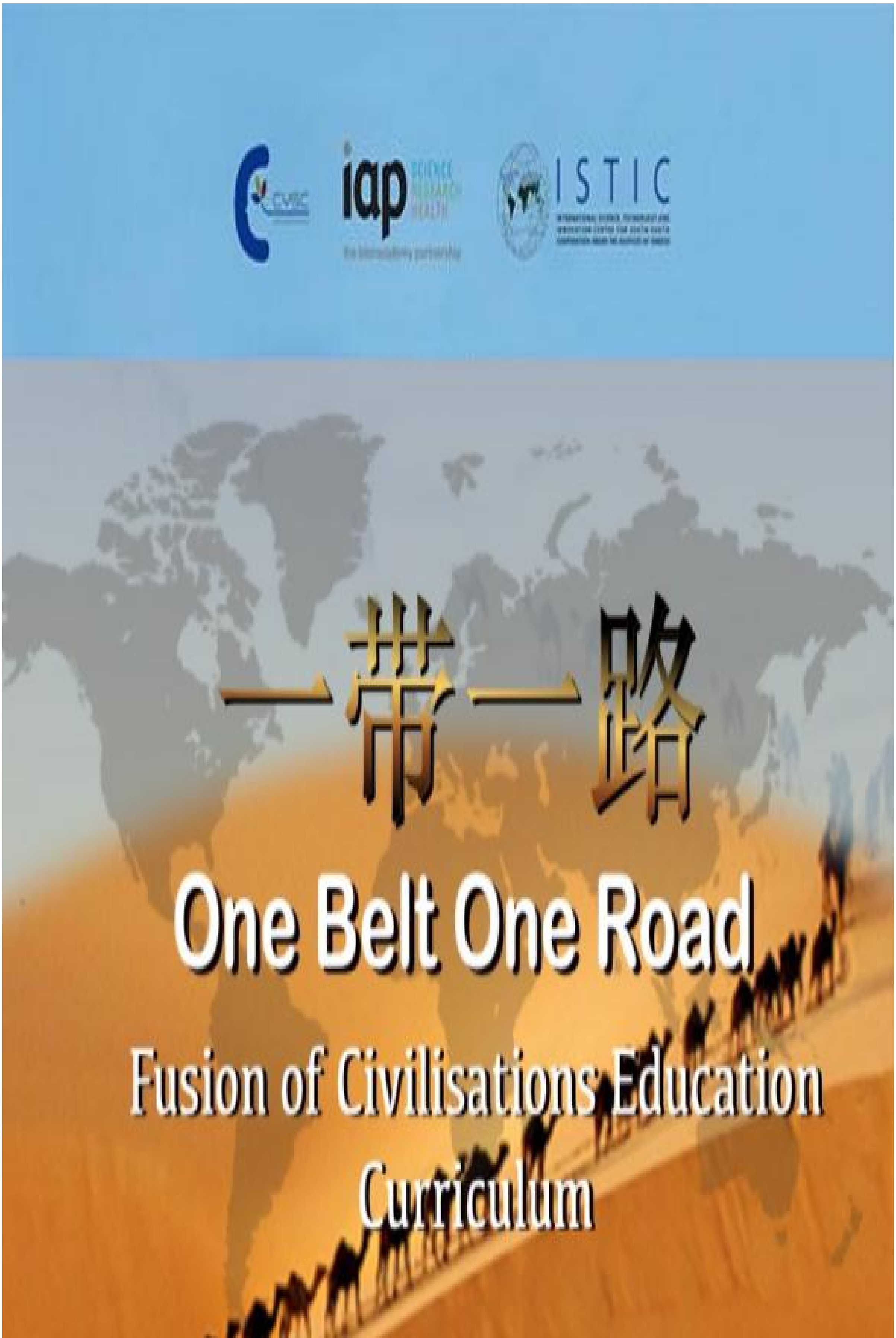

iap
ISTIC
一带一路
One Belt One Road
Fusion of Civilisations Education
Curriculum

Preface

Part 2 Maritime Silk Road

Part 3 ASSEESSMENT

PREFACE

The One Belt One Road Fusion of Civilisations Curriculum is a project initiated by the InterAcademy Partnership Science Education Programme (SEP) with the aim of promoting the integration of education, science and technology, civilization and culture along the Land Silk Road and Mari-time Silk Road. The curriculum is an attempt to help school children gain a better understanding of the shared benefits arising from the innovations of the Silk Road civilisations throughout the ages. Such shared benefits persist to the present day.

The Curriculum is inspired by the Belt and Road Initiative which is a development strategy adopted by the Chinese government involving infra-structure, investment, cultural and educational development and exchange amongst countries in Asia, Europe and Africa. The Belt and Road Initiative has spread to the Americas and the Pacific Islands and has become a global initiative that has promoted the political, economic and cultural understand-ing among member nations and economies.

The Curriculum is prepared in the form of a module. The module is in two parts, each emphasising the land and silk roads taken by traders, trav-ellers, scientists, philosophers and adventurers, respectively taking along not only commercial goods but also introducing scientific innovations; and lan-guage, cultural, religious and ethical values.

