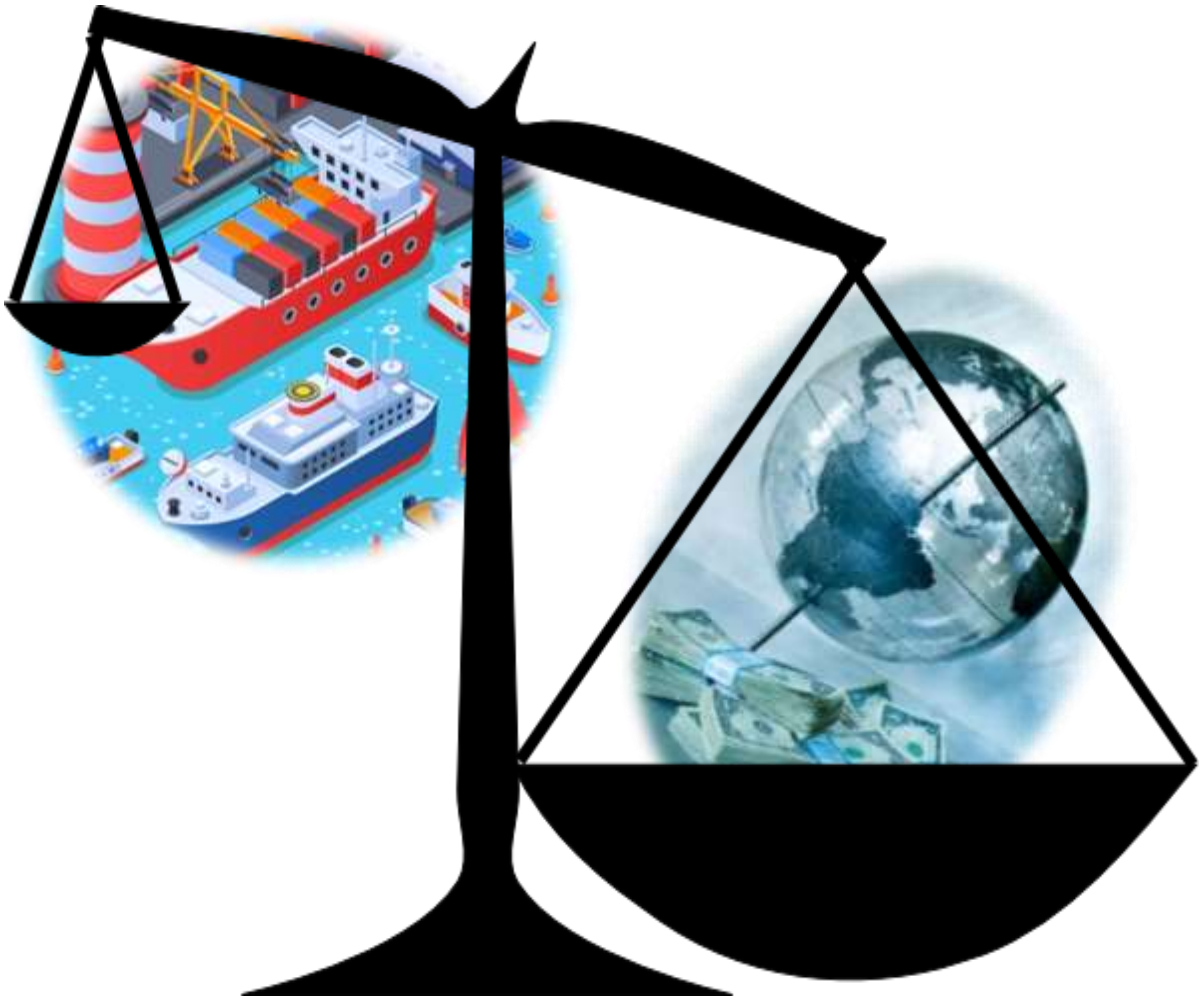
Maritime Economics

Grade 10-Term 3&4

Learner Guide



Maritime Economics
Grade 10 – Term 3 and Term 4

LEARNER GUIDE

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Primary resource:
Brian Ingpen, http://maritimesa.org/grade-10/, 2015

MOVE BEYOND CONSULTING

CONTENTS

PREFACE

The following icons are used in this study guide:

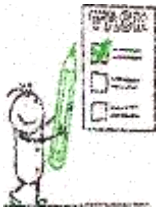
This is a note or an example.

This is a warning: It tells you about potential pitfalls and how to avoid producing errors.

This is a reference: It provides you with additional information that will help you with the subject under discussion.

This is a Question: Anything appearing in a box of this type is a question based on an application on the subject under discussion.

This is self-assessment: you are required to answer the questions found at these icons, as it will assist you in mastering the content.



This is a task: you, as the learner, must complete the exercises/tasks/activity/assignments that appear in the learning units.

This is a hint or a tip: It will guide you through the learning opportunity.

This is an experiment: It is an empirical procedure that may be used to test models or hypotheses.

Learning Outcome 3: International Trade

1. What is international trade ?

- The Rooibos plant is endemic to South Africa, and yet Rooibos tea is sold in shops in more than 30 countries around the World. On average, about 14,000 tons of Rooibos are produced in South Africa per annum, and about 6,000 tons of Rooibos is used abroad. How does the South African produced Rooibos tea get to these countries?
- Samsung is a dominant brand for mobile phones in the South African market. Samsung's market share in South Africa was over 43% in May 2018. Yet by 2020, the only countries which had been producing Samsung mobile phones were South Korea, Vietnam, India, Indonesia and Brazil. How is it possible that Samsung mobile phones are sold in shops in South Africa?
- South Africa consumed 11 billion litres of petrol in 2007, with most of the crude oil to meet the demand having come from Saudi Arabia, Nigeria, Angola, Qatar, and United Arab Emirates. How has South Africa arranged to get the crude oil and refined fuels from these countries?
- Countries such as China, India, Mozambique, Korea, Netherlands, Slovenia, Japan, and Switzerland use iron ore from South Africa. In fact, the total value of iron ore from South Africa in 2019 was USD5.7 billion. How does each of the iron ore receiving countries arrange for getting South Africa's iron ore?
- South Africa received USD8.84 billion from abroad and spent USD3.35 billion for international travel services in 2018.

Meaning of INTERNATIONAL TRADE

International trade is the buying and selling of goods and services between countries.

Figure 1: International trade

Movement of goods in international trade

In international trade, goods need to be moved from the supplying country to the country in need of the goods. For example, the large quantities of rooibos tea or platinum needs to be moved from South Africa to the country that needs it.

Shipping by water, using appropriate vessels, is the least expensive means of transporting large quantities of goods between countries.

Thousands of ships are used to move all types of goods between countries or regions.

Major shipping routes link the World's major trading nations.

Export and import

South Africa has an **open economy** because South Africa trades with other countries. Trade is made by import and export of goods and services.

- Import: Money leaves South Africa when goods and services are bought from abroad.
- Export: Money enters South Africa when other countries buy South African goods and services.
- Import and export of goods in large volumes are cost-effective by transport with ships, over navigable waters.
- About 92% of world imports and exports are transported by ocean shipping.
- Over 90% of South Africa's import and export of goods is by sea.
- Shipping and international trade are interrelated.

Figure 2: Different types of ships transport trade goods between countries

Did you know:

- There are over 50,000 merchant ships transporting cargo between ports around the World.
- The world fleet of merchant vessels is registered in over 150 countries.
- Over 1.6 million seafarers man the world fleet of merchant ships. These seafarers are from over 37 countries, including South Africa.
- By 2019, there was a total of five merchant vessels registered under the South African flag, which gives South Africa the possibility of a share in trade transport.

Task 1:

1.1. South Africa exports about 6,000 metric tons of Rooibos in a year. Convert 6,000 metric tons to the amount in kilograms.

1.2. Choose the most correct answer. If Japan imports 2,000 metric tons of Rooibos, this would be the equivalent mass of:

(a) 2,000 VW polo cars; (b) 2,000 unladen speed boats; or (c) 40,000 bags of cement

(Hint: 1 VW polo ~1650 kg; 1 unladen speed boat ~450 kg; 1 bag of cement ~ 50 kg)

1.3. Consider the below market share data for smart phone penetration in South Africa.

South Africa **Smartphone** Shipment Market Share (%)	2017	2018
SAMSUNG	33%	32%
MOBICEL	6%	16%
HUAWEI	9%	15%
HISENSE	8%	10%
APPLE	5%	5%
OTHERS	39%	22%
TOTAL	**100%**	**100%**

Counterpoint

1.3.1. Which of the brands of smartphones had the most significant market share in 2018?

1.3.2. Which brand had the most significant penetration jump between 2017 and 2018? What is the percentage jump for this brand?

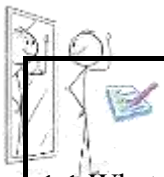
1.3.3. Which brand had the least significant change in market share between 2017 and 2018?

1.3.4. Which country developed Mobicel?

1.3.5. Which country manufactures Mobicel smartphones?

1.3.6. Give examples of service trade between South Africa and the manufacturing country for Mobicel.

1.3.7. South Africa has five ships on her register, would the Mobicel mobile phones be transported in bulk by any of these ships?



Self Assessment 1:

1.1. What do you think is the reason Mobicel's developers chose to have the smartphone manufactured outside of South Africa?

1.2. What percentage of goods, which is imported by and exported from South Africa, is transported by sea?

Advantages in trading between countries include:

i. Consumers have the opportunity to be exposed to goods and services not available in their own countries. As an example, people in Japan get to drink Rooibos tea because of trade with South Africa;
ii. The market size becomes bigger than just the domestic market. Adding a new country to your trading list can mean business growth and increased revenues;
iii. There may be benefits from currency exchange;
iv. Surplus goods can be exported for a profit rather than being disposed of;
v. More employment is created; and
vi. Goodwill and friendship is created between trading countries.

2. History of Maritime Trade

① During **prehistoric** times people used to barter.

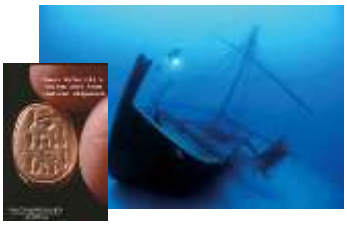
Did you know:

- The picture below is of the discovery, in 1987, of Africa's oldest known boat, the Dufuna Canoe.
- The Dufuna Canoe was discovered near the River Yobe, in Nigeria.
- Radio-carbon tests have determined that the canoe dates back to the Late Stone Age period. It is most likely between 8,000 and 8,500 years old!
- The Dufuna Canoe is the 3rd oldest discovered boat in the World!
- An archaeologist from the University of Frankfurt says the age of the Dufuna Canoe "*forces a reconsideration of Africa's role in the history of water transport. …the cultural history of Africa was not determined by Near Eastern and European influences but took its own, in many cases parallel, course*".
- The Dufuna Canoe is 8.4 meters long, ½ meter wide and 5 cm thick. The bow and stern are pointed and carved. The boat was built by skilled boat makers.

Use Google Earth to pin the location of the Dufuna Canoe find (the coordinates are 12.18°N, 11.18°E). Provide an explanation for the existence and use of this most sophisticated boat in 6,000 BCE, especially noting the location of the find.

②**Egyptian** trade with other countries existed by 3,000 BCE. Trading countries included Canaan (present day Lebanon, Syria, Jordan, and Israel), Nubia (present day northern Sudan and southern Egypt) and Punt (most likely modern day Somalia). Most Egyptians lived near the "life-giving" Nile River, which gave easy access to linked waterways. The Egyptians also had boats which could be dismantled, carried across land, and put together again. In this way the sailors could cross waterways that would otherwise not have been navigable. Egyptians exported grain, gold, linen, papyrus, and finished glass and stone objects. They imported gold, aromatic resins, ebony, ivory, tin, copper and wild animals.

Did you know:



- The Uluburun is a 3,300 year old shipwreck found in 1982, in south-western Turkey.
- The ship was carrying over 20 tons of cargo, including the golden seal of Egyptian Queen Nefertiti!
- Besides Egypt, the cargo was traced to six other cultures. These are Mycenaean (Greece), Syro-Palestinian (Syria and Palestine), Cypriot (Cyprus), Kassite (ancient Near East), Assyrian (ancient Middle East) and Nubian (present day Northern Sudan and southern Egypt). This find is evidence of early international trade in a circular route between lands along the Mediterranean coast.

③Perhaps the first maritime trade network in the Indian Ocean was by **Austronesian** people (who are from countries such as Brunei, Indonesia, Malaysia, Philippines, Singapore and East Timor). The Austronesian people established trade routes with India and Sri Lanka around 1500 BCE. They traded goods such as material for boats, fruits and spices. The Indonesians traded their spice with East Africa. This exploration and trade resulted in the Austronesian colonisation of Madagascar in the first millennium CE.

