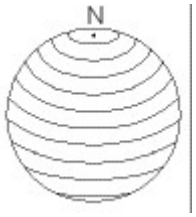
MARINER'S ASTROLABE

What is it?

- An astrolabe is an instrument to find latitude at sea.



Mapmakers divide the world into a grid of longitude lines that run vertically from pole to pole, and latitude lines which run around the world (as shown). By finding your latitude it is possible to work out what degree north or south you are.
The mariner's astrolabe was developed to help take more accurate readings of the midday sun or night time stars on a ship. It was heavier and more stable when used on a ship in rough seas.

Object No: NAV0022

How did it work?

- Sailors held the astrolabe at waist height and looked down onto it.
- The pointer was set towards the sun at its highest point in the sky (midday), or the pole star at night, then the angle was measured on the outer dial.
- Mariners' astrolabes were deliberately very heavy, and had sections removed, to stop them moving in the wind.
- Adjustments were needed for different times of year, so to save time with complex calculations sailors often carried tables of corrections for reference.

What's it got to do with the Circumnavigation?

- Drake knew that surviving the voyage would require excellent navigational skills and the latest up to date equipment.
- A miscalculation in position of up to four or five degrees could mean the difference between landing in London or Edinburgh, Scotland
- Drake received instruction in the latest navigational technology and techniques before the fleet left. This included Astrolabes and Cross Staffs which would be used to calculate latitude.
- As yet there was no method for calculating Longitude at sea (where you are around the world travelling East or West). It was impossible to precisely locate the position of your ship as a result.

LOG AND LINE

Object No: NAV0720

What is it?

- A tool consisting of a log and a line for measuring speed at sea.

How did it work?

- Sailors threw the log overboard. The log had just enough weight along the bottom to allow it to float upright in the water.
- As a result, there was a lot of friction between it and the water, so the log stayed where it was and the boat moved on.
- Sailors let out rope for a set period, usually half a minute. They had to move the rope quickly enough to allow the log to stay still in the water.
- To measure the amount of rope they were letting out, the sailors counted the knots tied every 6 feet (1.8 metres) (6 feet = 1 fathom). This allowed them to measure their speed.

What's it got to do with the Circumnavigation?

- This was the main means of measuring speed on a ship.
- When used alongside a compass, mariners could work out which direction they were sailing and how quickly.
- They would record this information regularly and record it on a traverse board.

SPANISH CHARTS AND MAPS

What Is It? **Object No: G244:1/3**

- A map showing South and Central America, ports and key locations of Spanish Settlement
- These were produced by European Map makers based on exploration and investigation of the Coastline and coastal waters of South America.
- This knowledge was gradually built up over time and recorded using maps and charts.
- Charts would include key locations, navigational information, and sometimes record depths of water to enable safe movement of ships.

What has it got to do with the Circumnavigation?

- English Sailors had very little or no information about the areas of the Americas they were sailing around at this time, especially about South America and the Pacific Ocean
- Plundering Spanish Charts during the Circumnavigation was useful to Drake but also allowed him to share the information with others when he reached home influencing English map and chart making which was an important industry supporting the growth in seafaring and navigation.
- Drake also took Spanish and Portuguese pilots prisoner and used their knowledge. Pilots are people who have in depth navigational knowledge of a particular area which was immensely valuable to keep ships safe when navigating potentially difficult or dangerous waters.

RUTTERS AND PILOTS

What are they?

- Mariner's Handbooks containing Sailing Directions
- Pilots were skilled navigators with precise knowledge of sailing in particular locations

How did they work?

- Rutters contained detailed descriptions of shorelines, sailing directions, harbours, tides, and vast amounts of other information essential to keep a ship safe at sea.
- The English had access to rutters but they did not contain information about South America.
- Pilots accumulated knowledge through study and experience and were also highly skilled in different navigational and sailing techniques.

What have they got to do with the Circumnavigation?

- The contents of Rutters were highly sensitive information that could be used for military or commercial purposes. For this reason information about the circumnavigation was suppressed.
- The books the Drake and the crew of the Golden Hinde were able to capture vastly increased English knowledge of the Americas and were later used by cartographers to make new and more accurate maps.
- Pilots were so important that Drake took pilots prisoner such as the Portugese pilot Nuna da Silva whose knowledge was limited to the Atlantic and as such Drake released him in the Pacific.
- Da Silva was interrogated by the Spanish and his account is one of the earliest sources of information on Drake's voyage in the Americas.

GOLD AND SILVER

What is it?

- Precious metals
- These were being mined in huge amounts by the Spanish from the Americas and then transported back to Europe (often using enforced Labour helping to drive the early Transatlantic Slave Trade)

What's it got to do with the Circumnavigation?