The narratives are accompanied by student activities following the Inquiry Based Science Education (IBSE) pedagogy in which students are given op-portunities to investigate, discover and seek solutions through the hands-on approach. The approach encourages the development of thinking skills and creativity which are in line with the current approach in teaching science in schools. Embedded in the narratives and activities are desirable values such as respect, tolerance and cooperation which promote peace and understanding.

I wish to express my sincere appreciation to the members of the working group for their invaluable contribution in the preparation of the module. Indeed, their expertise and experience in curriculum development and classroom practices have made it possible to translate the ideas into practicable activities suitable for the primary education level. Their involvement would not have been possible without the support of their organisations, namely the Ministry of Education, Malaysia; Research Center for Learning Science, Southeast University, Nanjing, China; Institute of the History for Natural Science, Chinese Academy of Sciences, Beijing, China; Children and Youth Science Centre of China Association of Science and Technology (CAST); China Association for Children's Science Instructors; Educational Center for "Learning by Doing" Science Education Reform Pilot Program, and Think-tank: Handsbrain Education, Jiangsu. China; the Institute of Educational Development Aga Khan University, Pakistan, SEAMEO Centre for Quality Instruction for Teaching and Education Personnel in Science (QITEP) and the National Science Museum of Thailand. To these organisations, I wish to extend my thanks.

I also wish to acknowledge CAST, the ECO Science Foundation (ECOSF), the Academy of Sciences Malaysia and the International Science, Technology and Innovation Centre for South-South Cooperation under the Auspices of UNESCO (ISTIC), Kuala Lumpur, the National Science Museum Thailand for facilitating the organization of the various workshops. My deep appreciation goes to the InterAcademy Partnership for the kind contribution and financial support for the initial conceptualisation of the idea and subsequent working group meetings. I am grateful to the China Association for Science and Technology for providing funding for the printing of the module. Above all, I highly value the encouragement and support of my colleagues in the IAP SEP Global Council and its International Advisory Board.

I sincerely hope that the module will reach out to as many teachers and educators as possible and that the project will achieve its objectives. I am confident that this Curriculum at the primary education level will spread horizontally to embrace civilizations in other parts of the global like the Americas and the Pacific Islands; and vertically to Curriculum in secondary and tertiary education levels. I have an abiding faith in our children and youth that through their understanding of the fusion of civilizations, they will be the agents of social change to guide our global village to peace and sustainability.

Academician Dato' (Ir) Lee Yee Cheong
Chairperson, IAP SEP Global Council
31 December 2018, Kuala Lumpur

