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**Efficiency in the Indian Ocean: Premodern technological trade advancements**

**Overview and Purpose:**

Technology plays a critical role in modern world economies. Technological advancement is strongly connected to the production of goods and services, as well as the facilitation of trade and logistics. Certain technologies such as the compass continue to be incorporated in to modern methods of transportation such as cruise ships, in the form of a GPS (Geographic Positioning System). Technologies like the compass were vital for premodern nautical navigation and trade. During the Ancient, Classical, Medieval, and First Global eras, creating new technologies was just as vitally important to economic development, both on the micro and macro scale. The state of technology and efficiency in the modern world is a culmination of trading networks of international trade that were used during these eras for trade advancements. However, premodern technology is frequently misunderstood or dismissed by students. Instead, students need to understand that modern technology is directly predicated on pre-modern technology, much of which originated in the Indian Ocean region. In this lesson, students will study technology that arose in the Ancient era, the Classical era, the Medieval era, and the First Global Era. By focusing on these pre-industrial eras, students will explore pre-industrial technology and the role of these technological antecedents to the modern world.

The Indian Ocean in World History Website ([www.indianoceanhistory.org](http://www.indianoceanhistory.org)), defines technology as the development and application of tools, machines, and methods for manufacturing and producing things. Technologies are ways of doing work or overcoming challenges. Technology does not have to be complicated. For it to be effective it must simply improve upon either preexisting conditions or objects. Technology can be very simple, such as picking up a rock or stick to smash something. The lesson will center on the definition of technology given in the previous paragraph. Instruct students to refer to this definition of technology as they are working through each part of the lesson. This lesson strives to educate students on the roots of certain pre-modern technologies and their relation to trade advancements. Moreover, the lesson aims to spark students to recognize similar ties to modern technologies that students are used to seeing in their present-day lives. The technologies that will be addressed in the lesson are demonstrated on the various icons within each map time period on the website, since the ancient era. The lesson will explicitly instruct which icons students need to utilize as they work through each section.

Students will learn about pre-modern technologies and analyze their relevance by using the Prehistoric, Ancient, Classical, and Medieval maps from the Indian Ocean in World History (IOWH) website.

**Performance Objectives:**

* Have students understand the origins of essential modern technology they have seen, heard of, or used.
* Have students recognize the role the Indian Ocean played in the formation of transportation technologies.
* Students will be able to discuss the impacts of early technology in relation to various aspects of human life, such as trade and economies during those eras.

Grades: 7-9

**Time: Two class periods**

* Part 1 & Part 2 (Worksheets with table) in first class period
* Part 3 (Discussion) in first and if need be, a small part of the second class period.

**Materials needed**

* Enough worksheets for every student in the class (1 of each for every student i.e. every student should have a copy of each of the four handouts) to complete part II.
* A laptop for each group (4 total) to complete part II.

Icons (will also serve as the answer key for teachers during the activities)

(Note: The icons that are listed as pre-modern technologies are being utilized because they tie into modern technology some way or the other. The relevance to modern technology of these icons is listed in the following answer key, but part of the lesson will direct students to figure out the relevance themselves. Instructors should refer to the answer key to make sure students are making sensible connections between modern and pre-modern technologies.

Procedure:

**Part 1:**

Teachers should give students a basic understanding of the technologies in the four eras of the lesson. The list of technologies that teachers should briefly review with students is included in a reference key below, and this list should serve as a reference/answer key to the answers students give in the next activity in part II of the lesson plan. Additional resources on the ancient era, classical era, medieval era, and the first global era can be found in the ""historical overview"" for these four eras:

* <http://indianoceanhistory.org/assets/Site_18/files/Era%20Overviews/Ancient%20Era.pdf>
* <http://indianoceanhistory.org/assets/Site_18/files/Era%20Overviews/Classical%20Era.pdf>
* <http://indianoceanhistory.org/assets/Site_18/files/Era%20Overviews/Medieval%20Era.pdf>
* <http://indianoceanhistory.org/assets/Site_18/files/Era%20Overviews/First%20Global%20Era.pdf>

These readings can be assigned as take home (or in class) reading to prepare students for the lesson. In the first class on the lesson, teachers should define technology in the context of the lesson by using the definition given in the introduction. Teachers should emphasize how the technologies that they are going to be focusing on in the lesson connect closely to modern technologies. Teachers should study the terms in the reference key in order to lecture students on what they should take away from the lesson.