- Precious metals were a driving force in early attempts at English colonisation with the desire to seize a source of previous metals that could benefit the English treasury.
- Communities of escaped enslaved people could be useful allies for Drake, notable Diego who was part of the crew of the Golden Hinde was a Cimaroon, who had escaped enslavement and joined Drake on a previous voyage, working as a crew member and crucially an interpreter.
- Moving vast amounts of wealth (for instance in the form of silver Dollars) made the Spanish vulnerable to English Privateers (/pirates) like Drake who attacked convoys and ships carrying treasure at various points.
- Drake captured a VAST amount of Gold and Silver during the circumnavigation, enough to give the queen an amount considerably greater than her regular yearly income, whilst maintaining a huge fortune for Drake.
- How to continue to make profit from seafaring while managing the relationship with other countries (notably Spain) was an ongoing problem for the English.

Object No: OBJ0197.4

RATIONS – SHIPS BISCUIT

What are they?

- Having enough food to eat was a major problem for long distance seafaring.
- These biscuits were typically taken on ships as they were very long lasting.
- They were used on ships for centuries and are also known as Hard Tack

How did they work?

- To eat them sailors would have to soak the biscuit in a liquid to soften it and then it would become edible.
- Disease and poor nutrition could be a cause of disease amongst Seafarers. Conditions like Scurvy (caused by lack of vitamin C from fresh fruit or vegetables) could be deadly.

What do they have to do with the Circumnavigation?

- Drake was aware that he needed his crew to stay healthy.
- Their regular contact with land around South America enabled them to gather or buy fresh food and they captured and ate any sea creatures they could.
- Animals were kept on board to provide food like eggs.
- Knowledge of food and how to purchase or find it while travelling around the world was valuable information in enabling future voyages to take place.

Object No: AAB0003

SPICES

What are they?

- Cloves, Nutmeg, pepper and other spices.
- They grew in Asia and due to climatic conditions were impossible to grow in Europe
- As a result, spices were incredibly valuable in Europe

How did they work?

- Spices were produced in what Europeans referred to as the 'Spice Islands'
- Today we would refer to these islands as part of Indonesia.
- At the time Portuguese sailors had attempted to set up trading ports in this area in the hope of dominating the spice trade, however local kings and rulers were resisting this.

What have they got to do with the Circumnavigation?

- Drake arrived in the Moluccas islands and established contact with the local Sultan.
- They were able to trade for spices using linen and gold and silver.
- Relationships with rulers and potential trade partners in the spice Islands would be incredibly valuable if the English could take advantage of them.
- Drake was able to gain favour with people in this area by stating that he was an enemy of the Portuguese.
- Knowledge and the creation of trade links had the potential to be a lasting legacy of the voyage. The East India Company was formed relatively soon after Drake's voyage.

SPANISH VESSELS

Object No: SLR0359

What are they?

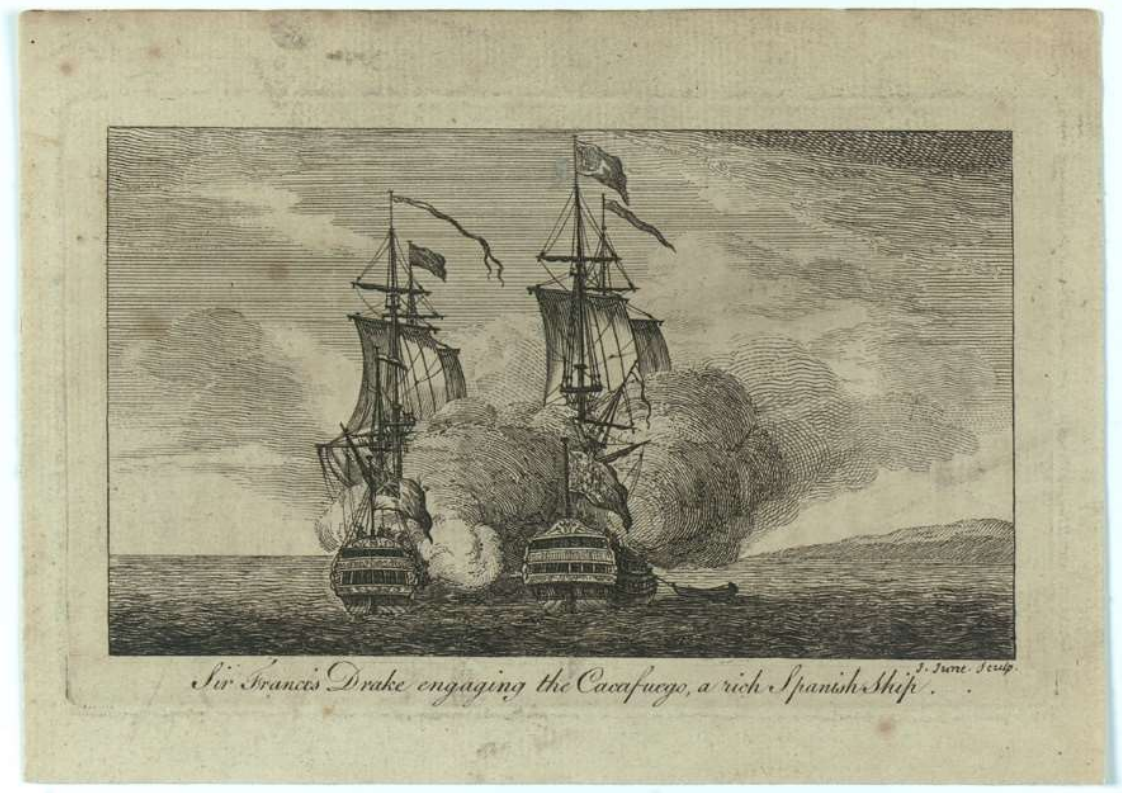
- Huge vessels which can be used to carry cargo or fight at sea