FUSION OF OBOR CIVILIZATIONS SCHOOL CURRICULUM

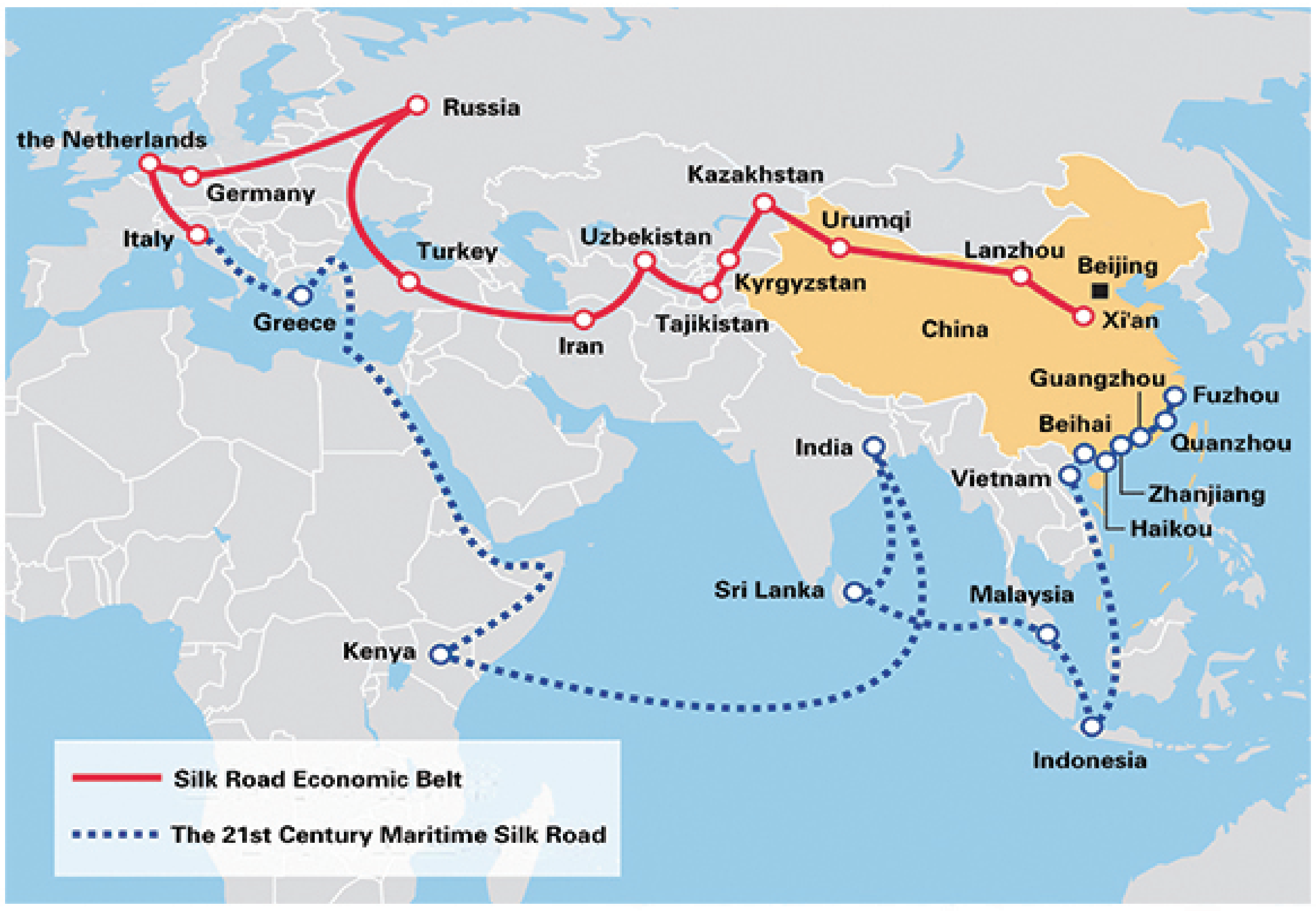
BACKGROUND

Education plays a key role in producing citizens of today for tomorrow. Various subjects are introduced into the education program to ensure that major educational goals such as being able to problem-solve and think critically, be creative, care and want to give back to their community, persevere, have integrity and self-respect, have moral courage and be able to use the world around them well.

The idea of implementing the fusion of civilization curriculum in the existing educational program has been debated since lately. It has been thought and believed as the new approach to promote world peace and harmonious human life among students from young age. By understanding and having good perception of different civilizations that contribute to present day knowledge, children will appreciate the need and importance to live in peace and harmony. Based on this premise Fusion of Civilization Education (FoCEd) Curriculum has been formulated and develop to address and fulfil the needs.

The project arose out of the need to inculcate peace and harmony through evidence based science education for children in the light of the current conflict and increase in violence in societies, and terrorism resulting in atrocities and displaces persons.

China's One Belt, One Road initiative



There is a need to develop a curriculum on the fusion of civilisations highlighting the discoveries and contributions of culture, trade, science and technology from each civilization and their beneficial impacts on other civilizations through the land and oceanic silk roads. It will hopefully instil respect amongst the young and promote tolerance, understanding and respect for one another' s culture and tradition.

FoCEd curriculum is formulated in line with thinking that connectivity of discoveries in each civilization along the Belt and Road (B&R) Initiative and how such discoveries influence the cultures and civilizations for the betterment of human condition along the B&R countries and regions. Understanding the connectivity between neighbouring cultures and civilizations among children could be an approach to instil the awareness of the importance of living in peace and harmony. The content of the curriculum also include the role of the great travellers along the B&R that helped to spread the fusion of B&R civilizations.

The "Fusion of OBOR Civilizations Curriculum Design" project is given modern relevance by China's "One Belt One Road" (OBOR) Initiative that aims to uplift the human conditions of the developing world by physical, cyber and cultural connectivity.

The InterAcademy Partnership (IAP) Science Education Programme (SEP) Fusion of One Belt One Road Civilizations Curriculum Design" project is inspired by two La Main a la pate (LAMAP) thematic programs, namely "Discoveries in Muslim Countries" based on the ground-breaking discoveries in the Golden Age of Islam; and "Discoveries in European Countries" that resulted from the European Renaissance with knowledge and technology transfer from Islam. Through the ancient Silk Road, Islamic discoveries interacted eastwards with the civilizations in India and China.

This IAP SEP project anchors itself on the tenets of the Islamic Golden Age:

- Seek and share knowledge freely throughout the world;
- Be knowledgeable not only in science, but also in religion, poetry, literature, music and the arts.

Two IAP SEP Forums were held to discuss the concept amongst S&T historians and curriculum designers in Khartoum Sudan, February 2017 and Beijing, China July 2017. This workshop assembled a working group of curriculum designers and science communicators to get down to work on the school curriculum. This was followed by a working group workshop in Kuala Lumpur which refined the document prepared, collect detailed information related to the framework and compiled data and prepared the first draft of the curriculum. Another workshop was held in Islamabad, Pakistan which looked at the draft of materials.

THE CURRICULUM

Science, technology, engineering and mathematics (STEM) education have been recognized as the vehicle to enhance the inborn curiosity and creative instincts of children to face the rapid pace of development in Industry 4.0 and the global digital economy. Thus stressing and promoting the importance STEM education especially the evidence based or inquiry based science education (IBSE) methodology has been given more emphasized in educational program of many countries.

Enhancement of STEM human capital has greatly improved the human condition in recent decades; it has also tremendously increased the killing power of traditional weapons as well as the chilling military hardware in cyber warfare. Hence, wars and conflicts have grown more destructive.

