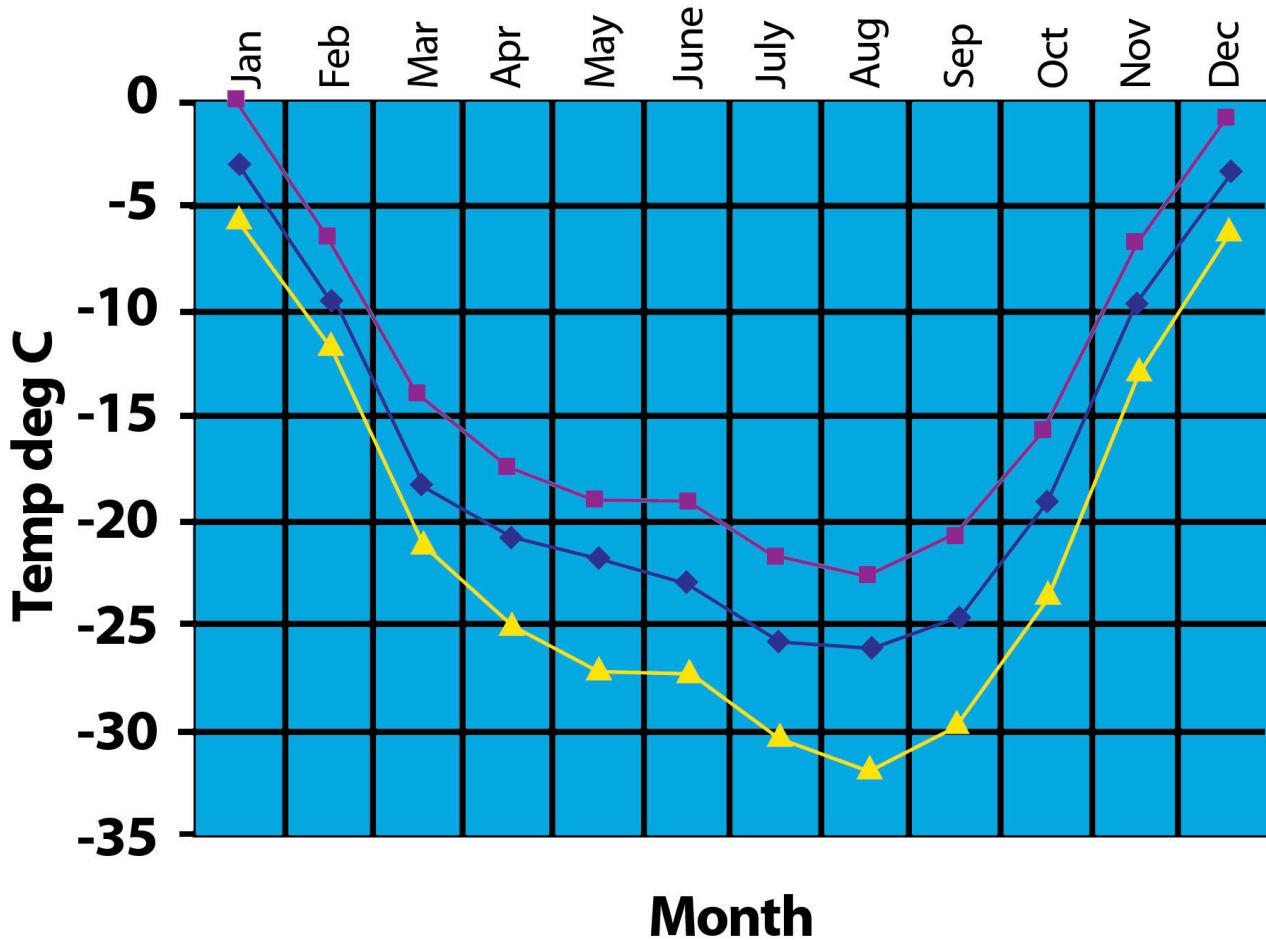
Latitude: 77.88°S; Longitude: 166.73°E.
Height: about 24m/78 feet above sea level.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual mean
Average daily temperature °C	- 2.9	- 9.5	- 18.2	- 20.7	- 21.7	- 23	- 25.7	- 26.1	- 24.6	- 18.9	- 9.7	- 3.4	- 16.9
Mean daily max °C	- 0.2	- 6.3	- 14	- 17.4	- 19	- 19.1	- 21.7	- 22.8	- 20.8	- 15.5	- 6.7	- 0.8	- 13.5
Mean daily min °C	- 5.5	- 11.6	- 21.1	- 24.9	- 27.1	- 27.3	- 30.1	- 31.8	- 29.4	- 23.4	- 12.7	- 6	- 20.6
Mean monthly rainfall* mm	15	21.2	24.1	18.4	23.7	24.9	15.6	11.3	11.8	9.7	9.5	15.7	Annual total 202.



