How did early explorers know where they were on the earth's surface?

Explorers used the **time** and the **angle of the earth's tilt in relation to the sun** to work out their location.

- What is longitude? Explorers used a <u>chronometer</u> to work out the **time** (longitude).

- What is latitude? Explorers used a <u>sextant</u> and tables to find the **angle of the earth's tilt in relation to the sun** at their location (latitude).

<u>Model 1</u>: This explains longitude.
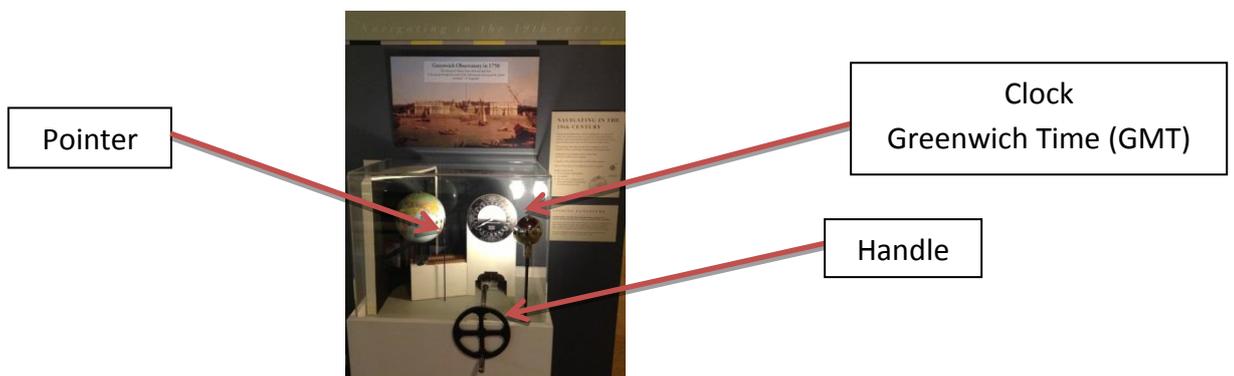
<u>Did <u>you know</u></u>?
The Earth spins on its axis once every 24 hours, giving us day and night and different time zones.
Imaginary lines (longitude) on the globe show the location east or west of Greenwich.
Time is measured from Greenwich in <u>England</u> (0°). Time and location are related.

STANDARD TIME ZONES OF THE WORLD
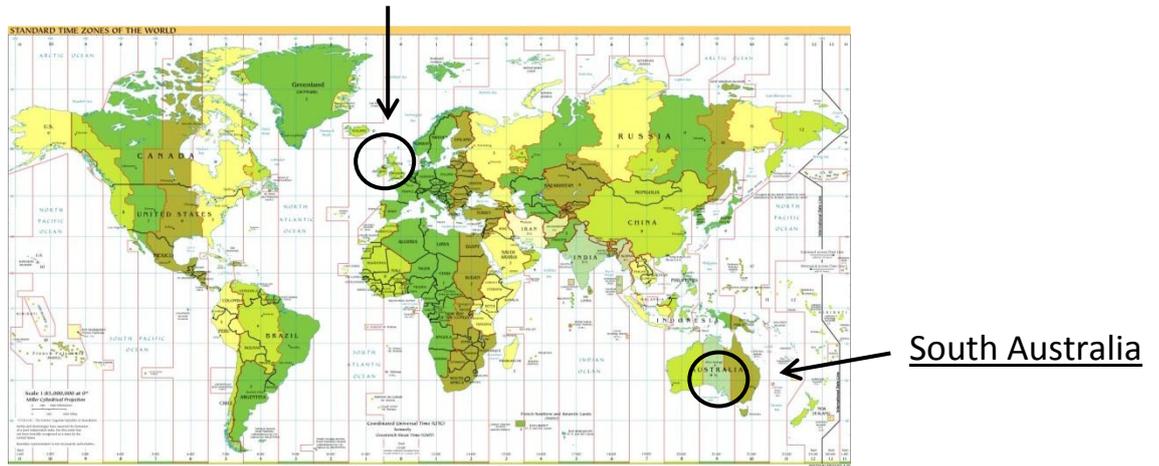
South Australia

<u>Learn</u>:
- Turn the handle so that the pointer's shadow is on South Australia.
  This is midday (local time), when the sun is at the highest point in the sky.
- Look at the clock to see what the time is at Greenwich when it is midday in South Australia. What is the time in Greenwich (GMT)?

Pointer

Clock
Greenwich Time (GMT)

Handle

- This time difference tells you your longitude.

Model 2: This shows us the angle of the sun in relation to the tilt of the Earth at different times of the year (north or south of the equator).