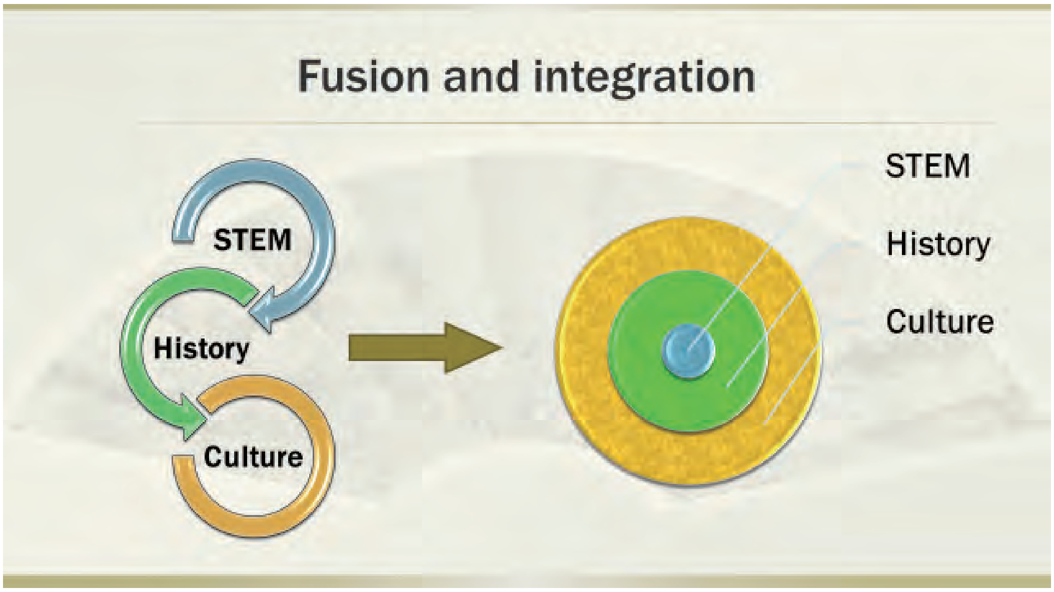
The increased of destruction of the world and humanity demands big shift of priorities in education. Education must prioritize world peace and harmony hand in hand with STEM for sustainable development. Education for peace and harmony may well succeed with the young.

Children are not only born inquisitive but also benign. In this internet and digital age, children are much more adept in acquiring and sharing information knowledge through social media. In turn, they can spread the message of peace and harmony to their parents and their communities. Indeed, they can be really agents of societal change for peace and harmony.

Focus of the Curriculum

The main focus of the curriculum is STEM education, history and culture. History is our best teacher. The glory of the ancient silk routes shows that geographical distance is something that cannot be overcome. If we take the first brave step towards each other, we can begin on a path leading to friendship, shared development, peace, harmony and a better future. His–

tory is also a mirror. Only by drawing lessons from history can the world improve for the betterment of mankind. The past cannot be changed, but the future can be shaped



DEFINITION OF TERMS

Civilization

The level of developments at which people live together in peacefully in communities.

Fusion of Civilization (FoC)

FoC is connection of different civilizations that contribute to present day knowledge and bring global peace and harmony.

FoC Education (FoCEd)

FoCEd is process of teaching, facilitating learning and acquisition of knowledge, skills, values, beliefs and habits that related to fusion of civiliza-tions.

FoCEd Curriculum

FoCEd Curriculum is a set of plan and arrangement concerning the purpose, content and learning materials and how to use as a guide for learning activities to achieve specific aims of FoCEd.

CONCEPTUAL FRAMEWORK OF FoCEd

Aim

FoCEd aims to promote tolerance and respect of other cultures and traditions through understanding of current scientific knowledge and discoveries driven from ancient wisdom to inculcate global peace and harmony.

Objectives:

The objectives of FoCEd are to enable students:

To identify the knowledge and scientific process as the common way to solve problems.

To describe development and connection between the early inventions to present day innovations.

To appreciate the contribution of discoveries from various civilizations.

To demonstrate teamwork for promoting peace and harmony.

ELEMENT OF CONTENT AREAS

FoCEd Curriculum framework includes Big Idea, Concept, Competency, Connectivity. However, Level and Standard should be determined by countries themselves to plan, adopt and adapt FoCEd framework and materials.

Big Idea: Declarative statements that describe main concepts that transcend grade levels. Big Ideas are essential to provide focus on specific science and technology content for students. The two big ideas, as evidenced the Belt and Road Initiative, are:

- Water
- Land

Concept: Describe what students should acquire i.e. knowledge, skills, values, beliefs and habits-that related to fusion of civilizations under each Big Idea as a result of teaching and learning specific to grade level.

Connectivity: Describe the link among civilizations that contribute to present day knowledge to bring about the acceptance of differences for peace and harmony. The civilizations include ancient discoveries and inventors of civilizations along Belt and Road countries that contribute to the present innovations.

Competency: Describe what students should be able to know, to do and to perceive the fusion of civilizations as a result of the instruction, specific to grade level.