Climate data for the American McMurdo station 2

McMurdo, Annual Temperature



- ◆— Average daily temperature °C
- Mean daily maximum temperature °C
- ▲— Mean daily minimum temperature °C



Data tables – Alaska

Average weather data for Barrow, Alaska.

Month	Average high	Average low	Warmest ever	Coldest ever	Average dew point	Average precipitation
January	-7	-19	36	-53	-20	0.2
February	-11	-23	36	-54	-23	0.2
March	-7	-20	33	-52	-21	0.1
April	-6	-7	38	-38	-6	0.2
May	24	15	46	-19	17	0.1
June	38	30	71	4	31	0.9
July	45	34	79	25	36	0.9
August	43	33	76	21	35	1.0
September	34	27	62	1	28	0.6
October	19	10	43	-32	12	0.5
November	4	-6	37	-38	-7	0.3
December	-5	-17	32	-51	-18	0.2



Pole to Pole

Numeracy Project 2: Miraculous measurements

Key Stages 2+



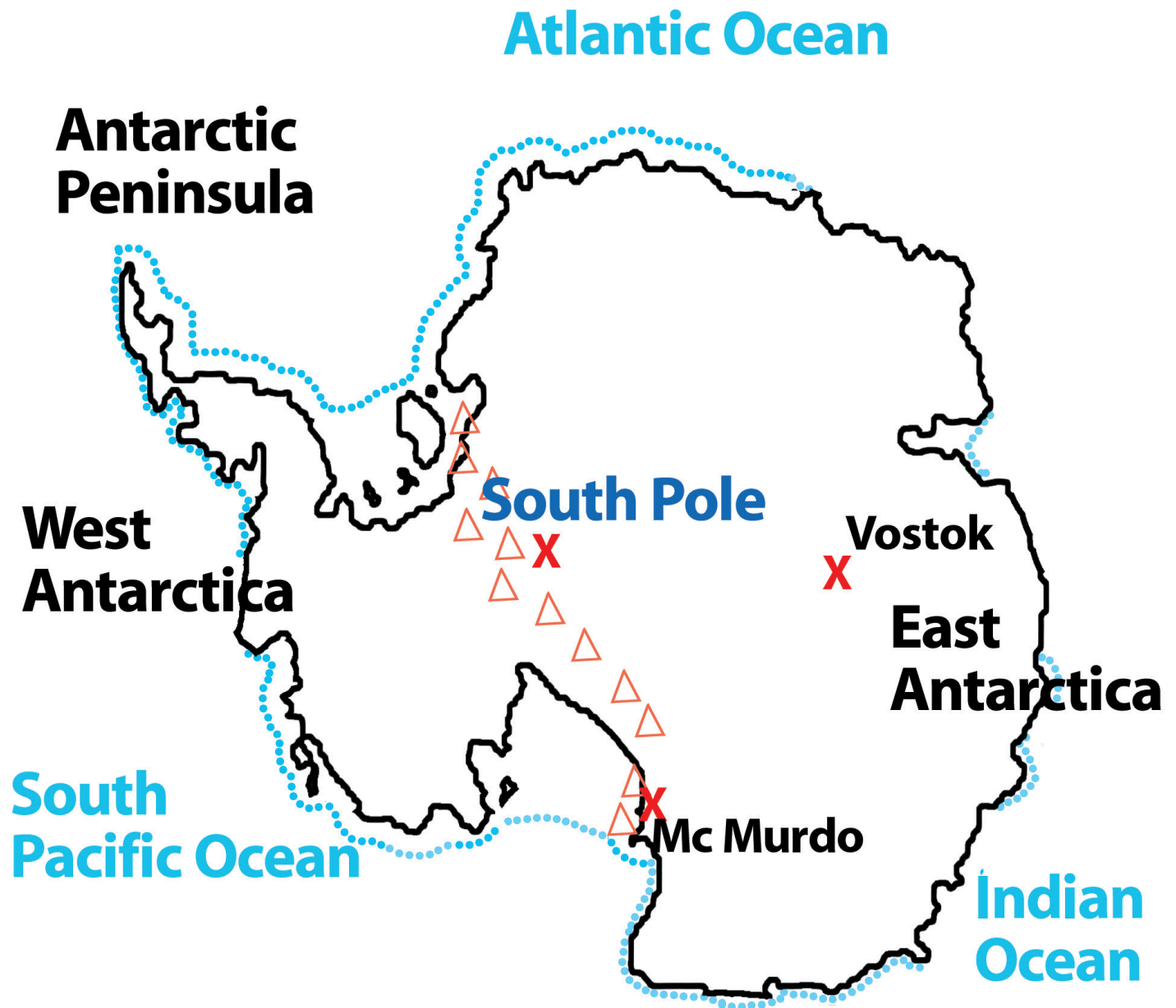


Antarctica measurements

- Antarctica is the fifth largest of the seven continents. It is situated over the South Pole almost entirely south of latitude $66^{\circ} 30'$ south (the Antarctic Circle). It is a very rough circular shape with the long arm of the Antarctic Peninsula stretching towards South America. There are two large indentations, the Ross and Weddell seas and their ice shelves.
- The nearest other land masses are South America 600 miles/1000 km away across the roughest stretch of water in the world – the Drake passage; Australia is 1550 miles/2500 km away; and South Africa 2500 miles/4000 km away.
- The total surface area is about 14.2 million square km (about 5.5 million sq miles) in summer, approximately twice the size of Australia, half as big again as the USA and fifty times the size of the UK.
- In the winter Antarctica doubles in size due to the sea ice that forms around the coasts.
- The true boundary of Antarctica is not the coastline of the continent itself or the outlying islands, but the Antarctic Convergence.



Antarctica





Pole to Pole

Numeracy Project 3: Icy shapes

Key Stage 1





Antarctic ice

The Ice Cap

As large as Antarctica is, when the surrounding sea freezes over, the ice cover doubles its area – extending the continent to approximately 30 million square miles (14,200,000 square kilometers). Even during summer, almost the entire continent is covered by ice with an average thickness of almost a mile (1.5 km). This ice cap contains over 7 million cubic miles (30 