Did you know?
The Earth goes around the sun once every 365 days.
The equator is an imaginary line on the Earth that divides the Earth into northern and southern hemispheres.
The Earth spins and tilts on its axis, changing the angle of the sun in relation to the Earth's surface. This angle is called <u>declination</u>.

Learn:
- Turn the handle. Look at the black pointer to see the angle of the Earth in relation to the sun at different times during the year.
- Look at the white pointer to see the declination (angle) and whether the sun is north or south of the equator.

Find declination:
- Turn the handle so that the white pointer is on January.
- Look at the black pointer to see the angle of the earth in relation to the sun.
- What is the **declination**?

Black pointer

White pointer

Declination angle
Degrees north or south (°)
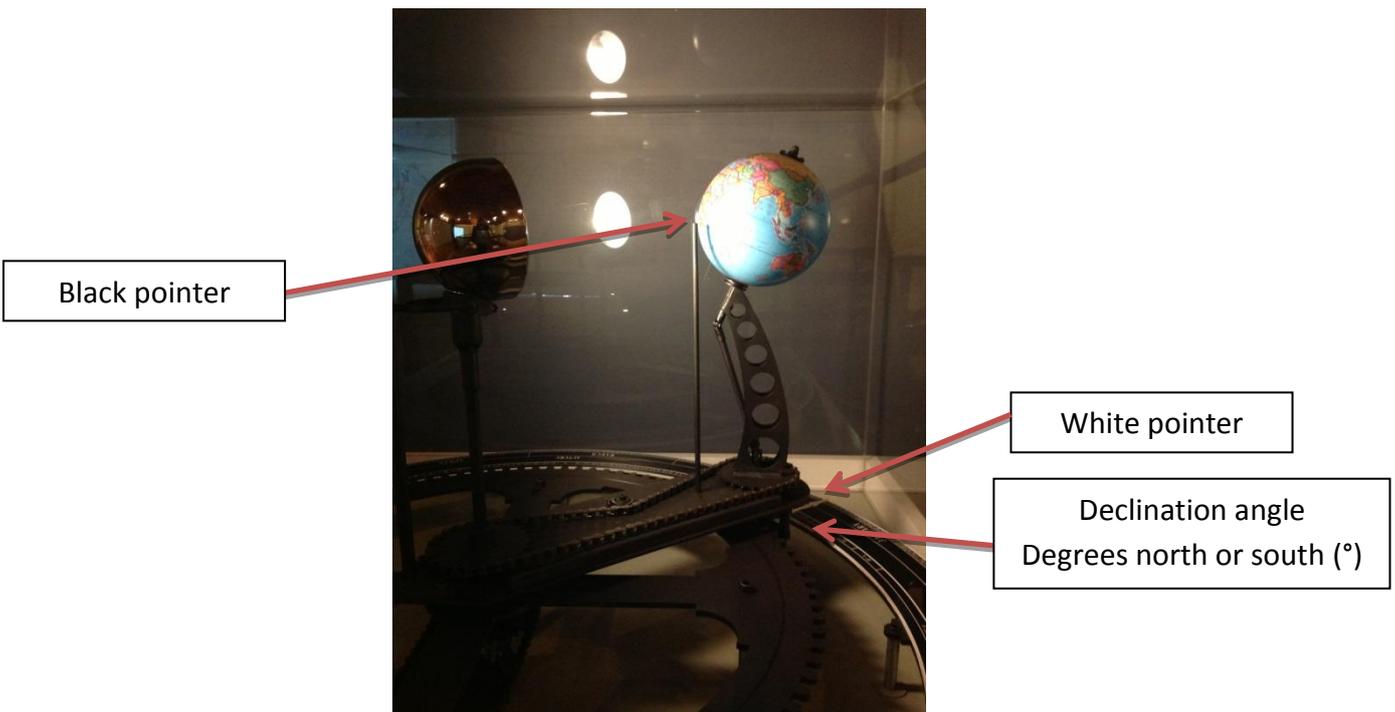
- Turn the handle so that the white pointer is on June.
- Look at the black pointer to see the angle of the earth in relation to the sun.
- What is the **<u>declination angle</u>**?

<u>Look for South Australia and compare the declination angle</u>:

January (summer)	June (winter)

- How did the angle of the sun change?

<u>**Model 3:**</u> **This is a model of a sextant. It shows how to measure the angle of the sun from your current location (in relation to the horizon).**

<u>**Did you know?**</u>
Sightings of the sun were taken at midday, when the sun was at the highest point in the sky. Sightings could also be taken using the stars and moon.

<u>**Learn:**</u>
- To find the angle of the midday sun above the horizon, turn the dial once to light up one of the dates on the ship's log.
- Look through the eye piece and move the sextant handle until the yellow sun sits on the horizon.
- Check the angle on the side of the sextant and see if it matches the angle shown on the ship's log.