THE FRAMEWORK

Big Idea	Concept	Connectivity	Competency	Level & Standard
Exploring the world through maritime	• Knowledge (sc & tech, astronomy, culture, language • Values, beliefs and habit: Support (power, funds and manpower); Offering (protection, goods, relationship, harmony), religion/ ethical values, overcoming the problem during travelling.	• Discovery: astrolabe -Inventor : hellenistic civilization (Roman and Greek) 220 B.C -improved by Islamic astronomer (Mohamad Al Fazari lived in 8th century) to find the qiblah for praying • Suggested activity: Making compas	Students appreciate the diversity of civilizations • Critical thinking -Comparing and contrasting • Communication -Describe. • Collaboration • Creativity -develop and design	To be filled up by the respective countries

Exploring the world through land	• Knowledge (sc & tech, astronomy, culture, language • Values, beliefs and habit: Support (power, funds and manpower); Offering (protection, goods, relationship, harmony), religion/ ethical values, overcoming the problem during travelling	• DiscoveryKarez/ Qanat (underground water ways) -Inventor:Persians (Iran) (Originated in Iran 3000 yrs ago -Spread from there slowly westward and eastward -Practised in many countries until now • Suggested activity: Making- water pump, -wind mill, -water mill (different ways to manage water)	Students appreciate the diversity of civilizations • Critical thinking -Comparing and contrasting • Communication -Describe.. • Collaboration • Creativity -develop and design	

TEACHING AND LEARNING

To implement the concept of FOC in the T&L practice it is suggested to refer the great travellers Ibn Battuta, from Morocco and Admiral Zheng He (Admiral Cheng Ho) from China. They have been identified as the iconic figures that portrayed the connectivity among civilizations. FoCEd concept may be delivered in classroom through story telling of the two great travelers, Ibn Battuta and Admiral Zheng He.

The story telling will lead to the class activities which emphasizes on pupils–centered orientation based on inquiry–based science education (IBSE) which encompass problem/project based learning (PBL) and contextual learning. Inquiry-based science education has been acknowledged as an effective delivery method in teaching science. According to the IAP SEP Inquiry-based science education is an approach to teaching and learning science that comes from an understanding of how students learn, the nature of science inquiry, and a focus on basic content to be learned. It also is based on the belief that it is important to ensure that students truly understand what they are learning, and not simply learn to repeat content and information. They use skills employed by scientists such as raising questions, collecting data, reasoning and reviewing evidence in the light of what is already known, drawing conclusions and discussing results. (IAP 2011)

FoCEd teaching and learning may cater the 21st century skills that are required to thrive in the future. The skills are:

- Critical thinking
- Communication
- Collaboration
- Creativity

The Module

The curriculum is presented in the form of a module and is prepared in two parts. The first part comprises the land silk route which covers the travels of Ibn Battuta of Morocco. It highlights his observations on the technological advancements which he documented along his travels in the middle Asian region. The second part gives focus on the travels of Zheng He, a famous Chinese explorer. His voyages brought about trading in goods and culture while his large ships were equipped with state of the art and navigation tools of the time. His fleet was complete with staff with different roles.

Guide to Teachers

The modules are aligned with Science for Primary Schools syllabus for most of countries. The activities chosen for the modules are based on the science process skills rather than the facts or principles of science. Thus the modules can be used for any level of primary schools children. The process of inquiry learned as ways of finding answers, can be applied without limit. Each activity begins with a story, and followed by the level, objectives and the main focus questions. The procedures for carrying out the activity and the necessary materials to be used are also stated as a guide. In addition to activities a glossary is also provided. This highlights the words that pupils will learn while using the modules.

It is suggested that this module to be used in conjunction with, soon after the related science topic is taught or as co–curricular activities. Teachers are not confined to implement this module by following the guideline rigidly. Teachers are free to adjust the module according to their pupils' needs and abilities.

Suggested Teaching and Learning Resources

Educators are encouraged to develop by adapting and adopting teaching and learning materials based on the travel of Ibn Battuta and Admiral Zheng He in the implementation of FoCEd.

The table below summarized the period and various places visited by them along the Belt and Road countries.

	Ibn Battuta (1325-1354)	**Zheng He (1405-1433)**
1	Sri Lanka, Straits of Malacca , Malaysia (Malacca), Indonesia, (Samudra/Sumatra/Pasai), Vietnam	
2	China (Guang Zhou, Fujian, Hang Zhou, Beijing)	
3	India (Calicut)	
4	Maldives	
5	Middle East (Makkah)	Middle East (Makkah, Aden, Djofar)

6	Africa (Timbuktu)	Africa (Mogadishu, Barawe, Zanzibar, Mombhasa)
7	Morocco (Marakesh, Fez, Tangiers)	-
8	India (Delhi)	India (Calicut, Cochine)
9	Central Asia (Baghdad, Damascus, Persia, Uzbeckistan, Bukhara, Afganistan, Samarkhan)	-
10	Asia Minor (Anatolia, Constantinople)	-
11	Europa (Granada, Spain, Valencia, Cordoba, Venice)	

Some recommended resources:

- Ibn Battuta: The Man Who Walked Across the World (Documentary)
- Chinese Treasure Fleet Adventure of Zheng He (Documentary)
- The Travel of Ibn Batutta UC Berkeley (time line of Ibn Batutta travels and students activities)
- The existing school curriculum that is relevance to the fusion of civilizations concept
- LAMAP/ISTIC "Discoveries in Islamic Countries" English version
- 1001 Inventions
- The Genius of China