**Below is the reference key teachers must use in order to make sense of the terms in the activities:**

**Answer/Reference Key**

* **Transportation by water**
	+ The earliest boats: wood, reed, and papyrus **(Ancient Era)**
		- Origin:
			* **Reed boats** originated from the early Sumerians of Mesopotamia.
				+ They were not as durable as boats that were made of wood.
				+ These boats were made by tying bundles of reeds together and coating them with bitumen.

Bitumen is a waterproof, asphalt-like tar.

* + - * + **Papyrus** is a type of reed boat

Theseboats originated from Egypt

Papyrus grew along the banks of the Nile River.

Ancient Egyptians made light rafts by tying together bundles of papyrus, which is also a type of reed.

* + - * **Wooden boats** to the Harrappan civilization in the Indus Valley around 3000 BCE.
				+ The use of these wooden boats were regularly used for trade with Mesopotamia.
				+ These boats are believed to have used no nails, however no one knows how they were held together. The durability of the boat however, was due to being carved from Indian teak wood.
				+ These boats had a lateen sail.
		- Used for:
			* **Reed boats**
				+ Used to sail short distances
				+ Used to travel across marshy waters and swamps in the Tigris and Euphrates rivers.
				+ **Papyrus boats**

Everyday travel

Papyrus boats were ideal for travel across shallow water and swamps.

* + - * **Wooden boats**
				+ Used for transportation across long distances (oceans), especially in the Indus Valley.
				+ The lateen sail allowed for wooden boats to be strong enough to sail close to the wind and cross into Mesopotamia.
		- Relevance:
			* The invention of these earliest ships allowed for travel, maritime trade and human interaction to occur.
			* Producing more wooden ships allowed for stronger transport of goods and labor during maritime trade.
	+ Phoenician ships **(Classical Era)**
		- Origin: Sidon, Lebanon
		- Used for:
			* Sturdy Cargo ships designed to transport large amounts of goods.
			* Called 'Gauloi' (round)
			* There were two eyes painted at the front of the boats on each side to allow the ship to 'see' the route it was traveling & to scare away enemy boats.
		- Relevance:
			* These ships allowed for the transportation of large amounts of goods.
			* A huge upgrade from ancient wooden boats, these ships were very technically advanced for their time.
				+ Phoenician ships used rectangular sails and were steered with broad rudders attached to the left side of the hull.
			* These ships were also designed to accommodate a crew of about 20 men, which was more than an ancient wooden boat could accommodate.
	+ Ancient fishing boats **(Classical Era)**
		- Origin: India
		- Used for:
			* Setting out from the coast
			* Made from teak or mango wood, which was resistant to rot.
		- Relevance:
			* The oldest fishing craft, used for lighting, which was unloading boats anchored offshore.
			* These boats were a significant upgrade from papyrus and other reed boats, as although they were only able to travel short distances, they were still made from wood, making them more stable than reed boats used for fishing.
* Arab dhow **(Medieval Era)**
	+ Origin: Western Indian Ocean
	+ Used for: Coastal trading around the Western Indian Ocean rim.
	+ Relevance:
		- The most popular ship of the Western Indian Ocean
		- Most commonly used by Arab traders during the medieval era.
		- Known for its triangular sail.
		- A significant advancement in maritime trade technology was the Arab Dhow for the following reasons:
			* The Arab Dhow was an advanced wooden ship as it was made of tropical woods such as teak, which grows in India, and does not rot easily in salt water.
			* The teak that made up the Arab Dhow, was hewn with an ax into planks, which were drilled with holes on both sides. The most unusual characteristic of dhows is that they were not nailed together. Instead, they were sewn, or lashed together with coir (coconut fiber) ropes.
			* Although in theory, nails sounds like a sturdier way to hold a ship together than coconut fiber, a sewn ship was flexible and the rope lashing lasted much longer than iron nails, which rusted and needed to be replaced.
			* A lashed ship would not break up easily on shoals (shallow stretches of water or sandbars), but would flex under the strain.
			* The Arab Dhow was also a more sustainable ship. The planks on the dhow were laid side-by-side and did not overlap like the shingles of a roof. This required less wood, and also presented a smooth surface to the water.
			* The planks were oiled regularly inside and out, to preserve the wood. The dhow was double-ended, instead of having a square stern and a pointed bow.
		- Dhows still exist in the gulf. However, today they are used for tourism, so visitors can experience the nautical history of an earlier time.
* Carrack or Nao **(First Global Era)**
	+ Origin: Spain/Portugal
	+ Used for:
		- These ships had structures built on top of the hull - a forecastle and an after castle. These castles were used for soldiers fighting from the ship.
			* A forecastle is a raised deck at the bow of a ship.
			* An after castle, also known as a stern castle, is the raised, upper deck at the back, or the stern, of the ship.
	+ Relevance:
		- The *carrack* was the favorite type of ship for exploration used by the Spanish and Portuguese explorers during the 14th through 16th centuries.
		- Changes in the hull design and use of triangular sails were combined with the qualities of north Atlantic ships used for cargo, like the cog.
		- The carrack developed from advances in shipbuilding which were most probably influences by knowledge of the Indian Ocean trade.
		- The advances were:
			* The carvel-built hull, meaning that the planks were fitted side-by-side rather than overlapping, or clinker-built. This made the hull lighter and more flexible.
			* The *carrack's* hull was wide and deep for cargo. Its stern was rounded by curved planks meeting at the rudderpost.
				+ Military advances:

Castles, at either the bow or stern, gave soldiers an elevated fighting platform, which in turn gave them a tactical advantage when they engaged other ships.

* + - * The carracks were also able to be efficiently large.
				+ Cabins for the passengers were on the third deck, and the fourth deck was for private cargo and luggage that was kept well above the waterline, such as bales of textiles and chests. It was very important to store the cargo well so it would not move around, and not to overload the ship.
		- More advances included:
			* *Carracks* growing larger between the 14th and 16th centuries, from two to three or four masts.
			* Sails also multiplied, using a combination of square and triangular (lateen) sails.
			* Later, *carracks* added a topsail above the mainsail and other, smaller sails. *Carracks* varied in size, from 300 to 400 tons, to as big as 2,000 tons.
* Cannon-bearing ships **(First Global Era)**
	+ Origin: Europe
	+ Used for:
		- As a tool the Portuguese used cannon-bearing ships to try and control all the trade in the Indian Ocean.
			* They attacked many of the Indian Ocean's major ports, including Mombasa and Kilwa in Africa, Calicut in India and Muscat in Oman.
		- Built in England in 1512, the Mary Rose canon-bearing ship was armed with bronze and iron cannons and held nearly two hundred soldiers. Its 500-ton hull was built to withstand the recoil of its heavy guns.
	+ Relevance:
		- Carracks were cannon-bearing ships, however these cannon-bearing ships were designed specifically for military use.
		- The technology of carracks advanced in order to efficiently bear canons on these ships.
		- By the time the Portuguese sailed into the Indian Ocean in 1498, Europeans had already been using ships armed with cannons for almost a century.
		- Cannon bearing ships such as the *Mary Rose,* built in England in 1512, were armed with bronze and iron cannons and held nearly two hundred soldiers.
		- Militarily advanced for its time, the *Mary Rose* had a 500-ton hull was built to withstand the recoil of its heavy guns.
* The Caravel **(First Global Era)**
	+ Origin: Near India
	+ Used for: Sailing
	+ Relevance:
		- Caravels were an important type of ship for exploration, because they were suited to exploring estuaries and rivers, in addition to the high seas.
		- Although not the ship was not militarily advanced, in terms of long-distance travel, it was.
			* The caravel had a hull with planks fitted side-by-side (carvel-built) rather than overlapping (clinker-built, like shingles on a roof).
			* Like the carrack, the caravel had a "castle" at its stern. However, it was not as tall as a carrack. This lower profile hull, while not as deep and could not store as much, made the vessel sail better than the bulky, sometimes unbalanced carrack.
			* Thus, cargo storage was not as much of a priority for caravel technology as the carrack, however the durability for traveling long distances was strong.
			* Caravels needed less crew to sail and were quicker and better than carracks for long voyages.
			* Caravels, because of their speed, were used to patrol the coasts, and were favored by some pirates.
* The Manila Galleon **(First Global Era)**
	+ Origin: China
	+ Used for:
		- Trade between the Spanish and the Chinese.
		- Trade between Portugal and Spain.
	+ Relevance:
		- The Manila Galleon was a type of large trading ship that made a trip from Mexico to the Philippines every year.
		- One-third of the silver mined in the Spanish empire in America went on the journey from Mexico to China.
		- The first 16th century Manila Galleon sailed in 1565 and continued until 1815.
		- The Manila Galleon was critical to advancements in trade as most precious Chinese trade items, traveled on this ship.
			* Manila Galleons shipped huge amounts of silver from Mexico to China.
			* The Spanish used the silver to buy products in East Asia--Chinese silk, porcelain, crafts, Indian Ocean spices, and ivory carvings like this one.
			* Sometimes the Manila Galleons would carry passengers, however they were mostly used for trade.
		- Portuguese merchants also profited off of the Manilla Galleons:
			* Many of the early goods that the Manila Galleons carried to Mexico came from the Portuguese port of Macao.
			* The Portuguese set up a trade route connecting Manila to Makassar, Nagasaki, Macau, and Malacca.
		- Galleons had a reputation for being a luxury trade ship
			* If too many galleons sailed at once, silver would become cheap in Asia.
			* Spanish authorities only allowed one galleon to sail to Manila each year to keep profits high, but profits fell anyway because of massive silver shipments.