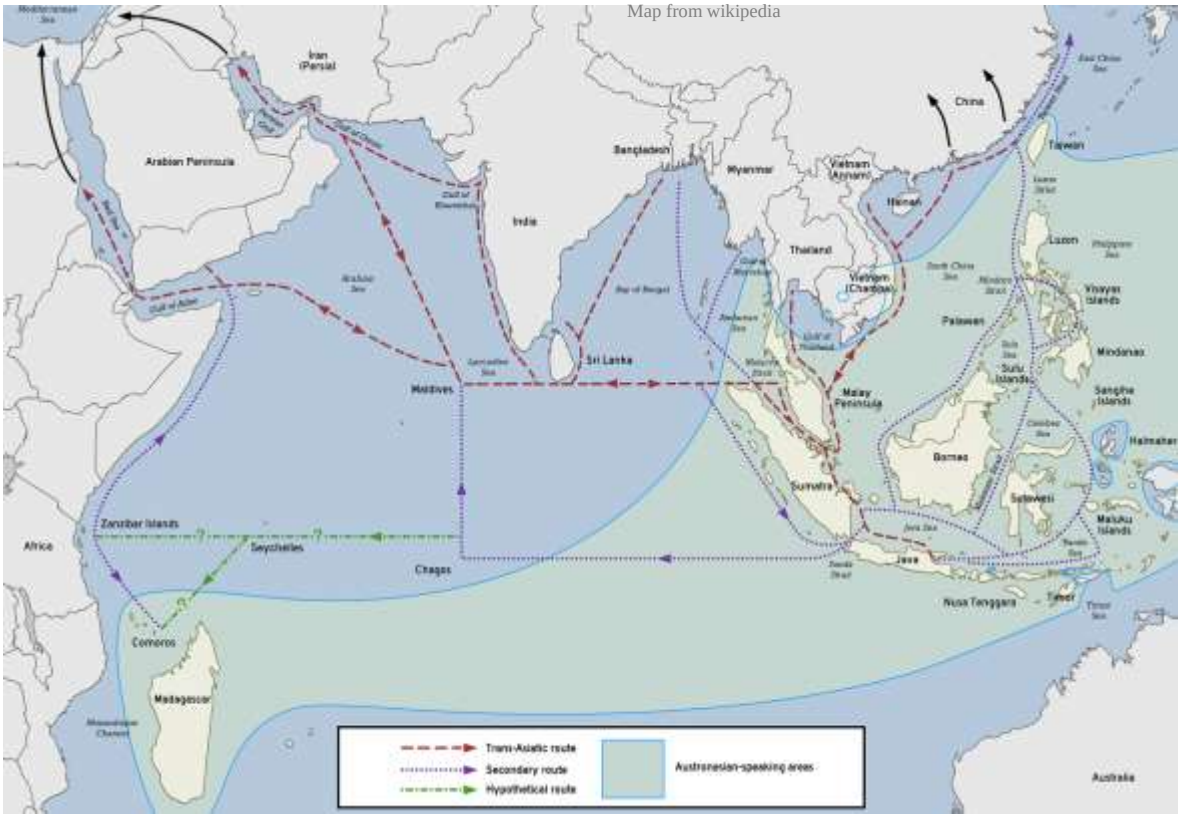
Did you know:

- The ancient outrigger canoe shown alongside is evidence of Austronesian people's use of boating technology to travel between lands. This artefact is in the Western Australian Maritime Museum.
- The outrigger would have increased the stability of the canoe and provided the possibility for paddling and sailing with relative speed in rough waters and open ocean. Also, favourable ocean current and monsoon weather patterns would have helped.
- In 2016 archaeologist Crowther and her colleagues found that Madagascar and the Comoros archipelago were dominated by ancient Asian cultivars, especially mung beans and rice.

Task 2:

Consider the below map of Austronesian proto-historic and historic maritime trade network in the Indian Ocean.

Map from wikipedia



2.1. List the countries in the Austronesian speaking areas.

2.2. List some of the water bodies along the Java-Red Sea trade route.

2.3. List the countries along the Java-Persian trade route.

2.4. In your opinion, what evidence provides support that Austronesians colonised Madagascar in the first millennium CE by sailing across the open Indian Ocean.

2.5. What is the meaning of "millennium"?

2.6. How many years ago was the start of the first millennium CE?

2.7. Which millennium are we presently in?

④**Phoenicians** established colonies in North Africa and Southern Europe and their maritime trading culture spread across the Mediterranean between the years 1550 BCE and 300 BCE. Even Arabia and India were reached using the Red Sea.

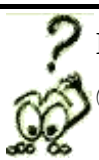
The Phoenician city, Carthage (which is in modern day Tunisia, northern Africa), was a maritime power that dominated in western Mediterranean.

Did you know:

- The word "Phoenician" is Greek for "People of the Sea."
- The North Star was known as the Phoenician Star because the Phoenician seafarer used to navigate by looking at the sun and the stars.
- The Phoenicians traded Tyrian Purple (which was a violet-purple dye). The dye was made of urine, sea water and ink from the bladders of the murex snails. One gram of Tyrian Purple was worth about 20 times more than gold.
- The Phoenicians also traded purple cloth, glass trinkets, perfumed ointments, and fish.
- Amongst a number of other items, the Phoenicians also traded timber for papyrus and linen from Egypt and copper from Cyprus.
- It is widely believed that the Phoenicians pioneered the concept of trading consumer products for raw materials on a large scale.
- The Phoenician alphabet spread through its trading network and was adopted by the Greeks and the Romans. The English alphabet, which can be traced to the Phoenicians, may be considered to be the result of international trade.

⑤The **Greeks** became a dominant trading nation in the Hellenistic period, which was the time between the years 323 BCE and 30 BCE.

⑥The **Romans** displaced the Greeks as a maritime power and developed large sea and land routes for international trade. Imperial Rome reigned between 31 BCE and 476 CE. They had a large fleet of galleys to transport goods from their colonies to Rome and vice versa.



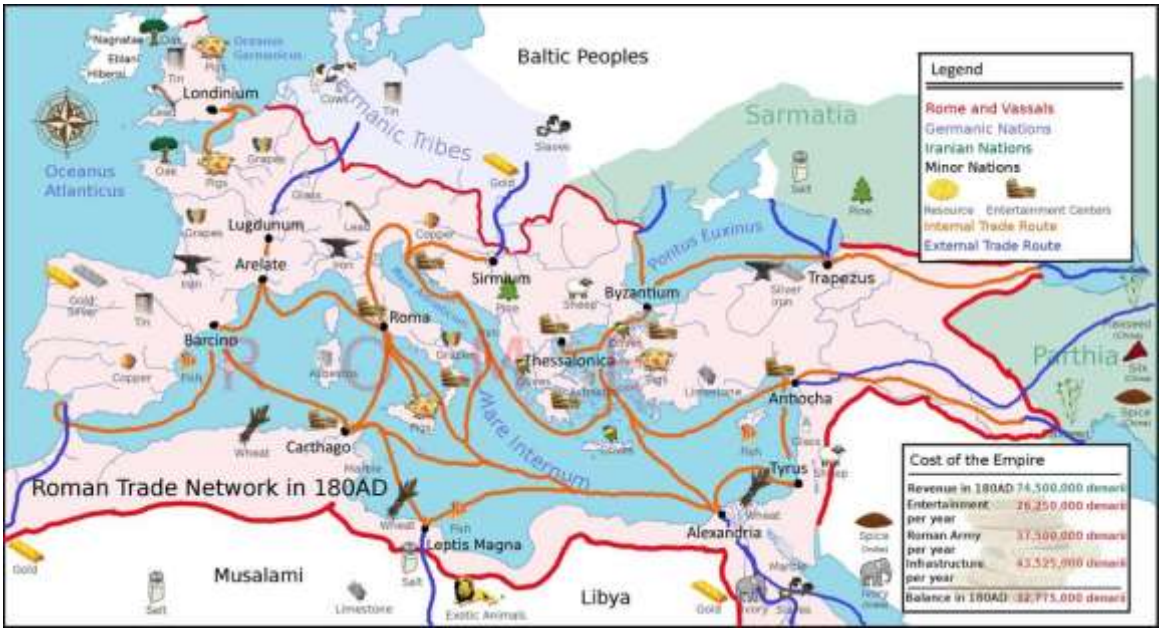
Did you know:

- Confirmation of international trade in ancient times is from the archaeological and vegetation findings at sites far from their place of production.

- These findings include raw materials (such as gold, copper, ivory), artefacts (such as tools, clothing, decorations, art), features (such as pyramids, shipwrecks), skeletal remains (of people and animals) and study of long-term changes in vegetation.

Task 3:

Consider the map of trade routes in 180 CE (from landofmaps.com) and the present day map of Southern Europe /North Africa.



3.1. What was Algeria known as?

3.2. What was the Mediterranean Sea known as?

3.3. What was the Black Sea known as?

task 3 continued …

3.4. Write the equivalent name of the places from present day and 180 CE:

3.4.1. Tunis

3.4.2. Tyrus

3.4.3. Byzantuim

3.4.4. London

3.4.5. Barcino

3.5. In which present day country would you have found Antiocha?

3.6. In which present day country would you have found Barcino?

3.7. In which present day countries were silver sourced in 180 CE?

3.8. List some of the trading ports along the Mare Internum coast, the present day country for these ports and the equivalent present day names of each of these ports.

3.9. List two natural resources that was sourced in Africa.

⑦The **Middle Ages** is the historic period between the 5th century to the 15th century. This is the time between the years 476 CE and 1453. Foreign merchants were allowed to live at international trading posts to trade their goods. This created new businesses and jobs. Ports had to develop consulates to protect the rights of nationals; there was opportunity to open shops and services to supply new needs (for clothing, food preferences, books, tools, repairs etc.). Investors and maritime insurers gave finance services and support. Trade law and regulations became prominent, as well as taxes and duties.

In competition to control the trade routes, nations had to use military. Organisations, such as the Hanseatic League, were established with the aim to protect the interests of merchants.

Did you know:

Map of the Mali Empire, c. 1337 CE

- The Mali Empire was one of the large empires during the middle ages.
- The Mali Empire spanned from the Atlantic Coast into the Sahara desert.
- The empire included modern day Senegal, Mauritania, Mali, Burkina Fasom Niger, Gambia, Guinea-Bissaum Guinea, Ivory Coast and Ghana.
- By the 14th century the empire ruled over 400 cities, towns and villages.
- The Mali Empire lasted 370 years, from 1230 to 1600.
- Timbuktu, which is along the Niger River, was a major trading hub and center of learning.
- The Sankoré Masjid, in Timbuktu, became a famous learning center in the middle ages and was capable of housing 25,000 students. This Masjid had one of the largest libraries in the World; with between 400,000 and 700,000 manuscripts!

- Students of ancient Sankoré Masjid studied many subjects, including trade, carpentry, farming, law, and navigation.
- Canoes and vessels were used on the navigable inland waterways for trade and transport.
- The Mali Empire traded gold, salt, copper, ivory, textiles, horses, glassware, cereals, spices, stone beads, and slaves.
- The economy was built with annual tributes from kingdoms, taxes from the citizens, and heavy taxes on imported and exported goods.

- The Mali Empire was wealthy during the reign of Mansa Musa Keita. This Mansa had an abundance of gold and during his pilgrimage to Mecca in 1324 he passed out gold to poor along the way! The sudden influx of gold devalued the precious metal in the cities of Cairo, Medina and Mecca for the 12 years.
- One of Mansa Musa's greatest achievements was to impose a single system of law and order across northern Africa, which helped facilitate trade.
- Emperor Mansa Musa accumulated USD400 billion during his reign from 1312 to 1337, making him the wealthiest man ever, according to an inflation-adjusted list by celebritynetworth.com!

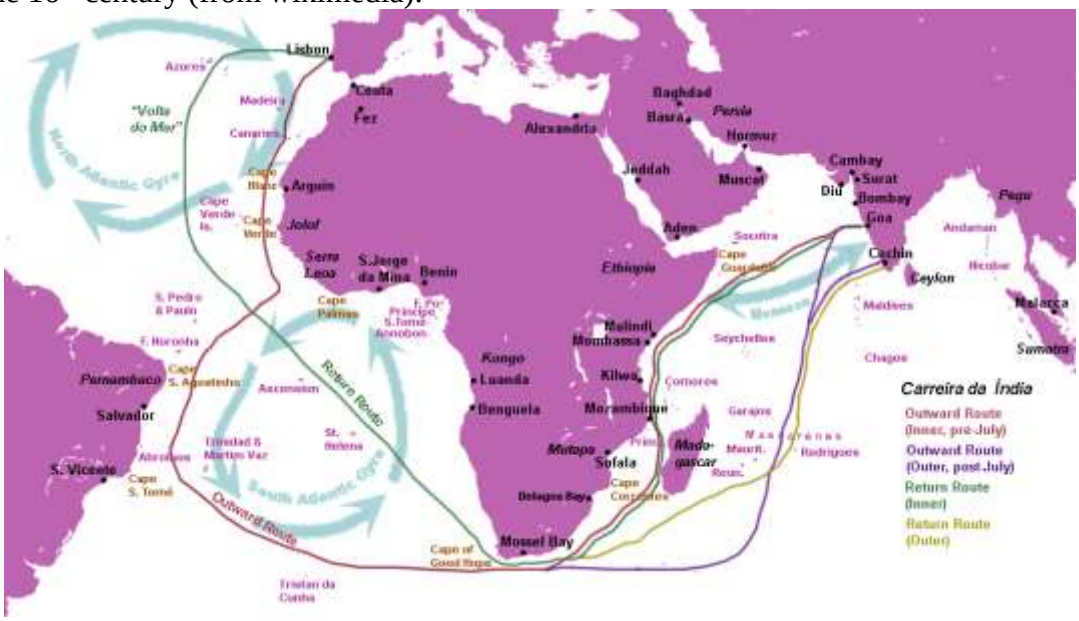
⑧The **Age of Discovery** (also known as the Age of Exploration) in European history marks the rise of colonialism and mercantilism as national policies in Europe.

- Global European exploration in the Age of Discovery was between the 15th and 18th century.
- European ships traveled around the World to search for new trading routes and trading partners. The factors which led to the search for alternate routes are:
  - European access along the silk road and through Constantinople was blocked in 1453 by the Ottoman Empire.
  - The Ottoman Empire also blocked access to North Africa and the Red Sea.

- The explorers were in search of gold, silver and spices.
- The European colonisers accrued wealth from trade.
- The explorers reached the Cape of Good Hope in 1490.
- By 1498, the explorers had a route from Europe to India by rounding Southern Africa.
- Some of the famous explorers were Vasco da Gama and Bartholomeu Dias.
- Explorers took knowledge from their travels back to Europe.
- With the exchange of knowledge, methods of navigation and mapping improved.
- New food, plants and animals were exchanged between the colonies and Europe.
- Indigenous people were exposed to new diseases, were exploited and enslaved.
- Slave trade persisted for 300 years.