ASSESSMENT

Assessment is an important part of teaching and learning. In IBSE there should be a good and effective measure in providing information on the effectiveness of the teaching approach which in this case is Inquiry-Based Science Education. Assessment covers classroom based assessment, tests and examinations. Thus it covers the activities that pupils are engaged in such as regular work, written or practical tasks given by teachers. The data can be collected through teachers' observations, tests, student work sheets, outcomes of experiments / practical activities, outcomes of tests carried out by teachers or external agencies. The data can be judged in relation to the performance of other pupils, criteria and pupils previous performance. The judgement can be communicated orally by the teacher, a mark or score or percentage, a profile of the achievement, or a grade or ranking.

The assessment items used in this module is based on what the pupil can do in comparison to the intended performance.

CURRICULUM TEAM

1. Dato' Ir. (Dr.) Lee Yee Cheong, IAP SEP Global Council Chair.
2. Ms. Zhu He, Director of Division of Teacher Development, Children & Youth Science Center of CAST, China
3. Prof. Ye Zhaoning, Associate Professor, Research Center for Learning Science, Southeast University, Nanjin, Jiangsu Province, China.
4. Dr. Chen Wei, Associate Professor, Institute of the History for Natural Sciences, Chinese Academy of Sciences, Beijing, China.
5. Dr. Tasneem Anwar, Assistant Professor, Science Education, Lead Faculty, Virtual Learning Environment (VLE) The Aga Khan University, Institute for Educational Development, Pakistan.
6. Dr. Indarjani, Deputy Director for Programme, SEAMEO Regional Center for QITEP in Science, Bandung, Indonesia.
7. Dr. Aphiya Hathayatham, Vice-President, National Science Museum, Thailand.
8. Datin Seri Norzamani Abdol, Deputy Director, School Management Division, history curriculum expert and former head of History, Curriculum Development Division, Ministry of Education Malaysia.

9.Mrs. Zainon Abd Majid, Head of Science Unit, Curriculum Development Division, Ministry of Education Malaysia and science curriculum expert.

10.Mrs. Salbiah Mohd Som, Senior Lecturer, Selangor Matriculation College, Ministry of Education Malaysia, science curriculum expert and former science officer Curriculum Development Division.

11.Datin Maharom Mahmood, former Head of History & Local Studies Unit, Curriculum Development Division, Ministry of Education Malaysia and history curriculum expert.

12.Dato' Dr. Sharifah Maimunah Syed Zin, special assistant to IAP SEP Global Council Chair and Director of the International Science, Technology and Innovation Centre for South-South Cooperation (ISTIC), Malaysia

ORGANISERS & PARTNERS

ORGANISERS

The InterAcademy Partnership Science Education Programme (IAP SEP)

The global IAP Science Education Programme (IAP SEP) was launched in 2003. The major efforts of IAP SEP have been focused on promotion of inquiry-based science education (IBSE), which emphasises a hands-on approach to teaching science especially for primary school children. It is a pedagogy that tries to steer away teachers, and students from rote- learning and being too dependent on text books and to develop thinking and analytical skills. This is to assure the development of innovative and creative young STEM professionals. IAP SEP also focuses on improving science literacy among the general population.

Partners

Academy of Sciences Malaysia (ASM)

The Academy of Sciences Malaysia (ASM) is a statutory body which came into force on 1 February 1995 and was established under the Academy of Sciences Act 1994.

As the nation' s Thought Leader on matters related to science, engineering, technology and innovation, ASM provides strategic advisory reports to the government. ASM also carries out programmes that contribute towards the development of human capital in science, engineering and technology. As such ASM collaborates and partners with national and international organisations and networks in achieving these goals.

The Academy of Sciences Malaysia acts as the lead academy for IAP SEP during the term of of Academician Dato' Ir. (Dr) Lee Yee Cheong (Malaysia), Chair of the Global Council (2013 – 2018)

International Science, Technology and Innovation Centre for South - South Cooperation (ISTIC)

ISTIC is an international organisation under the auspices of UNESCO and was established by agreement between the government of Malaysia and UNESCO and by resolution of the UNESCO General Conference at its session in 2007, ISTIC' s activities are global and regional in scope and contributes to UNESCO' s strategic objectives, global and sectoral priorities. ISTIC' s main objective is to increase the capacities for the management of science, technology and innovation throughout the developing countries by among others, fostering cooperation among governments, academia and industry in order to facilitate the transfer of knowledge between the public and private sectors and the development of well - planned and relevant knowledge based programmes and institutions in participation countries, developing networks and collaborative training programmes at international level, supporting the exchange of researchers, scientists and technologists among developing countries and facilitating the exchange and dissemination of information. ISTIC acts as an international platform for south–south cooperation in science, technology and innovation and makes use of the network of the G77 countries plus China and the Organisation of the Islamic Conference (OIC).