* **Transportation by land**
	+ Dromedary Camel **(Ancient Era)**
		- Origin: Southeast Asia
		- Used for:
			* Looking back to the definition of technology, the usage of the dromedary camel is regarded as technology because it allowed humans to transport themselves and their goods easier.
		- Relevance:
			* The camel's strength, speed, and endurance made it extremely valuable.
				+ The camel can carry 150 to 250 kilograms (about 500 pounds) and travel for days without water, and eats whatever desert vegetation it can find.
				+ It can travel about 50 kilometers per day carrying a load.
			* The dromedary camel was one-humped and was bred to spread across Saharan Africa, Arabia, and Southwest Asia (Iran, Iraq, and Turkey).
			* The camel contributed to developing trade routes that linked seas and civilizations, crossing barren deserts between distant places.
			* During the following millennium, the dromedary became an important military, draft, and transport animal, and contributed to developing trade routes that linked seas and civilizations, crossing barren deserts between distant places.
	+ Bactrian Camel **(Ancient Era)**
		- Origin: Mongolia
		- Used for:
			* They were first used for their meat, milk and wool, later for pulling wagons, and finally as caravan pack animals in long-distance trade.
			* This type of camel can endure both cold and heat, and walk on mountain paths.
		- Relevance:
			* The camel is two-humped.
			* May have been domesticated as long ago as 6000 BCE in Mongolia, where wild camels with two humps still live.
			* The use of Bactrian camels was an important technology for the Silk Road across Central Asia, because the animal can carry heavy loads up to 270kg (around 500 pounds)
			* This type of camel can endure both cold and heat, and walk on mountain paths.
			* These animals were essential to the development of long-distance trade across the vast distances and harsh terrain of Central Asia.
	+ The wheel **(Ancient Era)**
		- Origin: Mesopotamia
		- Used for:
			* Transporting heavy goods
			* Wheeled chariots carried soldiers in wars that led to empires.
			* A spinning wheel made an ideal platform for shaping clay, allowing more beautiful pottery to be produced faster.
			* Placing teeth around a wheel created gears that could transfer the energy from animal power, wind, or flowing water.
		- Relevance:
			* Transportation of heavy goods was easier with wheeled carts compared to sleds or loading the backs of animals
			* Wheels allowed technology to update significantly from depending on transportation from animals.
			* Wheels also contributed to military advancements:
				+ Wheeled chariots like the one in this image carried soldiers in wars that led to empires.
				+ The wheel was not invented by a single person, but developed gradually in more than one place.
				+ The invention of the wheel may have spread to the Indus Valley, and was used in Egypt by about 2500 BCE.
	+ Camel Saddle **(Classical Era)**
		- Origin: Northern Arabia
		- Used for:
			* Served as a pack frame that allowed the animal to easily carry heavy loads.
			* Evenly distributed weight on both sides of the camel.
			* The frame held the saddle over the hump with two pieces of wood or rope on each side of the hump parallel with the camel's backbone.
		- Relevance:
			* This invention allowed camels to carry heavy loads as well as enabled camel riders to have a comfortable seat while riding, which was essential technology to more efficient traveling.
			* The camel saddle was useful in establishing a livelihood for pastoral nomads, people who lead herds of animals to pasture in dry regions, and live from their milk, wool, and meat.
			* Because sitting and riding on animal with a huge hump in the middle of its back is a difficult task, the camel saddle was a more practical way to sit on the hump itself.
			* The camel saddle was innovative because it allowed the weight of the loads on a camel to be equally distributed on both sides.
* **Navigation**
	+ Navigation by Polaris **(Classical Era)**
		- Origin: Recognized by the Phoenicians
		- Used for: Locating the direct North in order to sail in the right direction in the ocean.
		- Relevance:
			* Polaris: a bright star located very close to the northern end of the axis on which the earth rotates. Also called the North Star, Polaris does not change its position, never rising and setting while the earth turns as do other stars.
			* This served as a point that allowed for more efficient navigation, thus serving as navigational technology.