Self Assessment 2:

Consider the below map showing the main oceanic routes by the Portuguese India Armadas in the 16th century (from wikimedia).



2.1. Why is the return route different from the outward route?

2.2. Did the Armadas often stage a stopover at the tip of Africa?

2.3. Why would the Armadas make a stop in Mossel Bay?

2.4. What in your opinion is the reason for two possible routes around Madagascar?

2.5. In your opinion, what were the advantages and disadvantages in the avoidance of stops in Southern Africa?

2.4. How did the Armadas arrange for supply of traded goods in India?

⑨**South Africa-** Recall the History of Cape Town Harbour (fromTerm1).

- The Dutch developed a settlement at the Cape in 1652. The settlement grew and supplied passing ships with fresh food, grain and water.
- Europeans imported slaves from Malaya. The Malayan artisan skills have contributed to the clothing industry.
- Europeans brought in new industrial and farming methods.
- Sugar production flourished.
- The local productions and natural resources could be traded internationally.
- Access to international trade was by harbours and shipping.
- There were a number of shipwrecks due to strong winds and huge swells in Table Bay.
- By 1870 a harbour was built in the Cape as a sanctuary for ships.
- The Suez Canal was opened in 1869 and led to reduced shipping traffic and trade opportunities between Europe, Southern Africa and the East.
- The discovery of diamond and gold in the interior of South Africa brought a wave of new ships and traders.
- South Africa became a major supplier of precious minerals to the global economy but internal conflicts (such as the Anglo-Boer wars) limited the market.
- Shipping services benefited after the unification, in 1910, of the Cape Colony, Orange Free State, Transvaal and Natal. There was now a single economic policy. A new wave of immigrants arrived and trade increased.
- As the economy grew, ports expanded to meet the international shipping needs.
- During the 2nd World War shipping services became disrupted as ships were used for wartime duties. Regular cargo and passenger services were interrupted.
- Commercial shipping and trade returned by 1946, after the 2nd World War. Freight and charter rates soared because of the shortage of ships and the economy benefited from the demand for shipping of goods and passengers which was needed for the rebuilding of countries after the war.
- South Africa also benefitted whenever the Suez Canal was closed and ships had to use the Cape route. Such occurrences were in 1956-1957 and 1967.
- In the 1960s South Africa experienced the 2nd largest economic growth in the World with the growth in international trade.
- The deepened and widened Suez Canal from 1975 onwards changed global trade routes since larger vessels were knowable to transit the canal.
- The active international policy of disinvestment in apartheid South Africa contributed to the fall of apartheid and the subsequent open economy.
- On 27 April 1994, the first democratic election was held in South Africa and shipping started to boom.
- The large-scale economic development in China by 2002 gave a huge boost to international shipping and trade, including for South Africa.
- Global shipping (and hence trade) slumped in 2007 when the “Credit Crunch” devastated the banking sector in USA and Europe.
- The South African economy declined in 2015 and this has led to a reduction in international trade. South Africa is rebuilding its shipping register to foster socio and economic gains with international trading.
- The Covid-19 pandemic of 2020 impacted negatively on global trade and shipping. South Africa kept ports open during the lock down to allow for import and export. Global shipping markets declined because of the subdued global demand with lockdowns.

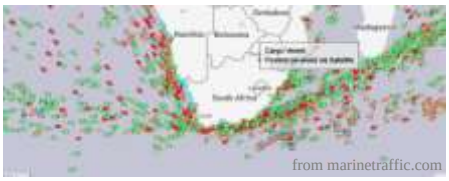


Figure 3: Ship traffic around South Africa on 21 June 2020, 19h45

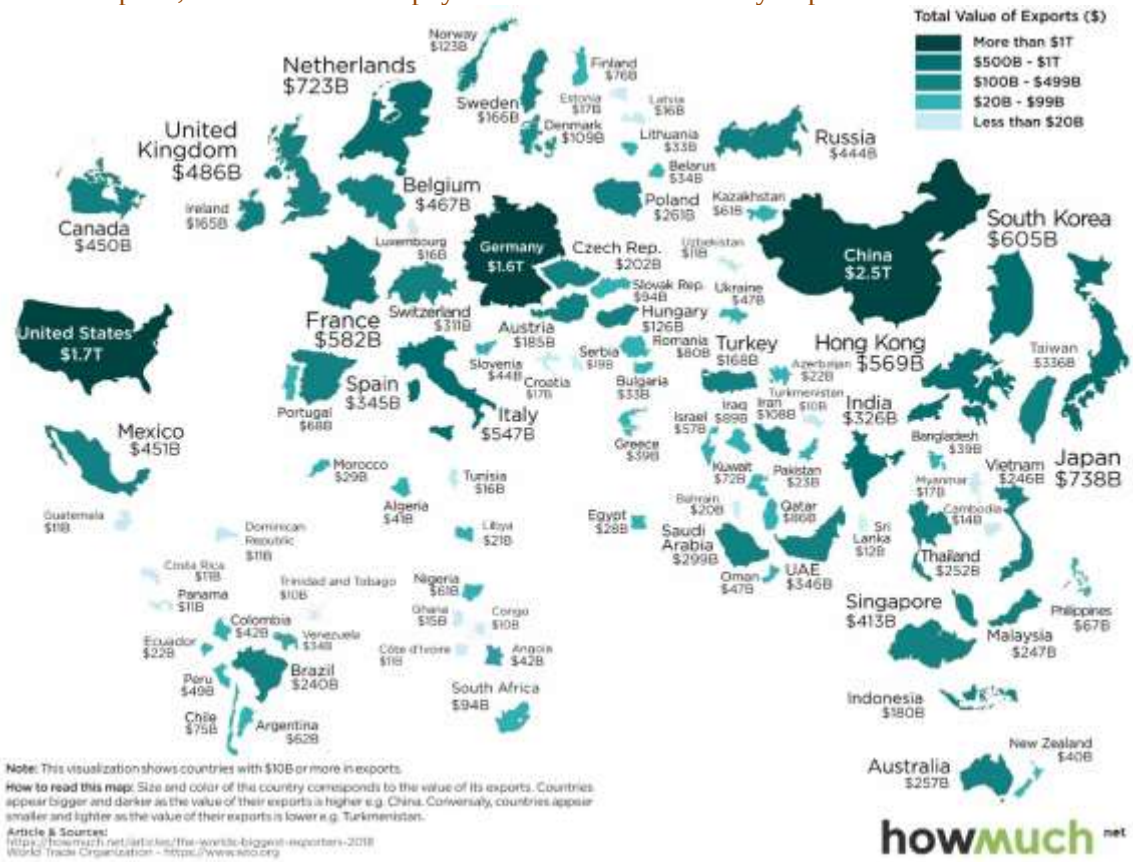
3. The World's leading trading nations

Exports

In 2018, world trade in goods was valued at above USD19 trillion.

The below visualisation shows the total value of exports by countries in the year 2018.

Some countries appear shrunk and others much larger than it would be on a world map. In this visualisation, the size of the country is shown as relative to the value of its exports, and not relative to physical land size. A cool way to present the data.



- The three largest exporting nations in 2018 were the European Union, China and the United States of America.
- Collectively, the European Union has the largest export industry. The value of export in 2018 was US6.5 trillion. Machinery, vehicles and chemicals had been the EU's main exports.
- China was the leading exporting country in 2018. This country exported goods and services to the value of USD2.5 trillion. China's main exports were broadcasting equipment, computers, machine parts, integrated circuits, and telephones.
- Other exporting nations with export values of more USD500 billion each, had been the United States of America, Germany, Japan, Netherlands, South Korea, France, Hong Kong, and Italy.
- South Africa was the leading export country in Africa. South Africa's export value was USD94 billion. The main products exported are platinum, coal, and motor cars. Some of the main trade partners are China, Germany, USA, India and Japan.
- Shipping is necessary to move the massive amounts of goods to the various trading countries. As an example, large bulk carriers load iron ore in Saldanha Bay, South Africa, for discharge in China.

Can you imagine living without numbers?

- How would "how old are you" mean?
- How would you know that you have enough sugar?
- How would you know when to go to school?

Numbers are connected to everything we do. As human beings, we count everything.
We even have names for special totals. If you score three goals in a row you will have a hat trick. If you buy 12 eggs, you will have a dozen eggs.

For very big numbers, like those in economics, it is useful to know orders of magnitude and numbers as big as trillions.

Orders of Magnitude		
Hundred	100	2 zeroes
Thousand	1,000	3 zeroes
Million	1,000,000	6 zeroes
Billion	1,000,000,000	9 zeroes
Trillion	1,000,000,000,000	12 zeroes
Quadrillion	1,000,000,000,000,000	15 zeroes

Self Assessment 3:

3.1.Write out the value USD17 trillion in figures.

3.2. How many millions are in 17 trillion?

3.3. How many thousands are there in 17 trillion?

Did you know:

- Freight forwarders organise transportation for goods.
- They combine smaller shipments to create a single large shipment which helps to minimise shipment costs.
- Companies using a freight forwarder will benefit as they are charged a much smaller shipping cost than if they had shipped their product independently.

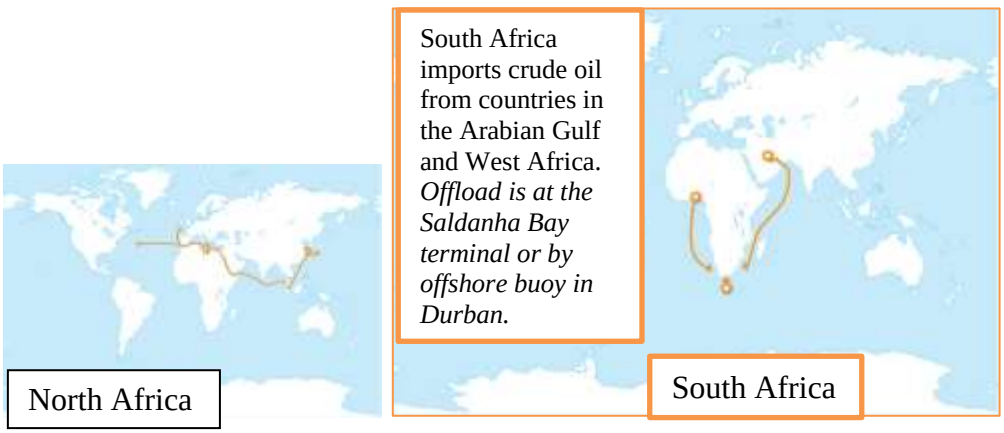
Imports

- Although China's thriving economy is built on exporting of goods, China is also amongst the World's leading importing countries. In 2018, China imported goods to the value of USD2.1 trillion! China imports, which are each above USD1 billion, included crude oil, ores, petroleum gases, vehicles, gold, yarn, meat, fish, flour, wine, fruits, barley, and rice.
- The United States of America was the biggest importing country in 2018. Imports above USD1 billion included vehicles, crude oil, smartphones, turbo-jets, furniture, aircraft parts, air conditioners, platinum, footwear, clothing, seafood, platinum, coffee, and beauty products.
- South Africa was the biggest importer of goods in Africa in 2018. Notice that South Africa import value was more than the export value. The main import products are crude oil, vehicle components, pharmaceutical products, smartphones, trucks, heavy machinery, solid fuels made from coal, rice, wheat, clothing, and footwear. Most imports are from China, Germany, USA, Saudi Arabia and Nigeria.
- Shipping is necessary to move the massive amounts of goods to the various trading countries. As an example, large tankers are needed to move crude oil from Saudi Arabia's Yanbu crude oil terminal for discharge in South Africa.

4. Trade Routes

Oil is basic to the economy of industrialised countries. The oil shipping routes are based on the most economic and safe travelling routes from supply site to the delivery site.

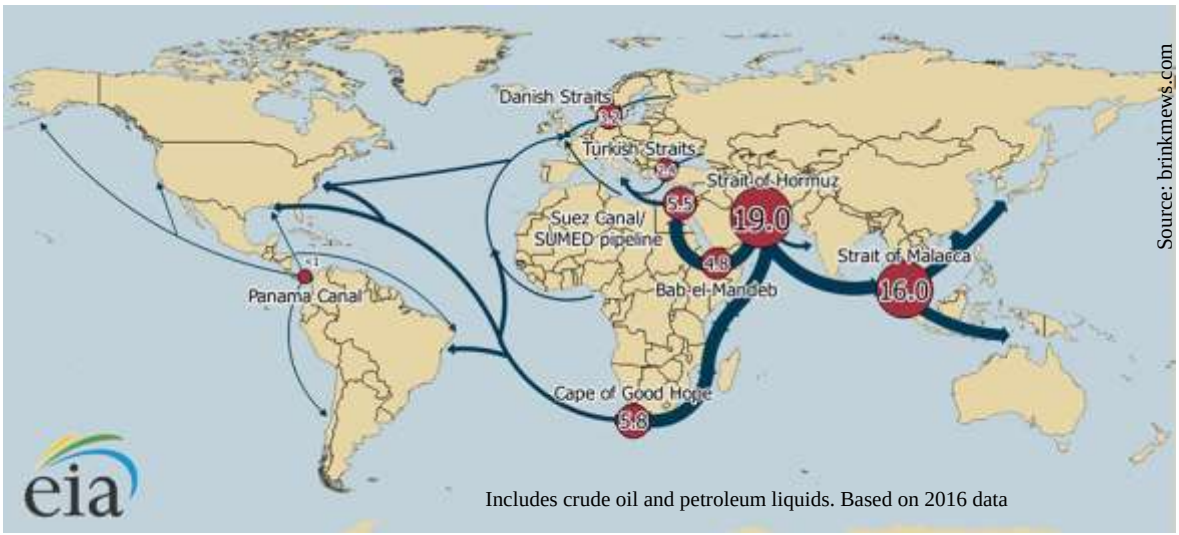
Follow the link http://maritimesa.org/grade-10/crude-oil-tankers/ to find the major crude oil shipping routes in 2015.