Economic Cooperation Organization Science Foundation (ECOSF)

The ECO Science Foundation (ECOSF) was established in Islamabad, Pakistan, in December 2011 as an Intergovernmental Specialized Agency of the Economic Cooperation Organization (ECO), mandated to promote scientific, technological and innovative research collaboration and other relevant activities among the member states leading to economic development in the region. Member states include: Islamic Republic of Afghanistan, Republic of Azerbaijan, Islamic Republic of Iran, Republic of Kazakhstan, Kyrgyz Republic, Islamic Republic of Pakistan, Republic of Tajikistan, Turkmenistan, Republic of Turkey and Republic of Uzbekistan.

To strengthen the science base for future generations and the region's economy, the Foundation promotes science education at school level, using the Inquiry Based Science Education (IBSE) approach. To ensure better engineering qualification standards in ECO region, ECOSF with UNESCO has also taken initiative for engineering qualification standardization as per FEIAP standards. This would allow engineers to travel not only in ECO region but rest of the world.

In addition, the mobilization and promotion of youth engagement in science, technology and education for economic development and peace within the ECO region and beyond, is and remains the priority of ECOSF. Integrating gender perspective in policies, plans and actions directed towards the improvement of life and development of youth is priority of the Foundation.

National Science Museum, Thailand

The National Science Museum, Thailand (NSM) is a group of science based museums established in honour of Queen Sirikit's 60th Birthday. As an agent of the Ministry of Science and Technology, NSM's first museum, The Science Museum opened in 2000 and over time, the Natural History Museum, the Information Technology Museum and the NSM Science Square were added. NSM also supports and consults other museums and learning centres across Thailand and some of its neighbouring countries. It leads at the forefront of science communication in South East Asia making science accessible for everyone.

As well as all the visitors to our museums, NSM meets millions of students each year through outreach and in-house programmes; sleepovers at the museum for Science Camps, a range of Science Shows and Labs , and eye-opening experiences in astronomy. The Science Caravan brings NSM to schools in the many regions of Thailand. NSM also hosts activities, training and seminars for teachers, educators, scientists, researchers and other museum professionals, for both national and international events. Working with partners, NSM organises a number of annual events such as Science Avenue, Science is Out There and the Science Film Festival. The National Science and Technology Fair is a science event highlighting science in Thailand and beyond. As a national institution for museums in science and technology, NSM research branches into many fields and works with many institutes and researchers. Two niche areas of research are science communication and the natural history and biodiversity of Thailand.

Children and Youth Science Centre of China Association for Science and Technology (CYSCC)

Children & Youth Science Center (CYSC), a non-profit organization affiliated to China Association for Science and Technology (CAST), was established in 1978. CYSC is committed to engaging the public with science and technology and inspiring innovation in young generation through science education programs and public events. CYSC, together with provincial branches, science museums and STE centres have made up a national wide network for informal science education and science popularization events in China.

China Association of Children's Science Instructors (CACSI)

Founded in 1981 and headquartered in Beijing, CACSI was established by the well-known bridge scientist, educator, academician Mao Yisheng, famous physicist, educator, academician Zhou Peiyuan and other scientists. CACSI is the institution in the China Association of Science and Technology (CAST) that takes the main responsibility of providing science education programmes for teachers. CACSI consists of five standing committees: organization committee, training committee, children and youth science centre committee, publicity committee, and theoretical research committee. CACSI's current membership includes individual membership as well as institutional membership, and has branches in 30 provinces and cities nationwide. Local CACSI branches are affiliated to the local association of science and technology. CACSI hosts an academic journal "China Science and Technology Education".

Part 1 Land Silk Road

Overview

The Silk Road was an ancient network of trade routes that connected the East and the West. It refers to both the terrestrial and the maritime routes connecting East Asia and Southeast Asia with Central Asia, West Asia, East Africa, and Southern Europe.

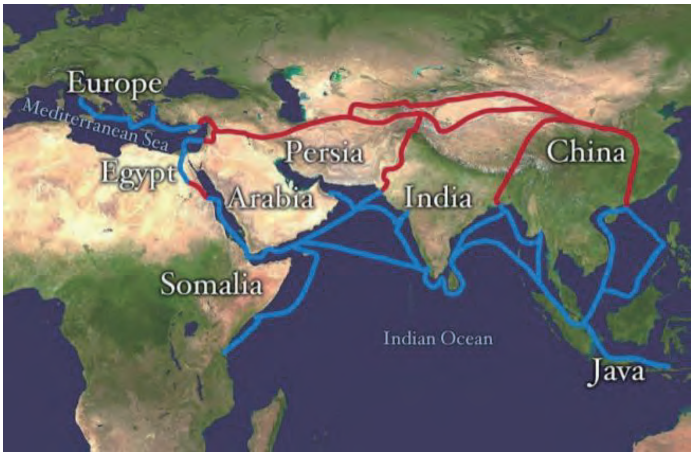
The Silk Road derives its name from the lucrative trade in silk carried out along its length, beginning in China's Han dynasty (207 BCE–220 CE). The Han dynasty expanded the Central Asian section of the trade routes around 114 BCE through the missions and explorations of Chinese imperial envoy Zhang Qian. The Chinese took great interest in the safety of their trade products and extended the Great Wall of China to ensure the protection of the trade route.