			* While traveling across vast oceans where no land was visible, Phoenician sailors stayed on the correct route by observing the location of Polaris, called the 'Phoenician Star' by ancient writers
	+ Kamal **(Classical Era)**
		- Origin: Indian Ocean
		- Used:
			* To determine latitude at sea by observing the distance between the horizon and a particular star at the same time each night.
			* It consists of a small, rectangular card with a knotted cord passed through it.
			* The concept is that these reference stars, observed at their highest point in the night sky, would always appear the same distance from the horizon if the position of the ship was at a certain latitude.
			* At a higher or lower latitude (that is, closer to or farther from the equator) the distance would be greater or less.
		- Relevance:
			* The Kamal is a simple navigation device used by Arab navigators in the Indian Ocean since ancient times.
			* This was an advancement from just using a star as a point for navigation, because it added latitude to directional headings.
			* While traveling across oceans, the pilot's job was to aim for a certain latitude where he knew that the port city lies. In this way, the knots on the cord would represent the latitude needed to reach a series of specific places.
* Astrolabe (**Medieval Era)**
* Origin: Syria or Egypt
* Used for:
	+ An astrolabe could tell time, find out the height of a mountain or the depth of a well, find latitude at sea or on land, or locate a star.
	+ Muslims could calculate the direction of Mecca for prayer.
* Relevance:
	+ *Astrolabe* is a Greek - Arabic word that means 'star-holder,' because its pointers and dials could show the positions of stars, sun, moon and planets on a series of brass disks that worked as maps of the sky at different latitudes.
	+ Astrolabes still exist but are not in common use. They exist as artifacts that have multiple, interchangeable disks for the Northern and Southern hemispheres, at the latitude of different cities.
	+ Astrolabes was an important innovation in navigation science that allowed oceanic voyages to succeed (but only after an initial voyage, wouldn't know the stars/headings without the initial exploration).
	+ They were used on shipboard by Europeans from about 1480, and later devices such as the cross-staff, the back staff, and the quadrant was derived from the astrolabe.
	+ Together with the magnetic compass, pilot charts and cartography, astrolabes were among the important advances in navigation science that allowed oceanic voyages to succeed.
	+ Astrolabes were used on shipboard by Europeans from about 1480, and later devices such as the cross-staff, the back staff, and the quadrant were derived from the astrolabe, but simplified for use on board ship.
* Longitude and Latitude (**Medieval Era)**
	+ Origin: India
	+ Used for:
		- A system of coordinates that helped find the latitude, or north/south position of a place on earth.
		- It pinpointed its longitude as well, so that the place where the line of latitude and the line of longitude meet gives an exact location on earth's surface.
	+ Relevance:
		- Latitude: "Both the Phoenicians (600 BCE) and the Polynesians (400 CE) used the heavens to calculate latitude. Over the centuries, increasingly sophisticated devices, like the gnomon and the Arabian Kamel were designed, to measure the height of the sun and stars above the horizon and thereby measure latitude."
			* <https://www.open.edu/openlearn/history-the-arts/history/history-science-technology-and-medicine/history-science/latitude-and-longitude>)
		- Longitude: “Great minds had tried for centuries to develop a method of determining longitude. Hipparchus, a Greek astronomer (190–120 BCE), was the first to specify location using latitude and longitude as co-ordinates. He proposed a zero meridian passing through Rhodes.”
			* <https://www.open.edu/openlearn/history-the-arts/history/history-science-technology-and-medicine/history-science/latitude-and-longitude>).
			* Although longitude was theorized thousands of years ago, it was not measurable, i.e. useful, until the late 19th century.
		- Discovery of measurable longitude:
			* Was discovered much later than latitude
			* Longitude really only held relevance after an international conference was held in Washington, D.C. in 1884.
				+ At this conference, the imaginary line, also known as the Greenwich Meridian, was established. This line was used to indicate 0-degree longitude that passes through Greenwich, a borough of London, and terminates at the North and South poles