- Crude oil from the **Arabian Gulf** is shipped to Europe (via Suez or Cape), North America (via Suez or Cape), Japan, Korea, China, India and Singapore.
- Crude oil the **North Sea** is shipped to Europe and North America.
- Crude oil from the **Black Sea** is shipped to Europe, North America and Asia (via Suez).
- The main crude oil exporting countries in **West Africa** are Angola and Nigeria. Crude oil from West Africa is shipped to Africa, Europe, North America and Asia.
- Crude oil from **Venezuela** is shipped to Europe, North America, and South America.
- Crude oil from **Brazil** is shipped to Europe, North America, Asia.
- Crude oil from **Alaska** is shipped to western coast of North America and South America, and Asia.
- Crude oil from **North Africa** is shipped to North America, Europe, and Asia (via Suez).

Task 4:

Consider the below global trade route map for crude oil. The encircled numbers are the estimates of volume of crude oil movement in million barrels per day. About 61% of the World's oil supply moves through vulnerable maritime chokepoints.



4.1. What is a maritime chokepoint?

4.2. How many maritime chokepoints are shown on the trade route map?

4.3. The Strait of Malacca is the shortest passageway from the Persian Gulf onto the Indian Ocean, South China Sea and the Pacific Ocean. This strait is only 2.7 km at its widest point, and is the narrowest maritime chokepoint in the World. What would ships travelling to Singapore, from the Persian Gulf, have to do if the Strait of Malacca became blocked?

4.4. What would the impact on people if the Strait of Malacca would be blocked?

task 3 continued …

4.5. The narrowest point of the Panama Canal is 33.5 m wide. The width of a midsized oil tanker is about 51 m and large super-tankers have widths are over 68 m.

4.5.1. Can such tankers be routed through the Panama Canal.

4.5.2. How can the large tanker loads be transported from the Arabian Gulf to the west coast of America?

3.4.3. What is the alternate route for ships needing to avoid the Bab el Madeb Straits or the Suez Canal.

5. Containerisation

- The maritime transport industry moves trillions of dollars worth of goods each year and most of these goods cannot simply be transported in loose form.
- The goods must be transported in a way that protects them from damage and natural motions of the ship.
- As an example, South Africa needs electronic equipment, machinery, chemicals and many other products. Such items will be moved from the supplying country in containers, mostly with containerships.
- A shipping container is a vessel or box that is commonly used to transport goods over a long distance.

Did you know:

An average size container ship carries between 15,000 and 20,000 containers, each with a capacity of holding anywhere between 30,000 to 60,000 litres worth of goods. This translates to an enormous amount of trade volume per ship.

Image: wikipedia

5.5.1 The advantages of containerisation

- Containers are suitable for storage of a variety of goods. Examples are heavy bulky goods, livestock and flammable products.
- Shipping by container improves on the security of transportation.
  - They can have a locking device to avoid tampering of cargo during transit.
  - Container handling solutions limits the risk of damaged goods.
  - Containers protect goods from damage during natural motions of the ship wet weather.
  - Each container has a unique tracking number.
  - The cargo is handled only at two stages: by shipper and then consignee.
- Containers are strong and durable. They can be reused over years.
- The durability and improved security with transportation by container reduce insurance costs and insurance claims.
- Unlike other types of vessels, containerships are versatile and can carry a wide variety of goods. The only constraint is that the volume needs to fit inside the container.
- Containerisation is a **system** of freight transport. This means that containers are of an internationally standardised size which can be loaded onto specially-designed ships, trucks, trains.
- The standardising of containers enables efficient transfer of cargo from one medium of transport to another.
- Standardised containers and specially designed transport platforms (on ships, trucks, trains) promote intermodalism.
- Containers can be used for global destinations since container standards are internationally accepted.
- There is a choice from different sizes and types of containers and the possibility to share containers. So shipping by container can be affordable.

There are variations of containers to make shipping efficient and less costly


General cargo


Bulk shipping


Tank


Reefer


Flat rack


Open top


Car shipping

5.5.2 Standard Containers

There are two standard sizes of container:

- 20 feet (approximately 6 m, which is slightly longer than of a large pickup). The gross weight of a general 20 feet cargo container is 24,000 kg.
- 40 feet (approximately12 m). The gross weight of a general 40 feet cargo container is 30,480 kg. A 40 foot container is regarded as two twenty feet containers or 2 TEU (The container is sometimes referred to as FEU for Forty Foot Equivalent Unit).

Figure 4: Three trucks loaded onto a 40ft flat rack collapsible container

- A full container load (FCL) is a standard container that is loaded and unloaded under the risk and account of one shipper and only one consignee. With FCL, the whole container is intended for one consignee.
- Less-than-container load (LCL) is a shipment that is not large enough to fill a standard cargo container. Cargo from more than one shipper is in this container and cargo for more than one consignee is in this container.

5.5.3 Container management

Container management is needed to ensure that containerisation reduces the expense of international trade and increases the speed of handling and delivery. Container management includes the overseeing of containers at both the container depot and container terminal.

Management of a container shipment begins when a **shipper** needs to send a cargo and ends when the **consignee** receives the cargo.

- Some containers are owned by the liner company.
- Some are leased (*hired*) from their owners by shipping companies.

A common misconception is to consider that storage facility for fully-loaded containers is also container depots.

Loaded containers are kept in holding facilities or terminals, and are temporary in nature since shipping companies aim at transferring the goods to the receiving party or to the care of the port at the earliest.

- A **container depot** or yard is where several containers are stored or held in transit, once they are unloaded.
    - The cost of transporting an empty container to a place where it can be used is considered high.
    - The container depot is where empty containers are stored until required.
    - Generally, the depot is where containers are repaired, painted, cleaned, etc.
    - Loading and unloading of goods from a container can take long periods so the container needs to be stored in a safe and permitted place.
    - Most companies do not have adequate space to store an entire container.
    - A depot is a single place where shipping and logistics companies can keep their containers until it is time for reloading.
    - Once containers have been unloaded, they are trucked to the depot, where they are registered by company officials.
    - Containers are kept in bond (this means that the containers are awaiting "clearing" by customs or are waiting to be loaded onto another ship to be taken to another port).
    - Cargo is loaded into containers or removed from containers at the depot.
    - In general, the depot is located inside a port or terminal or in the surrounding area. This enables for a quick and immediate transfer of containers between different locations.
    - A container depot need not be close to a harbour.

- A **container terminal** is a place in a harbour where containers are loaded onto a ship or discharged from a ship.
- An **inland container terminal** (e.g. Johannesburg) enables customs clearing to occur away from the coast, and helps to relieve congestion at container terminals at the harbours. Containers are gathered at an inland terminal for onward movement to the harbours.

Fluctuating fortunes

Containership operators have had good and bad times.

An example of a bad time is the “credit crunch” that began in 2007 with the collapse of several leading banks. Its effects continued for several years. Some of the effects of the “credit crunch” on containership operators were:

- Less cargo available.
- Less demand for ships.
- Freight rates were low, so profits were low.

When larger and more economical containerships came into service, a number of smaller companies could not compete and they either stopped trading or got absorbed by larger companies.

The larger ships can only be used on trades where the water depth in harbours allows deep-draughted ships to operate. Ports around the World needed to upgrade to accommodate the larger vessels. Without the upgrades, costs in shipping are higher than at the upgraded ports. There is also the risk that the large vessels are re-routed to avoid under-developed ports. This too would increase the overall cost for shipping a container.

Container handling solutions

- A ***container stack*** is a demarcated area in a container terminal where containers for one ship are kept for up to 72 hours before they are loaded onto the ship.
- The term stack also applies to a demarcated area in the container terminal where imported containers are kept before being cleared by customs and removed from the harbour.
- In order to keep costs at its lowest, container handling must be fast and safe. Various freight-carrying vehicles can be used to efficiently handle containers. Three solutions are the straddle carrier (or straddle truck), the reach-stacker and ship-to-shore cranes.

Straddle carrier

Reach-stacker

Ship-to-shore cranes

These links show the skill needed to control a straddle carrier:
https://www.youtube.com/watch?v=7Gi6sq8VA0I
https://www.youtube.com/watch?v=ePoB0NUtbF8

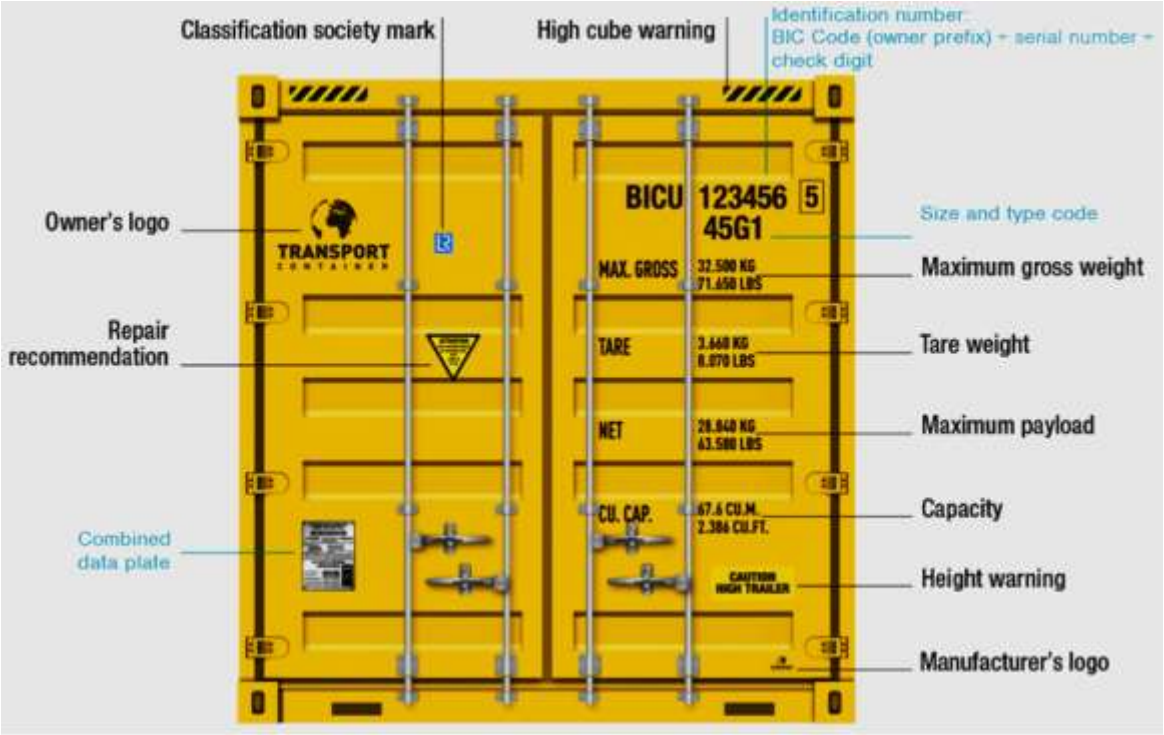
- Some container ships are designed to carry only containers. Such ships are called ***fully cellular*** and are fitted with cell guides in the holds and can also carry containers on the deck.

Figure 5: Containers being stowed in slots on a fully cellular container ship

- The draft of containerships back in the 1950s was 7 m and such ships could be loaded/unloaded with 22 m gantries. By the 1990s the drafts increased to 15 m and gantries up to 52 m were needed. By 2015, the drafts were 19 m and greater and gantries of greater than 70 m became necessary.

Markings on containers

- Markings a container provide essential information.
- Located on the front, sides and top of a container is the BIC Code (owner prefix) + check digit. These are useful for finding more information on the container, such as its owner's address and contact details, by entering it into the official BIC Code database.
- The below image (*from bic-code.org*) shows the standard markings on a container.



Task 5:

(Fun Trivia)

5.1. How many containerships are active today on liner trades?
a. almost 5000 b. almost 4000 c. almost 6000

5.2. A Galaxy tab weighs about 0.3 kg. How many Galaxy tabs could you load on a Triple E vessel with a capacity of 18,000 TEUs?
a. 4,450,000,000 b. 1,440,000,000 c. 2,350,000,000

5.3. How many advantages are there in containerisation?
a. at least 10 b. at least 30 c. at least 5

5.4. one FEU container is equivalent to
a, !/2 TEU b. 40 TEU c. 2 TEU

6. Transgressions of maritime law

Maritime Law

- Maritime law is about laws, conventions and treaties that **govern the maritime industry**.
- Maritime law **guides how people must interact and do business** in the maritime World.
- **International rules**, governing the use of the oceans and seas, are known as the Law of the Sea.
- The United Nations (UN), through the International Maritime Organization **(IMO), issues conventions**.
- The **IMO has no power to enforce** any convention.
- The IMO conventions can be adopted into domestic law by the national maritime authorities. So **countries** which adopt a convention **can** also **enforce** the convention by the relevant authority. Examples are their navy, coast guard, marine surveyors, inspectors, harbour masters, and ship masters.
- Maritime law **governs** many of the **insurance claims** relating to ships and cargo; as well as civil matters between shipowners, seamen, and passengers; and piracy.
- Maritime law also **regulates ship** registration, licence, certification and inspection procedures.
- Maritime law also **regulates shipping contracts** and **carriage of goods and passengers**.
- Conventions are reviewed and new conventions are added to **keep up with business practices and technologies**.
- The **three primary conventions** are:
  - The International Convention for the Safety of Life at Sea,
  - The International Convention for the Prevention of Pollution from Ships, and
  - The International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers.

Navigate the IMO website (http://www.imo.org) to find the complete list of existing conventions and explanatory notes.

Navigate the South African Maritime Safety Authority website (http://www.samsa.org.za/Pages/default.aspx) to find which of the international conventions have been adopted for enforcement by South Africa.