How did they work?

- Each galleon had three or four masts.
- They could carry large numbers of fighting men but the Spanish were not anticipating being attacked along the west coast of South America so their ships were not prepared to defend themselves.
- Even war ships were often converted armed merchant ships, designed to have large storage capacity and were altered to become more suitable for war only when needed.
- Usually made of oak with up to 2,000 trees being used to construct one ship.

What did they have to do with Circumnavigation?

- Drake attacked and looted several unprepared Spanish Vessels.
- These vessels were unprepared as they were surprised by Drake's presence so far from Europe.
- The vessel ***Nuestra Señora de la Concepción*** was Drake's most high-profile capture. This was surprised and surrendered quickly after coming under fire and being boarded by the English.
- There was so much treasure on board that it took days to load it onto the Golden Hinde
- The Spanish organised ships to hunt for Drake but there was massive confusion about how many English Ships had reached the Pacific and where he had gone. This ineffective pursuit ended with the Spanish Guarding key points and in future protecting their ports and ships more closely.



Object No: PAH6253

RACE-BUILT GALLEONS

What are they?

- The Pelican (renamed Golden Hinde) was most likely an early form of a Race Built Galleon
- These ships were designed to have a lower profile in the water and were narrower than other vessels.
- This made the ship faster, more manoeuvrable and stable at sea.
- Drake set off with 5 ships but only the Golden Hinde made it to the Pacific Ocean.

Object No: PAF7919

How did they work?

After 1578 the English warships were all race-built galleons.

- Lower castles so they caught less wind.
- Fairly slim underwater shape, which reduced the drag on the boat allowing them to move faster.
- More efficient design of sails which allowed them to sail closer to the wind (take advantage of wind coming from behind). As a result they were able to stay on the windward side (the direction from which the wind blows) of the Armada.
- Because they were much slimmer and faster than the Spanish galleons they had much less storage capacity and could carry less people.
- They had relatively heavy guns close to the water and could manoeuvre fast and easily, firing at a distance to disable and isolate their opponents before boarding and looting them.
- Their small size and cramped conditions made for difficult living conditions for the 80 crew

What have they got to do with the Circumnavigation?

- The design of their ships allowed the English to attack the Spanish in their preferred way - from a distance, and without getting into hand-to-hand combat.
- Race built galleons were ideal vessels for privateering/piracy as they could easily catch and overwhelm any isolated Spanish vessels they encountered.
- Drake set off with 5 ships but only the Golden Hinde made it to the Pacific Ocean. Even so the vessel was so well suited to this role that they were able to attack and loot unprepared Spanish settlements and vessels all along the west coast of the Americas.

ARTILLERY AND WEAPONRY

What is it?

- Large and transportable armament (e.g. guns and cannon)

Object No: KTP0023
NB this cannon is from the mid-17th Century and the gun carriage is a modern reconstuction

How did they work?

- The cannons were made of Bronze, cast iron, or other strong metals and loaded through the muzzle (the 'mouth') with shot.
- Different styles of shot were used for different purposes. Solid shot (the classic 'cannonball') was used to puncture holes in the walls and decks of ships. Grape shot sprayed out in pellets, killing men and destroying objects.
- English Cannons were mounted on special gun carriages which allowed them to fire more rapidly.

What's it got to do with the Circumnavigation?

- The Golden Hinde carried around 20 cannons.
- Different forms of ammunition could be used for different functions, such as grape shot made up of small balls which spread out of the cannon as it fired and larger cannon balls which could damage ships.
- These cannons could damage or threaten a vessel and force it to surrender at which point it could be looted.