<https://www.britannica.com/place/Greenwich-meridian>).

* + - * + The conference designated "the [meridian](https://www.britannica.com/science/meridian-geography) passing through the centre of the transit instrument at the Observatory of Greenwich as the initial meridian for longitude."

(<https://www.britannica.com/place/Greenwich-meridian>)

* + - The importance of longitude today, primarily has to do with the prime meridian serving as the world’s standard time zone system.
		- According to Britannica, "the north-south line at Greenwich is used as the reference for all other meridians of longitude, which are numbered east or west of it."
* Magnetic compass (**Medieval Era)**
	+ Origin: China
	+ Used for: Direction
	+ Relevance:
		- Helped with direction and navigation using specific points of direction (north, south, east, west).
		- Through contact with the Indian Ocean, the innovation of the compass reached Arab mariners, and by 1233 CE the invention had appeared in a story with detailed instructions on how to use an iron fish-shaped needle in a bowl of water to find direction.
		- The compass was a significant improvement from the astrolabe because of its construction and how simple it was to use:
			* By the T'ang dynasty in the 7th and 8th century, the Chinese knew how to magnetize an iron needle by rubbing it with magnetite ore, and a little later they recorded that a red-hot needle cooled while it was held in a north-south direction would also be magnetized.
			* A thin, iron needle could then float on the surface of water in a bowl, where it would spin until it pointed.
			* By the 11th century, simple compasses using a needle suspended in water or on a silk thread, or even placed on a pointed pin could indicate direction.
		- Another major advancement for maritime navigation was the compass, as later, the compass was mounted in a swiveling gimbal (i.e. a gyroscope) to keep it level on shipboard.
			* Gyroscopes became integral technology to satellites, GPS, and many other aspects of modern technology.
* The stern rudder for steering ships **(Medieval Era)**
	+ Origin: China
	+ Used for: Steering ships more efficiently.
	+ Relevance:
		- A stern-rudder is a hinged blade attached to a squared or angled stern-post made of wood. A rudder could be moved with a tiller attachment, or with ropes that moved it from side-to-side.
		- Different from other methods of steering ships, a rudder could be moved with a tiller attachment, or with ropes that moved it from side-to-side.
		- Chinese rudders also had openings in the blade (fenestrations) that made it lighter and easier to turn by reducing resistance, but did not affect its ability to steer.
		- For stronger steering:
			* European ship-builders made an important innovation in their adaptation of the stern rudder's attachment to the ship.
			* A system of iron strap-hinges and post called pintle and gudgeon attached the rudder to a heavy timber post on the squared-off stern like the one in this image.
			* This invention gave the rudder a strong, permanent attachment that could be controlled by a tiller or ship's wheel.
		- Variations of the stern rudder are still used today.
* Carriera Da India **(First Global Era)**
	+ Origin: Portugal
	+ Used for:
		- The Carriera da India was part military and part commercial, and the fleet had to follow specific navigational paths laid out in the regulations. These routes were based on careful navigational charts and maps of the route.
	+ Relevance:
		- The *carriera* was a long-distance, round-trip maritime route of the Portuguese Empire, a fleet of five to seven ships that set out annually to India under orders of the king.
		- The *carreira* served as route technology because it was a careful and much shorter voyage route that the Portuguese could take on their regular trips to India.
		- In spite of the advances in ship design and navigation instruments, the *Carriera da India*was still tied to the monsoon calendar in the Indian Ocean, since this was the wind system that ensured safe passage.
		- Between 1500 and 1635, almost a thousand ships made the journey, sailing in fleets of seven, five, and later three ships per *carreira*.