Guarding against Maritime Crimes (including from maritimesa.org)

- **Piracy and Ship Hijacking**: This is when a person or people attack a ship – often using one or more fast boats from which the usually well-armed pirates board the ship – with the intent to steal cargo or to hijack the ship. In recent times, numerous incidents of piracy and ship hijacking have occurred in and around the Malacca Straits and Indonesian islands, off the coast of Somalia and West Africa. Slow-steaming ships with a low freeboard (e.g. laden tankers or bulk carriers or small ships) are the most vulnerable to piracy and hijacking as it is easier for pirate gangs to board. Although ships' crews have to remain extremely vigilant when passing through affected areas, concerted efforts by the governments of Singapore, Indonesia and Malaysia have reduced the number of piracy incidents in that area, while naval patrols, armed guards on board ships and more control by the Somali government over some areas of its coastline have also reduced piracy off that country's coast. By 2020, the seas off west Africa's oil rich coastline became the most dangerous in the maritime World.
- **Smuggling**: All countries ban the import of some dangerous items such as drugs, or items that have the potential to damage the environment (e.g. many countries ban the import of plants without special licenses). Sometimes bans on trading in a particular item may be to protect wildlife (e.g. trade in ivory and rhino horns is banned internationally.) There are also restrictions on importing certain items to protect a local industry making those items (e.g. some countries do not allow the import of clothing so that the local clothing industry does not suffer from cheaper imports from another country). Often countries allow the importation of competing products but impose a fee (customs "duties") on those products to discourage their importation. A country may charge a 15 percent duty on an item (e.g. clothing) to protect a local industry (e.g. the clothing industry). If someone brings a banned item into a country without special permission or avoids paying the full customs duty on an item, the person is guilty of smuggling. The work of customs officers (in South Africa the agency is called South African revenue Service – SARS) and other border control agencies is to prevent the importation of banned items and to ensure that the full customs duty is paid on items entering the country, if those items carry a duty to be paid.
- **Cargo broaching**: Crew stealing cargo is called broaching. This can happen when high-value cargoes (e.g. liquor, clothing, electronic goods, and some foodstuffs) are moved by ship. However, containerisation, the international ship and port security code, closed-circuit television surveillance and electronic tagging of valuable items have reduced the problem.
- **Terrorism**: To try to damage a country's economy, to damage property or ships belonging to a country, or to harm its citizens, terrorists may try to attack ships, canals, harbours or other maritime installations. The International Ship and Port Security Code (ISPS Code) is a number of security measures to prevent terrorist attacks on ships and harbours.
- **Stowing away**: Some people (e.g. those seeking employment in other countries, or refugees) may try to board ships illegally to go to another country. The ISPS Code has reduced the number of unauthorised people who enter harbours, and all ships have "stowaway searches" prior to sailing. On board, the ship-owner or master is tasked with locking all doors, hatches and means of access to storage spaces, and ensuring adequate patrolling of the deck at all times, as well as appropriate lighting at night. Dogs are also trained to search for stowaways. Ship owners also use containers that are

modified into prison cells to lock up stowaways. The number of stowaway incidents has nearly halved during the 11-year period from 2007 to 2017. The presence of stowaways on board ships may bring serious consequences for ships and, by extension, to the shipping industry as a whole; the ship could be delayed in port; the repatriation of stowaways can be a very complex and costly procedure involving masters, shipowners, port authorities and agents; and the life of stowaways could be endangered as they may spend several days hidden, with the risk of suffocation and without any water / provisions. In 1997, dockworkers at a port in Britain found the bodies of seven stowaways onboard a ship.

- **Trafficking of people, drugs and weapons**: As all of these are international crimes, naval and coastguard patrols and harbour police services are constantly on the look-out for incidents of this kind. In the Caribbean Sea and US Gulf, the United States Coastguard, Royal Navy, the Dutch Navy and other agencies have intercepted several shipments of drugs being moved from South America to North America or Europe. Similar interceptions have been made elsewhere. In December 2019 the Mozambican defence and security forces intercepted a gang of drug traffickers off the coast of Cabo Delgado. On interception, the traffickers jumped into the Mozambique Channel. Three of the traffickers died in the escape attempt and the other 12 were rescued and arrested. X-ray machines have helped in examination of cargo for drugs. In June 2019 Australian Border Force officers intercepted an excavator from South Africa which had a concealment of cocaine. The on-going trafficking of people (mainly refugees) from Syria and North Africa through southern Europe has seen hundreds of people drown when the boats carrying some groups of people sank en route to Europe. Dozens of European and Turkish warships and coastguard vessels are patrolling the eastern and southern areas of the Mediterranean Sea to try to prevent loss of life and also to reduce the flow of refugees to Europe.
- **Poaching of fish**: All sea life forms part of the marine food chain. For this reason, strict control measures are implemented to prevent too many of one species of fish being caught, thereby dislocating the food chain and perhaps destroying it completely. These measures include quotas (allowing only a certain number of marine creatures to be caught by a person per day, or a fishing company to catch a certain tonnage of fish), restricting fishing of certain species to the non-breeding season; limiting the size of fish of a particular species to be caught (this prevents young fish from being caught and preserving species for future breeding); restricting the size of the mesh in nets (this allows smaller fish – future breeding stock – to escape); and banning fishing in certain areas (the creation of these marine reserves allows undisturbed breeding of fish and assures future fish stocks.) By disobeying these regulations, individuals or companies endanger the survival of certain species of fish, and put at risk future fishing stocks. That could put at risk a vital food source for many and disrupt ecosystems. Fisheries agencies undertake patrols at sea and also ashore to try to prevent the contravention of fishing regulations.
- **Marine pollution**: Deliberately dumping of oily waste overboard is against international maritime regulations and is a criminal offence. Regulations have been introduced to check that oily waste is not dumped overboard, and regular checks on the amount of oily waste on board ships are made by authorities to determine where regulations have been contravened. Patrols by aircraft equipped with high-tech scanning devices are a deterrent to those who might want to dispose of oily waste illegally. Some of these waste materials pose serious risks to marine life. Seals, dolphins and other marine creatures can become entangled in jetsam (such as plastic strips, or can ingest plastics), usually with lethal consequences.

Task 6:

6.1. What is maritime law?

6.2. List eight transgressions of maritime law?

6.3. In your opinion, what are some of the factors that contribute to piracy?

6.4. Consider the below density map of piracy and armed robberies at sea in 2018.

6.4.1. List five of the most affected waterways by piracy and robberies.

6.4.2. The waterways of which countries are affected along the Gulf of Guinea?

6.4.3. The Horn of Africa had a relatively low density of piracy incidents in 2018. Which country is at the Horn of Africa?

6.4.4. Several attacks off Yemen were linked to the ongoing conflict in Yemen. Ships with a military profile or with a sailing pattern associated with logistical support to either party in the conflict had been targeted. Yemen is at the south entrance of which canal?

6.4.5. How was South Africa affected when Saudi Arabia suspended oil shipments through the Red Sea due to Yemen related conflicts.

7. Maritime Environment Challenges

- Understanding environment factors such as waves, tidal currents, and wind are important for safe and economic ship navigation.
- Clean technologies and responsible mining of marine resources are necessary to protect the environment. Disruptions to a marine ecosystem and climate can in turn put safe and economic shipping at risk.

7.7.1 Tides and their formation

(including material from http://maritimesa.org/grade-10/tides-and-their-formation/)

- Tides are caused by the gravitational pull of the moon and sun on our planet.
- Tides are the vertical rise and fall of water level.
- The ocean is the most affected by tides.
- Even though the Moon only has about 1/100th the mass of Earth, since it's so close to us, it has enough gravity to move things around.
- The water on the side of the Moon always wants to bulge out toward the Moon. This bulge is called a high tide.
- High tide is experienced at two places in the ocean simultaneously. This is because the rotation of the earth causes the **centrifugal force**, which causes the water level to rise on the opposite side of the earth at the same time.
- The rotation of the earth also means that the high tide moves around the earth from east to west. High tide (when the water level is higher) occurs every 12 hours 25 minutes, and low tide (when the water level is lower) follows 6 hours 13 minutes after each high tide.
- Changes in the level of the ocean are most noticeable along the coast. High tide will reach a particular level on a beach, while the water level at the time of low tide will be further down the beach (see Figure 7).
- *The tide is coming in* or the *flood tide* is the rising tide.
- *Tide is going out* or the *ebbing tide* is when the tide subsides.
- The tides occur in regular cycles.
- Tidal range is the difference in water level between high tide and low tide.

Figure 6: High and low tide at the Bay of Fundy, Canada.

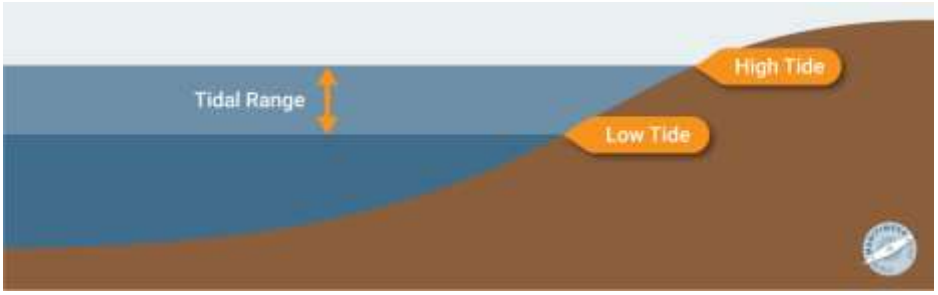
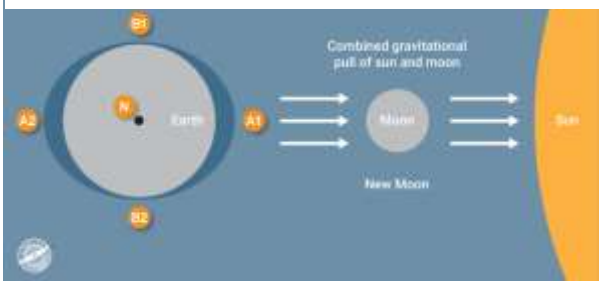


Figure 7: High tide and low tide water levels on a beach and the tidal range

The tides during the New Moon and Full Moon are called Spring Tides.
The tides during the New Moon and Full Moon are called **Spring Tides**. This is when the gravitational pull of the moon and sun work together to form a higher high tide. This combined effect of the gravitational pull of the sun and moon occurs at New Moon and at Full Moon.

Spring Tides

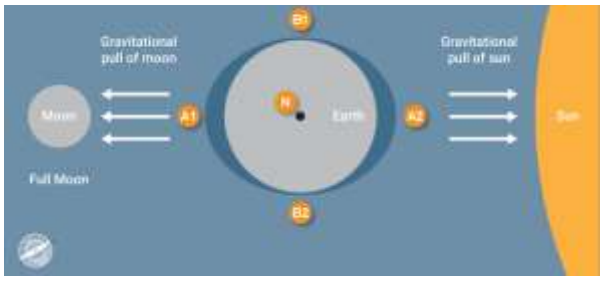
N: North Pole **A:** Spring High Tide **B:** Spring Low Tide



At **New Moon,** the moon is between Earth and the Sun (and also parallel).

The gravitational pull of the sun and moon combine, raising the water level at point A1. The rotation of the earth causes the **centrifugal force**, which causes the water level to rise on the other side of the earth (point A2). The higher high tide (the **Spring High Tide**) is at two places simultaneously.

The rise in the level of the ocean at A1 and A2 will drain some water from B1 and B2, causing a lower low tide at New Moon (the **Spring Low Tide**).



At **Full Moon**, Earth is between the moon and the Sun.

The gravitational pull of the moon causes the level of the ocean to rise at A1. The rotation of the earth causes the **centrifugal force**, which causes the water level to rise on the other side of the earth (point A2).

Simultaneously, the gravitational pull of the Sun raises the level of the ocean at A2. The rotation of the earth causes the centrifugal force, which causes the water level to rise on the opposite side of the Earth (point A1).

This means that the rise in the ocean levels caused by the moon and the sun combine to form a higher high tide (the **Spring High Tide**).

The rise in the level of the ocean at A1 and A2 will drain some water from B1 and B2, causing a lower low tide at Full Moon (the **Spring Low Tide**).

You too can feel the effect of centrifugal force.

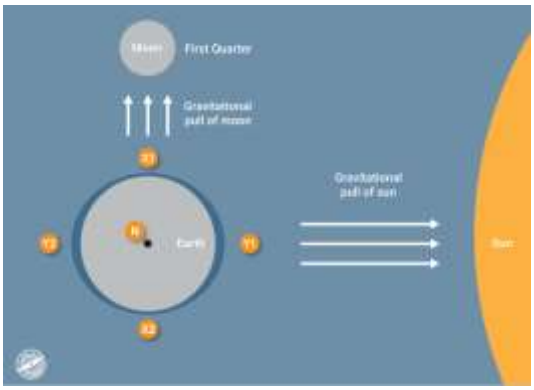
The merry-go-round is a place to go.

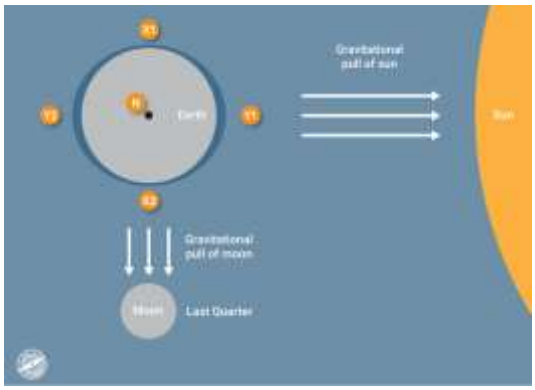
Neap tide is when there is least difference between high and low tide. When the moon is at 1st quarter and at 4th quarter, its gravitational pull is at right angles to that of the sun. This means that the effect of each on the ocean is not as noticeable as at Spring Tide.