million cubic km) of ice – about 90 per cent of all ice existing in the world and 68 per cent of the world's fresh water. The weight of the Antarctic ice is so great that in many areas it actually pushes the land below sea-level. Without its ice cover Antarctica would eventually rise up another 1500 feet (450 m) above sea level. The ice cap has built up over 100,000 years of compacted snow fall, falling just a few inches a year but never melting.

Glaciers

While most of Antarctica is covered by an ice cap, within this system there are distinctive glaciers, the majority of which occur around the coast. The largest in the world is the Lambert Glacier in the vicinity of the Prince Charles Mountains. Some 25 miles (40 km) wide and 250 miles (400 km) long the Lambert Glacier drains a vast area. The most famous Antarctic glacier, however, is the Beardmore.

Icebergs

The Antarctic ice cap moves slowly but constantly, flowing under its own massive weight towards the coast. In places the ice protrudes into the surrounding waters. The effects of waves, swell, currents and tides soon bend and twist the floating ice tongues and shelves, causing chunks of all sizes to break off in a process known as 'calving'. Long before the Antarctica continent can be seen, vestiges of its glaciers and ice shelves in the form of massive icebergs can be seen.

Antarctica as a rule has much larger icebergs than the Arctic. A large Antarctic iceberg may weigh 400 million tonnes, tower ten stories above the surface of the water and contain enough fresh water to supply a city of three million people for a year. Some icebergs breaking off from the Antarctic shelf can be as much as 2,500 square kilometres in area and more than 300 metres thick.

Each year an enormous number of icebergs calve from Antarctica. While the resulting icebergs do eventually melt, many last for years and even decades if they become grounded. In 1963 one monster iceberg measuring 70 miles by 47 miles (110 km by 75 km) was observed by satellite. It lasted until 1970. Most icebergs are less than 180 yards (200 m) across at the waterline. The paths of icebergs larger than 10 km across can be plotted by satellite images.



Antarctic iceberg

Image: The Landsat satellite captured this image 21 January 2005. IT shows the B-15a iceberg. Taken from NASA website.