**Part II: Handouts**

Using the Ancient era, Classical era, medieval era, and First Global Era maps, students will be asked to identify specific technologies from the Indian Ocean related to each of these eras on their handouts. These icons are technologies created by Europeans, Arabs, and other groups of civilized peoples, which were cultivated for use in other regions of the world as well as their own. These items are found in the charts below; they are intended to help highlight what aspects of the individual technologies students should be focusing on in their map search.

 Teachers should have students work in small teams in a computer lab and divide the class into four groups (one for each era) to fill out the worksheets (provided at bottom of lesson plan) with these details. Remind students to think critically about why these items are important to all four eras and how they may be linked to the items found being found by other groups. Encourage students to think about how their specific items can fit into the larger picture of technology in the world, more specifically, how these premodern technologies hold as roots to modern technologies.

 Each student will receive a handout, however each group will only work on one era as a group. For example, one group will work on investigating the listed technologies on the ancient era map while another group works on investigating the listed technologies on the classical era map.

**Part III: Discussion**

 Using the filled out sheets for every group's distinct assigned era, volunteers from each group will start by taking turns to share what they learned from every technology on their era so that students can learn about other eras from their peers. Once they receive this shared information, students will be directed to fill out what they are hearing onto their own blank handout of the era that is being shared. After every group has had their turn to share and discuss the information on their chart with the rest of the class, everyone should have all four of their sheets filled out.

 After this part, ask students if they noticed an advancement from one trade technology to the next in each section, and what those advancements were. How did maritime trade technology advance? How did technology for trade used on land advance from one era to the next? How did Navigation technology advance from one era to the next? Students must leave the lesson understanding the relevance of the technologies on trade advancements in all three sections.

**Worksheets: Starting from the next page**

**Ancient Era technologies**

|  |  |  |  |
| --- | --- | --- | --- |
| Icon  | Origin  | What was it used for? | Relevance  |
| The earliest boats: wood, reed, and papyrus |  |  |  |
| Dromedary Camel  |  |  |  |
| Bactrian camel  |  |  |  |
| Bitumen  |  |  |  |
| Bronze |  |  |  |
| The wheel  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Icon  | Origin  | What was it used for? | Relevance  |
| Phoenician ships  |  |  |  |
| Ancient fishing boats  |  |  |  |
| Camel saddle  |  |  |  |
| Navigation by Polaris  |  |  |  |
| Kamal  |  |  |  |

**Classical Era Technologies**

**Medieval Era Technologies**

|  |  |  |  |
| --- | --- | --- | --- |
| Icon  | Origin  | What was it used for? | Relevance  |
| Arab Dhow  |  |  |  |
| Astrolabe  |  |  |  |
| Longitude and Latitude  |  |  |  |
| Magnetic compass  |  |  |  |
| The stern rudder for steering ships  |  |  |  |
| Wootz Steel  |  |  |  |
| Gunpowder  |  |  |  |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Icon  | Origin  | What was it used for? | Relevance  |
| Carrack or Nao  |  |  |  |
| Cannon-bearing ships  |  |  |  |
| The Caravel  |  |  |  |
| The Manilla Galleon  |  |  |  |
| Carriera Da India |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Global Era technologies**