The Neap Tide tidal range is smaller than the Spring Tide tidal range. Simply put, Neap tides are not as high and not as low as spring tides.

Neap Tides

N: North Pole **X:** Neap High Tide **Y:** Neap Low Tide



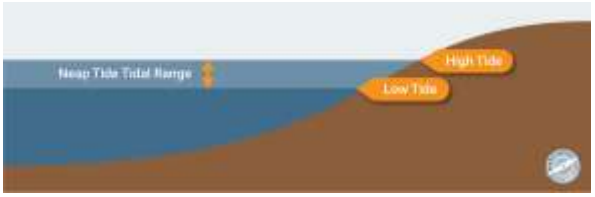


The high tide (at X1 and on the opposite side of the earth at X2) is not as high as the Spring High Tide, and the low tide (at Y1 and Y2) is not as low as the Spring Low Tide.

Tidal Range

Spring Tide

Neap Tide



Effects of tide on shipping

- In some harbours, laden ships can only enter or leave during the period from a few hours before high tide to a few hours after high tide when the water depth will accommodate the draught of the ship. At low tide, the water will be too shallow and the shop will hit the harbour floor. Ships need to schedule their arrival at, or departure from, some ports around the high tides at those ports.
- Ships' mooring lines tighten as the tide rises, and slacken when the tide goes out. This means that ships' crews will have to adjust the mooring lines. Most modern ships are fitted with equipment that automatically adjusts mooring lines as the tide rises or falls.
- Where the tidal range is great, the flow of water into or out of a harbour at the change of the tides can cause dangerous currents in or near the harbour entrance.
- In some areas, such as the coast of eastern Canada or in some areas of Europe, the tidal range is so great that harbours need to have locks (areas with water-tight gates) that maintain the level of the water inside the harbour. Ships can only enter or leave the harbour during the period from shortly before high tide to shortly after high tide.

- Determination of accurate tide height is vital for safe navigation of ships, especially deep draft ships.
- A tide table is an important source of navigation information for a ship when it has to sail in and out of ports.
- The tide table would enable the ship's captain to adjust the time of sailing in a port to avoid touching bottom.
- The fishing industry and fishing vessels would use the knowledge of tides and tidal currents to locate resourceful fishing grounds.
- Marine construction companies would use the knowledge of tides to plan the construction stages (for example in water-bridges, oil-rigs, ports etc.)
- Oceanographers and atmospheric scientists may study tidal fluctuations to better understand the circulation of the ocean and its relationship to world climatic changes.

Did you know:

The excerpt at

https://oceanservice.noaa.gov/education/tutorial_tides/tides09_monitor.html

shows the importance of accurate knowledge of the tides for navigation.

On June 14, 2002, the four industrial cranes (on the alongside heavy-lift ship), valued at approximately $1.25 million each, arrived in San Francisco Bay from Shanghai, China. Designed to rapidly hoist 40-foot-long (FEU) containers from super-sized cargo ships, they had to be transported beneath the Oakland Bridge to reach their final destination, the Port of Oakland. The tidal range of San Francisco Bay when these cranes were transported was 1.25 m and the bridge had a motion of 15.24 cm. With light chop on the bay and winds blowing at around 4.47 m/s, there was little room for error. With detailed knowledge of the tidal cycle and skillful piloting of the vessel, the cranes cleared the bottom of the bridge by about 1.83 m.

Image: wikipedia

Diurnal tide ranges are determined relative to the average level of the highest tides and the average level of the lowest tides (see Figure 8). The average level of the highest tides is called the mean high water springs (MHWS). The average level of the lowest tides is called mean low water springs (MLWS).

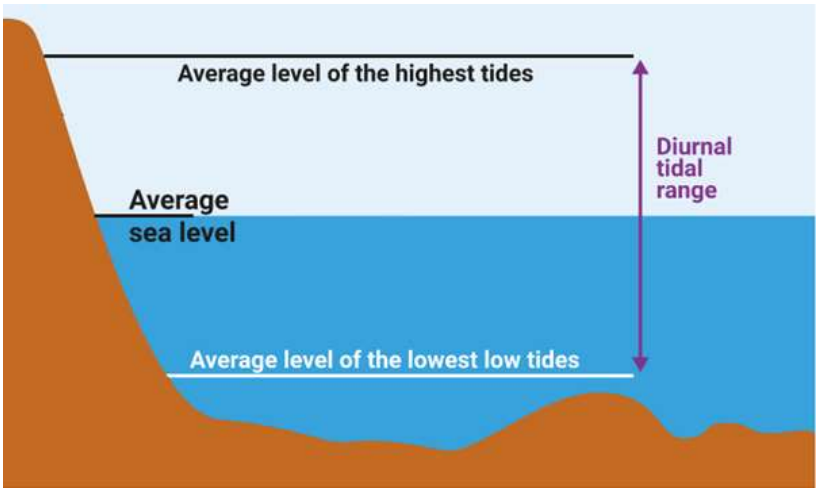


Figure 8: Diurnal tidal range relative to MHWS and MLWS

Task 7:

(from http://maritimesa.org/grade-10/tides-and-their-formation/)

Study the table below. It shows the tides at Port X. The time of the high or low tides are shown. The other figure given is the height of the water above the level of the mean low Spring Tide (MLSW) for that port. The depth of water at MLSW is 14 m.

DATE	HIGH	LOW	HIGH	LOW	HIGH	MOON
Mon 5	3:28 AM / 1.72 m	9:32 AM / 0.50 m	3:35 PM / 1.71 m	9:46 PM / 0.39 m		Full Moon
Tue 6	4:01 AM / 1.73 m	10:04 AM / 0.50 m	4:08 PM / 1.69 m	10:16 PM / 0.40 m		
Wed 7	4:33 AM / 1.73 m	10:36 AM / 0.51 m	4:39 PM / 1.66 m	10:45 PM / 0.42 m		
Thu 8	5:05 AM / 1.71 m	11:08 AM / 0.54 m	5:11 PM / 1.61 m	11:15 PM / 0.47 m		
Fri 9	5:37 AM / 1.67 m	11:41 AM / 0.58 m	5:44 PM / 1.55 m	11:47 PM / 0.53 m		
Sat 10	6:09 AM / 1.62 m	12:17 PM / 0.63 m	6:19 PM / 1.48 m			
Sun 11		12:20 AM / 0.65 m	6:45 AM / 1.56 m	12:58 PM / 0.69 m	6:59 PM / 1.41 m	
Mon 12		1:00 AM / 0.67 m	7:27 AM / 1.50 m	1:48 PM / 0.74 m	7:48 PM / 1.34 m	
Tue 13		1:50 AM / 0.70 m	8:19 AM / 1.45 m	2:54 PM / 0.77 m	8:56 PM / 1.29 m	Last Quarter
Wed 14		3:00 AM / 0.81 m	9:29 AM / 1.42 m	4:14 PM / 0.77 m	10:22 PM / 1.29 m	
Thu 15		4:26 AM / 0.82 m	10:49 AM / 1.44 m	5:31 PM / 0.70 m	11:45 PM / 1.35 m	
Fri 16		5:45 AM / 0.76 m	12:01 PM / 1.51 m	6:32 PM / 0.60 m		
Sat 17	12:48 AM / 1.47 m	6:48 AM / 0.66 m	12:59 PM / 1.61 m	7:23 PM / 0.48 m		
Sun 18	1:38 AM / 1.61 m	7:41 AM / 0.54 m	1:50 PM / 1.72 m	8:08 PM / 0.37 m		
Mon 19	2:23 AM / 1.74 m	8:28 AM / 0.43 m	2:36 PM / 1.82 m	8:52 PM / 0.26 m		
Tue 20	3:05 AM / 1.85 m	9:13 AM / 0.33 m	3:20 PM / 1.88 m	9:34 PM / 0.21 m		New Moon
Wed 21	3:48 AM / 1.93 m	9:58 AM / 0.26 m	4:04 PM / 1.91 m	10:15 PM / 0.20 m		
Thu 22	4:30 AM / 1.97 m	10:42 AM / 0.27 m	4:48 PM / 1.89 m	10:58 PM / 0.22 m		
Fri 23	5:14 AM / 1.95 m	11:27 AM / 0.30 m	5:32 PM / 1.82 m	11:41 PM / 0.29 m		
Sat 24	5:58 AM / 1.89 m	12:15 PM / 0.38 m	6:19 PM / 1.72 m			
Sun 25		12:27 AM / 0.40 m	6:46 AM / 1.79 m	1:07 PM / 0.48 m	7:10 PM / 1.59 m	
Mon 26		1:16 AM / 0.53 m	7:39 AM / 1.67 m	2:08 PM / 0.60 m	8:10 PM / 1.46 m	
Tue 27		2:19 AM / 0.66 m	8:43 AM / 1.55 m	3:23 PM / 0.69 m	9:26 PM / 1.37 m	First Quarter
Wed 28		3:41 AM / 0.76 m	10:03 AM / 1.47 m	4:52 PM / 0.72 m	11:00 PM / 1.34 m	
Thu 29		5:15 AM / 0.78 m	11:30 AM / 1.46 m	6:12 PM / 0.69 m		
Fri 30	12:23 AM / 1.39 m	6:33 AM / 0.74 m	12:42 PM / 1.50 m	7:11 PM / 0.62 m		
Sat 31	1:22 AM / 1.48 m	7:31 AM / 0.67 m	1:34 PM / 1.55 m	7:56 PM / 0.55 m		

7.1. Look at the tides at Full Moon.

7.1.1. On what date is the Full Moon?

7.1.2. What is the height of the high tide above MSLW on the day of Full Moon?

7.1.3. What is the height of the low tide above MSLW on the day of Full Moon?

7.1.4. What is the tidal range on that day?

7.1.5. What tide is this? (Spring or Neap Tide)

Look at the tides at Last Quarter.

7.2.1. On what date is the Last Quarter?

7.2.2. What is the height of the high tide above MSLW on the day of Last Quarter?

7.2.3. What is the height of the low tide above MSLW on the day of Last Quarter?

7.2.4. What is the tidal range on that day?

7.2.5. What tide is this? (Spring or Neap Tide)

7.3. A ship will arrive at Port X on Saturday 17. She will load cargo that will give her a draught of 11.5 metres. By when should she finish loading to enable her to sail on a low tide that will give her a clearance under her keel of 2.7 m?

7.4. (optional) A ship will arrive at Port X on Wednesday 21. She will load cargo that will give her a draught of 12.1 metres. By when should she finish loading to enable her to sail on a low tide that will give her a clearance under her keel of 2.7 m? (*HINT: use the rule of twelfths*)

7.7.2 Ocean currents

(including material from http://maritimesa.org/grade-10/ocean-currents/)

- Ocean currents affect ships during their voyages. A ship steaming against a current will need to use more fuel to maintain a required speed. A ship steaming with a current will save fuel and can proceed at an increased speed.
- Ocean currents form as a result of the unequal heating of the oceans – warm water predominates in the tropics where solar heating is more intense, while the water nearer to poles is very cold, and, where vast amounts of water in the polar areas remains frozen.
- The difference in water temperatures leads the 'global conveyor belt'. Convection currents moves colder water towards the Equator, and warmer water is moved towards the poles.

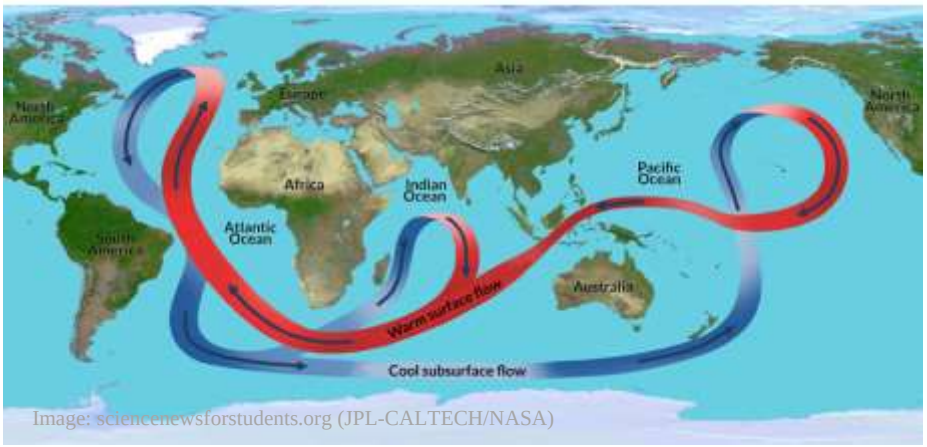
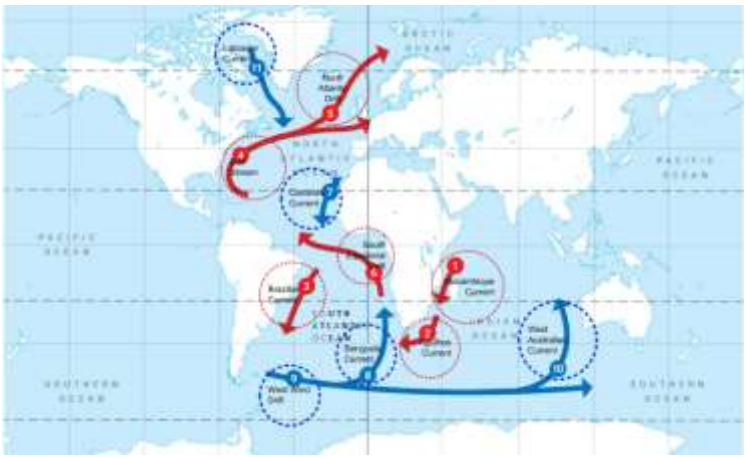


Figure 9: The global conveyor belt

Some Ocean Currents:

The below map shows the currents in the Atlantic Ocean, Indian Ocean and Southern Ocean.