Eye piece

Dial

Angle (°)

Handle

You need to know the <u>sextant angle</u> and <u>declination angle</u> to calculate **latitude**.
Look at model 2 to find out the <u>declination angle</u> for the 17th October.

Declination angle
Degrees north or south (°)
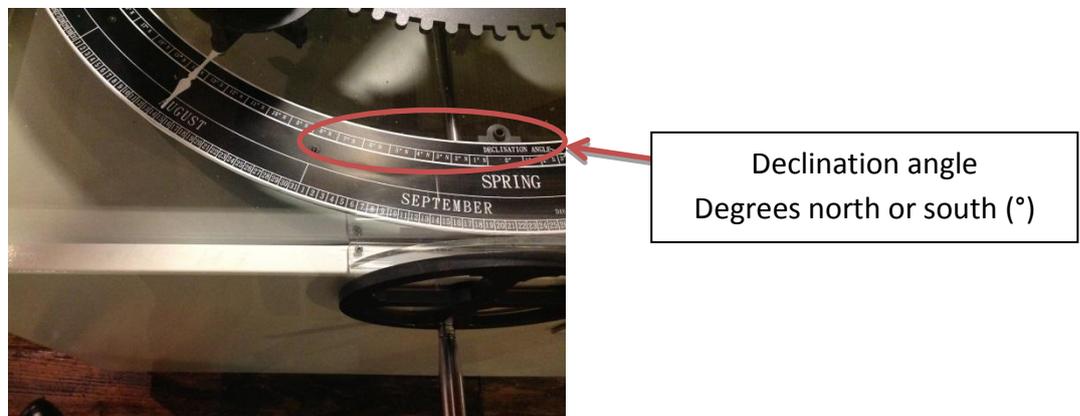
Simple maths is used to work out <u>**latitude**</u>, using the following formula:

If the declination angle is <u>**north**</u>	If the declination angle is <u>**south:**</u>
Sextant angle + declination angle = __?__	**Sextant angle – declination angle = __?__**
90 - __?__ = _____ (latitude)	**90 - __?__ = _____ (latitude)**

Model 4: This puts latitude and longitude together to show Matthew Flinders' location on the Earth's surface.

Learn:

• Select a date on the ship's log.

• Wind the handles to show the longitude (GMT time)

• Wind the handle to show the latitude (angle of sun)

• Look at the silver ship model to see if it is at the location shown in Matthew Flinders' log?
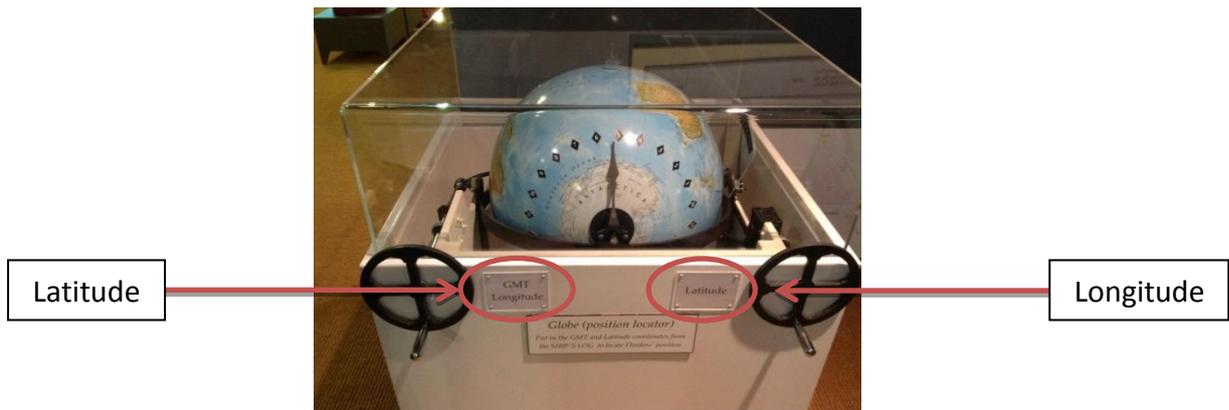
Go further:

• Turn the dial on the sextant to light up another date in Mathew Flinders' log.

• Go through the steps again to work out his position on the earth's surface.

Expert task:

Once you have mastered the calculations, see if you can work out Matthews Flinders' location on 15th August 1809. Use Model 4 to see if your calculations are correct.

Date	Longitude Time (GMT)	Declination Angle Find this on model 2. (DA)	Sextant Angle Move the sextant handle so that the sun sits on the horizon. What is the angle? (SA)	Latitude SA + DA = ? 90 - ? = latitude	Location
15 August 1809	08:15	_____	_____	___ + ___ = ___ 90 - ___ = ___	Mauritius