- The warm currents which flow from the tropical regions are marked in red.
- The cold currents which flow from the polar regions are shown in blue.
- The rotation of the earth causes a general anti-clockwise circulatory pattern in the southern hemisphere, and a general clockwise circulatory pattern in the northern hemisphere.
- The West Wind Drift in the Southern Ocean is generated by the constantly strong westerly winds in this area, a movement that is also influenced by the rotation of the earth.

The Effects of Ocean Currents on Shipping:

- A warm current may keep ports ice-free in winter. This is particularly true of the North Atlantic Drift that introduces "warm" water to the north-west European coast and ports as far north as northern Russia (e.g. Murmansk) or northern Norway (e.g. Tromso). (The current in this area is only just above freezing!) The cold Labrador Current, however, introduces very cold water to the eastern coast of Canada where some ports freeze.
- Off the South African coast, the Agulhas Current flows at about 2 knots (1.03 m/s), and sometimes faster. This has the effect of creating small counter currents. Because of the strength of the main current, ships steaming from Durban towards Port Elizabeth will keep about 12 nautical miles (~22 km) off the coast to benefit from the fast-flowing current and to avoid the counter currents. Ships going from Port Elizabeth towards Durban follow a course closer to the coast to avoid the strong current and to take advantage of the counter currents. However, they need to guard against being moved off course towards the coast by the counter currents. (Several ships have gone ashore because of these currents.)

  - Currents also affect the climate and weather in the region, especially in the formation of fog
  - The south-flowing Labrador Current off the Canadian east coast is responsible for the southerly drift of icebergs from the polar region and into the shipping lane off the Canadian coast.

Task 8:

(from http://maritimesa.org/grade-10/ocean-currents/)

A ship is steaming from East London to Cape Town and her Master wishes the ship to steam at 15 knots.

8.1. Should the Master set a course that is about three nautical miles off the coast or 12 nautical miles off the coast?

8.2. Explain your answer to Question 8.1.

8.3. The current is flowing at 2 knots. The Master decides not to reduce the revolutions of the ship's propeller. What will the ship's speed be on the voyage from East London?

8.4. Assume that, for the first 16 hours out of East London, the ship benefits from the current most (i.e. she will be steaming at the speed you calculated for Question 8.3.).

8.4.1. How many nautical miles will she have steamed in that time?

8.4.2. The distance from East London to Mossel Bay is 310 nautical miles. Will she still be steaming at this speed when she passes Mossel Bay? (assume the revolutions of the ship's propellor is unchanged)

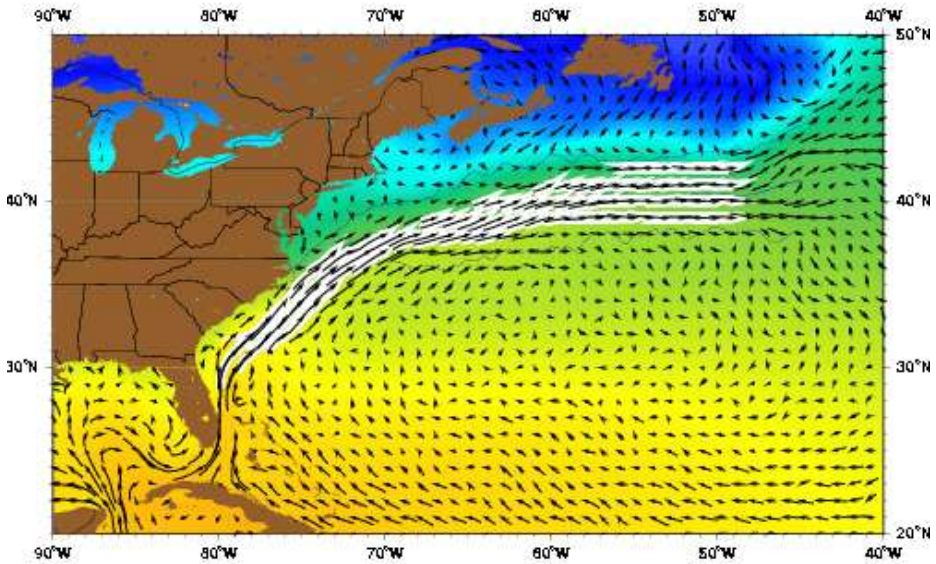
8.5. Will the current cause her to use less or more fuel on this voyage than she would have used if the current had not been flowing?

8.6. Will the current help her all the way to Cape Town?

Did you know:

The scientist Benjamin Franklin (who is on the USA 100 dollar note) noticed that ships traveling from England to the North American colonies would take a week longer than those traveling the opposite course.

He asked whalers about their experience and, in this way, learned there was a river in the sea, called the Gulf Stream, that flowed up the east coast of America and then east to England, helping those ships traveling, (The section in the white, in the below chart, is the Gulf Stream).



7.7.3 Meteorological factors

(including material from http://maritimesa.org/grade-10/meteorological-factors-that-impact-on-shipping/)

The ocean has many moods. On some days, it is beautifully calm and shipping operations can continue without interruption. On other days, the ocean can be wild, with enormous swells that have a negative effect on shipping operations and can even be extremely dangerous to ships. Similarly, windy conditions can be problematic to shipping, as can fog, while the dangers of icebergs – repeated often in the context of the Titanic tragedy – are well-known.

a. Turbulent waters and high waves

b. Approaching a storm

c. Calm sea

d. Dense fog

e. Ice-berg

f. Waterspout and rough sea

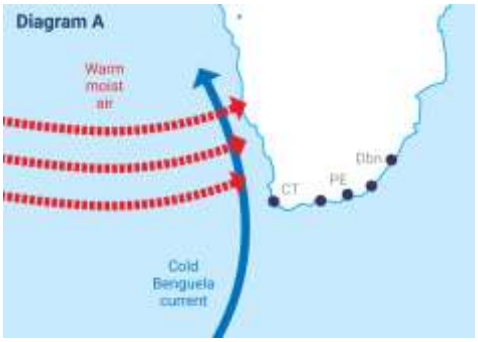
Figure 10: Sample of ocean weather conditions

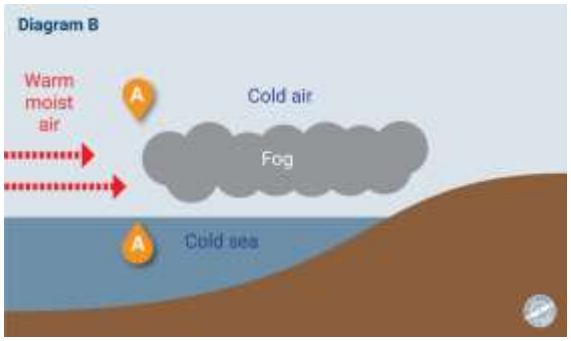
Fog

- Good visibility at sea is important for safe navigation
- Although modern radar and electronic chart display systems help to make navigation safe, even in very dense fog.

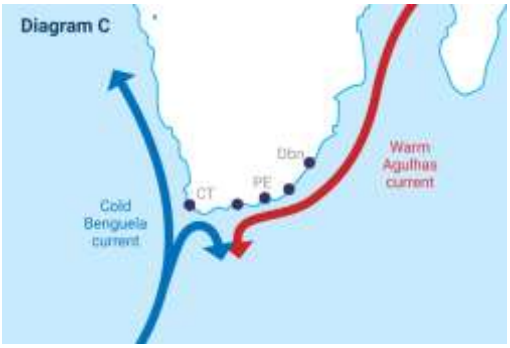
Fog off the southern African coast is formed in two different ways.

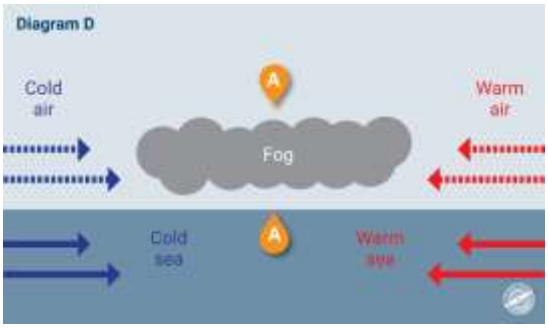
i. **Advection Fog** forms mainly along the west coast when warm, moist air – originating from sub-tropical areas – moves over a cold current and comes in contact with cold air above that current. The temperature of the warmer air drops, and condensation occurs. (See the Diagrams A and B below) Other areas where this type of fog occurs include off the west coast of Australia, Chile and North Africa.





ii. **Fog formed from mixing of air masses with different temperatures**. Off the southern Cape coast, the warm Agulhas Current meets branch currents from the colder Benguela Current. This brings warm, moist air above the Agulhas Current in contact with colder air above the colder current. The warm air cools and condensation occurs. (See the Diagrams C and D below). Other areas where this type of fog occurs include the Japanese coast, the eastern coast of Canada, and the coast of north-western Europe.





The effects of fog on shipping:

- Poor visibility will slow down harbour operations – ships' movements will be slower, while some cargowork will also proceed more slowly. This is particularly true in container operations where the container gantry operators need to see the cell guides into which they need to load containers, or the twistlocks onto which they need to place containers.
- Despite modern electronic devices that assist navigation, ships at sea usually reduce speed in fog. This will delay a ship's arrival at port, or cause the ship to have to increase speed when in clear weather to make up time. This results in higher fuel consumption and higher fuel costs.
- Skippers of small fishing vessels or leisure vessels might not have sophisticated navigation aids and can become disorientated when in fog.

Wind

Strong wind will have significant effects on shipping.

- High-sided ships (e.g. large passenger ships, containerships, large bulkers in ballast, large tankers in ballast and oil rigs) present a large area to the wind. If a strong wind is blowing, it will be difficult to maneuver such a ship in a harbour. Therefore, strong wind will delay the berthing and sailing of these ships.
- Container operations are very difficult in strong wind as containers begin to swing while they are being discharged or loaded. Apart from the danger this poses to stevedores and the possible damage to other containers and even to the ship herself, this makes the work of the container gantry operators very difficult as they try to fit the swinging container into the cell guides on the ship or onto the twistlocks.
- In strong winds, ships may move a metre or two along the quay, also making container operations very difficult.
- Strong winds can cause ships to break mooring lines in harbour, posing a danger to the ship, and other ships in the harbour.
- A strong headwind can cause a ship to use more fuel to maintain her speed. A sternwind will assist the ship on her voyage.

Figure 11: Cruise vessels crash; caused by wind gusts and strong currents.

Figure 12: Gale-force wind gusts blew off containers from mega ship in Belgium.

Sea Conditions

Rough sea (caused by strong wind, aggravated sometimes by a sudden change in the depth of water or shape of the coastline) will have several negative effects on shipping.

- Rough seas can damage a ship and/or her cargo. Cargo can shift if the ship is rolling heavily, and this can cause the ship to list dangerously. The loss of the containership El Faro off the Florida coast in October 2015 was attributed to her being overwhelmed by heavy seas that had been caused by a hurricane in the area.
- Heavy swell off a harbour can make it very difficult for pilots to board or to disembark from ships. This can lead to the temporary closure of a harbour, leading to delays to shipping.
- Harbour installations can be damaged by heavy seas.
- Ships can be driven ashore by a combination of strong wind and a heavy swell. When the bulk carrier Ikan Tanda (Figure 13) broke down off the Cape Peninsula coast in 2001, 17-metres swells drove her ashore at Scarborough near Cape Town.

Figure 13: Ikand Tanda which drifted toward land

Ice

Although icebergs have a sinister reputation following the loss of the Titanic in 1912, they **pose limited danger** to ships now as they are ***tracked using satellite images and ships in the area receive regular updates on the position and course of icebergs***. However, with an increasing number of cruise ships and research ships going into polar regions, more diligent tracking of icebergs and floating ice sheets is necessary.

Although the Antarctic region is not a general shipping area, specially-equipped polar research and supply vessels do go there in the summer months carrying supplies for several research bases in Antarctica and also carrying scientific teams to undertake research in meteorology, geology, animal life and forms of geophysics. Some cruise ships also venture into the Antarctic waters but are required to be ice-strengthened.

Freezing of water in harbours and waterways presents a problem for shipping, and ***some harbours*** in northern Russia (e.g. Archangelsk) and in Canada are ***closed for several months each year***. Part of the St Lawrence Seaway and the entire Great Lakes in Canada are also closed during the severe winter months. (Harbours on similar latitudes in Western Europe remain open because of the presence of relatively warmer water, brought in by the North Atlantic Drift that has its origin near Florida in the United States). The north-west passage (from the eastern coast of Canada to the Bering Sea) is open to shipping for several more weeks now as it appears that some of the northern polar ice sheets disappear for longer. A similar situation exists in the north-east passage (from north-western Russia to the Russian east coast).

Task 9:

(Tragedy at Sea)

9.1. On April 10, 1912, the Titanic set sail England for the journey to New York. Four days later, the ship struck an ice-berg and sunk.

Consider the map alongside, which shows the route taken by the Titanic and the possible route of the ice-berg.

9.1.1 Along which current would the ice-berg have travelled?

9.1.2. Why did the ice-berg not melt completely along the current?

9.1.3. Which current did the path of the Titanic coincide with?

9.1.4. Was the Titanic sailing along or against the ocean current?

9.2. The below bar chart shows International Ice Patrol data on how many icebergs were noted in shipping lanes over the years 1900 to 210.

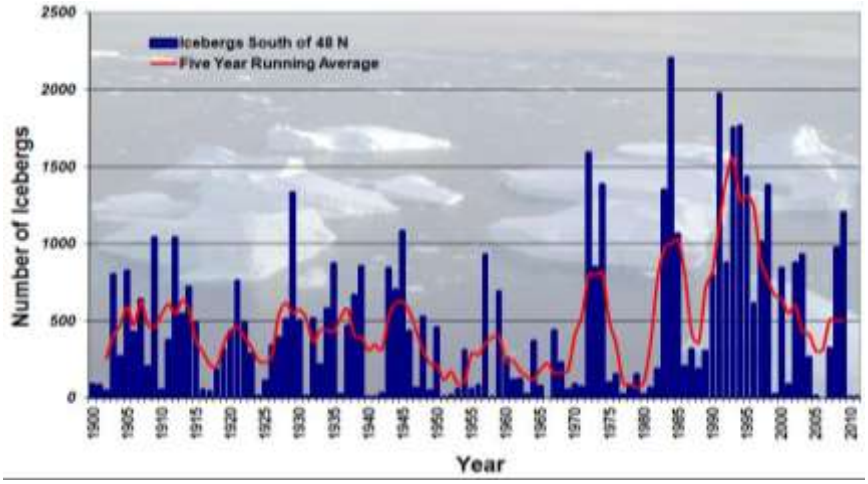


Image: /cdn.theatlantic.com

9.21. How many years had more than 500 noted ice-bergs?

a. less than 10 years b. between 20 and 30 years c. more than 40 years

9.2.2. What was the maximum number of ice-bergs within a single year?

9.2.3. What was the count of ice-bergs in the year of the Titanic tragedy?

7.7.4 Extraction of marine resources

(*including material from* http://maritimesa.org/grade-10/extraction-of-marine-resources/)

Marine resources are materials and resources found in the ocean that is considered as valuable.

These resources include food, fuel, renewable energy, minerals, sand, gravel and tourism.

Finding and recovering diamonds or to prospect for and produce oil or gas from below the seabed is not easy, and require specialised ships and platforms.

Offshore prospecting and production is costly. Some of the vessel involved cost hundreds of millions of dollars to build and vast sums to operate.

Diamond recovery operations

Diamond deposits lie in gravel beds off the north-west coast of South Africa and the southern Namibian coast The deposits were most likely brought to this site by the Orange River system from ancient eroded volcanic pipes inland in the Kimberley area, and also perhaps the product of the erosion of undersea volcanic structures.

Although onshore diamond recovery has occurred along the coast to the north and south of the Orange River mouth since the early part of the twentieth century, offshore diamond recovery began in the late 1950s. A number of companies started the operations by using a vacuum recovery system, but DeBeers Marine Ltd was the first to employ specialised technology using vertically- or horizontally-operating equipment. The vertical technology involves lowering a large drill device to dig into the loose gravels and sand on the seabed. While the drill is boring into the seabed, the sediment is pumped up to the vessel where sophisticated equipment recovers the diamonds (see Figure 14.

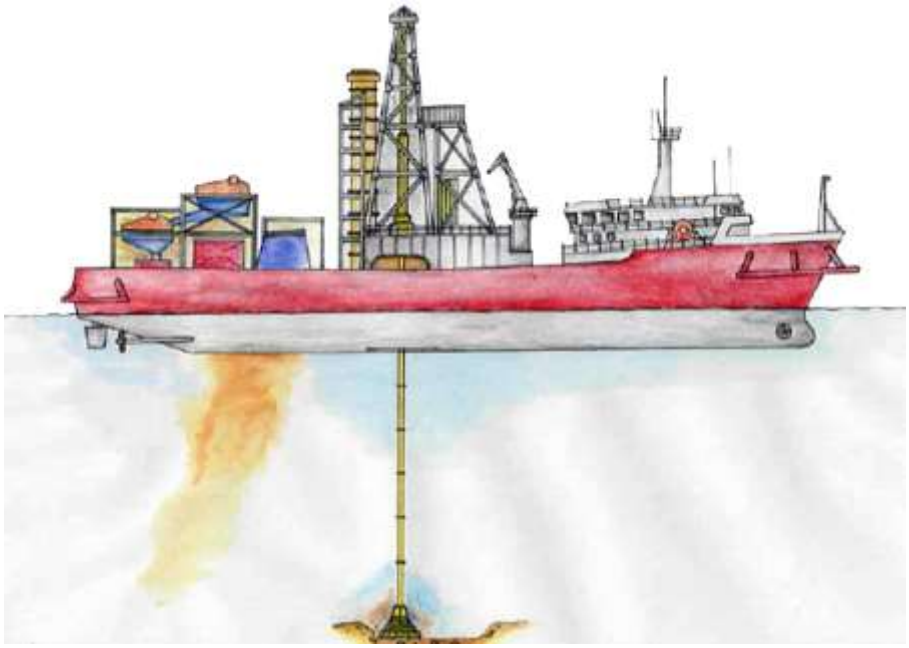


Figure 14: Vertical system of diamond recovery. A large, wide-based drill is lowered to the seabed and disturbs the sediment and gravels. The sediment is then suctioned to the ship for the diamonds to be recovered. *(Diagram: De Beers)*

Figure 15: Gariep – Diamond recovery vessel using the vertical system

Another system that is used to recover diamonds from the seabed uses a remote vehicle onto which a suction dredger is attached. This is lowered to the seabed where it moves along the seabed, sucking up the sediment and gravels that are processed on board the vessel for diamonds to be recovered.

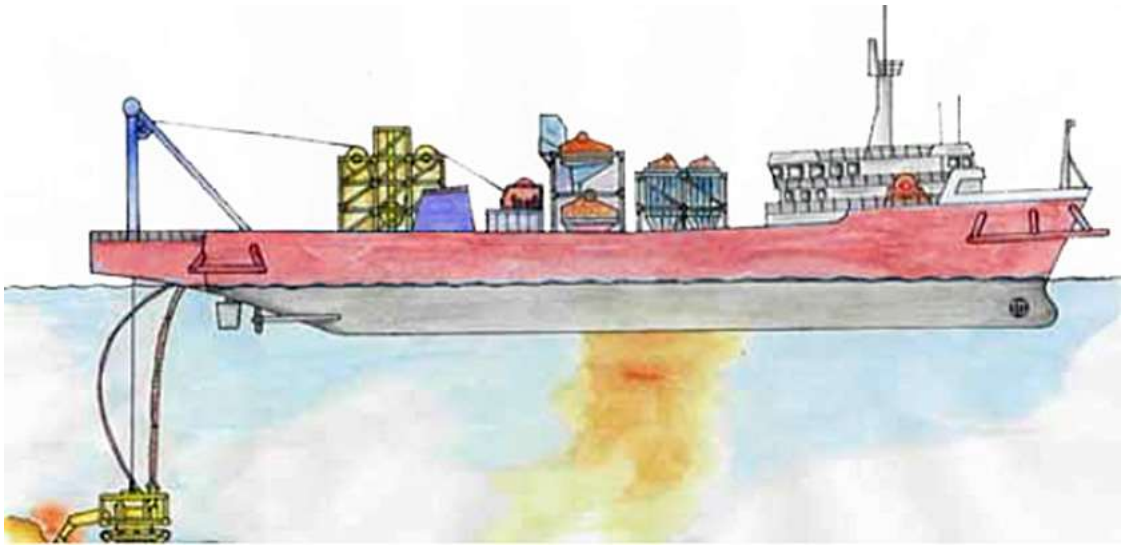


Figure 16: Remote vehicle with attached suction device to recover diamonds from the seabed (Diagram: De Beers)

For a review on your earlier study on prospecting vessels, refer to section 1.34. in your Term 1 study guide.

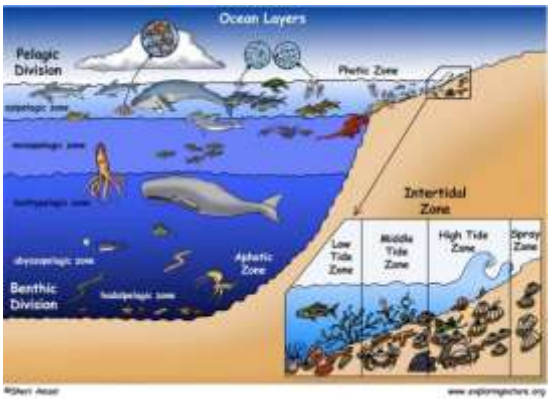
Also look at the section on page 30, on poaching under Maritime Crimes.

7.7.5 Fragile marine ecosystems

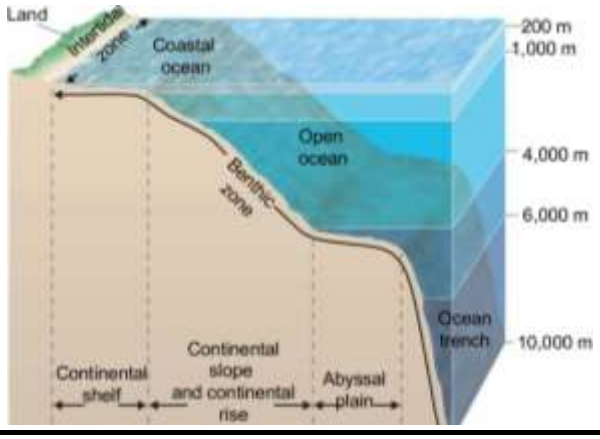
Concept of Ecosystems

- An ecosystem is all organisms interacting within a particular environment (or habitat).
- Marine ecosystems is the interaction of plants, animals, and the marine environment.
- The marine ecosystem includes the oceans, the inter-tidal zone along shorelines, river mouths, lagoons and the seabed.
- Within that sphere, a system exists where minute plant life supports the lowest level of animal life, which, in turn, supports a longer chain where animals on one level are the prey (food) for those on higher levels. Thus each level is interlinked with other levels. Most ecosystems are finely balanced; therefore any disturbance of the system will upset this fine balance and can cause a failure of the system. Within marine ecosystems is a large diversity of species.
- Marine ecosystems, like all ecosystems, are finely balanced.
- Four key factors affect marine ecosystems:
  i. Water depth,
  ii. Temperature,
  iii. Amount of dissolves nutrients, and
  iv. Currents.

Did you know:



- Oceanographers are scientists who study the oceans.
- Oceanographers divide the ocean into layers and regions (with classification of each as shown in the pictures).
- The regions are determined by the water characteristics such as depth, temperature, density, and amount of sunlight.
- The hadalpelagic zone is the deepest region of the ocean (from a depth ~6,000 m).
- The pelagic division is the open water. The benthic division is the ocean floor.
- 90% of all ocean creatures live within only 10% of the ocean (in the coastal zone -from water surface to continental shelf).



The Marine Food Chain

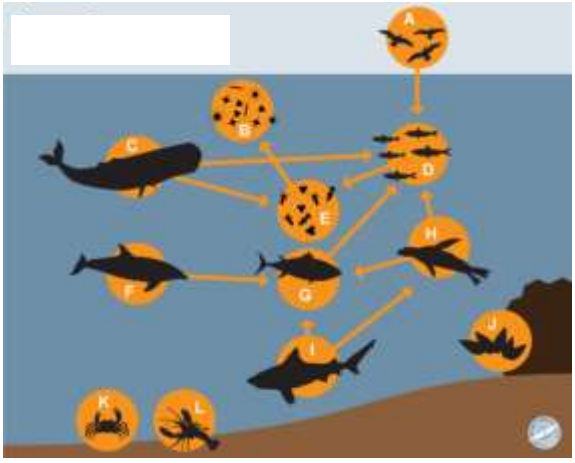


Figure 17: Marine food chain

Like most food chains, the marine food chain is delicately balanced.

With reference to Figure 17**Error! Reference source not found.** *(from maritimesa.org):*

- Marine life depends either directly or indirectly on phytoplankton (B) on which zooplankton (E) prey.
- Birds (A) feed on small fish species (D).
- The fish can form prey for seals (H) or sharks (I)
- Whales (C) prey on forms of plankton (E) or smaller fish species (D).
- Seals (H) prey on a wide range of fish – pilchards (D) or tuna (G)
- Sharks feed mainly on seals (I).
- Crabs (K), crayfish (L), other bottom feeders and even filter feeders (J) play an important role in the marine ecosystem as they "clean up" the seabed, eating all remnants of other creatures.

Need for safe shipping practices that aid conservation of marine resources

Although shipping is crucial for global commerce, responsible shipping is needed if we are to conserve marine resources. Shipping must adhere strictly to the international prohibition on dumping toxic, oily or non-biodegradable waste overboard. Records have to be kept on board each ship regarding the stowage and dumping of any material, and failure to keep proper records will result in prosecution of the offenders and a fine for the ship.

Some of the negative impacts caused on marine ecosystems, by shipping: are:

- Oil spills
- Air pollution
- Introduction of invasive marine species
- Collision with marine creatures, such as with whales
- Overfishing

Management and protection of marine resources

All marine life forms part of the marine food chain, so strict control measures are implemented to avoid dislocating the food chain and perhaps, destroying it completely. These measures include:

- quotas (allowing only a certain number of marine creatures to be caught by a person per day, or fishing companies are allowed to catch a certain tonnage of fish),
- restricting fishing of certain species to the non-breeding season;
- limiting the size of fish of a particular species to be caught (this prevents young fish from being caught and helps to preserve species for future breeding);

- restricting the size of the mesh in nets (this allows smaller fish – future breeding stock – to escape);
- banning fishing in certain areas (the creation of these marine reserves allows undisturbed breeding of fish and assures future fish stocks.)
- creating artificial reefs by sinking old ships or by dumping clean rubble (this creates a habitat that is conducive for sea creatures to live and breed)
- ballast water treatment to actively remove, kill and/or inactivate foreign organisms prior to discharge.
- Sulphur scrubber system to reduce air pollution
- IMO has identified that fouled ship hulls increases a ship's carbon emission. Fouled hulls tend to slow down a ship so additional power is needed to keep speed, hence consuming more fuel. South Africa recently introduced mandatory hull cleaning for vessels before they set sail.
- Construction of green vessels.

Did you know:

- Companies around the world are putting effort into designing and building eenvironmentally and climate friendly ship technologies that will reduce operational costs.
- Green ships are recognised as giving competitive advantage because of environmental regulations, fines, and incentives.

Image: Lloyd's List-Informa

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