The intercontinental Land Silk Road consisted of the Northern Steppe Route (from Mongolia, Siberia to Central Asia) and the Southern Oasis Route (from Xinjiang in China to Central Asia), extending east-westwards among the ancient commercial centers of the old world.

From the 2nd century BCE to around the 13th and 14th centuries CE, the Land Silk Road was an important bond linking the birthplaces of ancient civilizations like China, India, Mesopotamia, Egypt, Ancient Greece, and Rome.

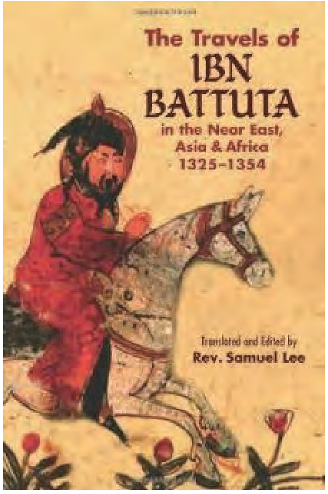
Trades on the Silk Road had played a significant role in the development of the civilizations of China, Korea, Japan, India, Iran, Afghanistan, and other regions in Europe, the Horn of Africa, and Arabia. Though silk was major trade items, many other local goods were traded along the Road as well. Many items as are part of our lives nowadays such as wheat, pepper, cucumber, grape, cotton, tables and chairs, etc. , were introduced to China via this long route.

The Silk Road was also a channel for cultural interchanges among the civilizations. Merchants, envoys, pilgrims, adventurers, labourers, and craftsmen who made long journeys across the East and the West facilitated the integration of arts, languages, religions, sciences and technologies among the East and the West. Diseases, most notably plague, also spread along the Silk Road.



Routes of Land Silk Road

Many of these travelers took overland and maritime routes alternatively for their travels. If the load of cargo was not huge and time also allowed, they preferred to travel overland for a more predictable and safe trip.



Ibn Battuta (1304–1377) was one of the pioneers exploring the whole known world at that time. During 30 years, the man from modern Morocco in the westernmost of the old world made three major long trips, with a total distance of about 75,000 miles. In his book The Travels of Ibn Battuta, he recorded the information about many nations and peoples in modern Egypt, Iran, Uzbekistan, Pakistan, India, Maldives, Bengal, Malaysia, Indonesia, and China.

Battuta tried both overland and maritime routes for his travel. His maritime trips, often encountered unpredictable challenges like a shipwreck, due to which he had to stay in Maldives for nearly one year. But his overland trips went much more smoothly. Besides his good luck, he should be grateful to many full–fledged technologies at his time that already ensured a safe and comfortable living and travelling overland.

At Battuta's time, the sophisticated use of water resources had allowed people to live comfortably even in drought areas; the traditional astronomy was able to lead the people to find their ways in the journeys; and the buildings with local characteristics provided much–needed shelters for travelers. Without the development of science and technological know–hows for these facilities, it would have been much more difficult to travel from place to place, even for the brave like Battuta!

In all, the historic Land Silk Road has made achievements similar to today's globalization in terms of its contribution to cross–continental exchanges. Without this path, the world we live in today would be much different.

Now, let us revisit the Land Silk Road, and follow the footsteps of our ancestors to explore the development and application of science and technology along this east–west channel.

UNIT 1 Water Resource

There is a Chinese household legend.

Long, long time ago, the Huge Flood inundated many regions of China. The Chinese ruler of the time sent an expert named Gun to fight the flood. Mysteriously, Gun had the magic power to conjure soil at his will. When fighting the flood, Gun deposited soil wherever the flood went. But his dam eventually broke. The impetuous torrent of water was out of control and swept away the towns. Gun' s son Yu was asked by the ruler to take Gun' s position to continue the fight. This time, instead of building a huge dam, Yu built many canals to divert flood into low-lying grounds. With his patient and persistent efforts for years, Yu finally tamed the flood.

Though this legend was like a myth, it revealed that the utilization of water resources had a very significant impact on the survival and development of human being. Most of the regions along the Land Silk Road were semiarid and/or arid lands with a shortage of water resources. It was hard to efficiently use the limited water resources and direct water to the places near housing, farm lands, and pastures. In some places, water was lifted from low-lying ground to a high position for use, whereas in some places water was brought in from afar. In rainy season, rain water was saved somehow for dry days in the future. In the areas with little surface water, people had to fetch water from underground.

To survive, people in these regions have developed a series of water conservancy facilities. They used windlass, water wheels, and water pumps to lift water, built canals and karez to transport the water, and developed the water mill driven by water flow.

These water conservancy facilities have not only provided agricultural irrigation for the oases and farmlands feeding the population, but also demonstrated the integration of science and technology along the Silk Road.

As the book The Travels of Ibn Battuta described, thanks to the wide use of water wheels, there were gardens across even the most arid cities, and wild areas turned into pastures and farmlands.

Activity1.1 Windlass

✳Introduction

The starting point of the Land Silk Road, Xi’an (originally known as Chang’an), is the capital of ancient China’s Han dynasty and Tang dynasty. In this journey exploring the Land Silk Road, we start from Xi’an.

There were several big wells in old Xi’an city that supplied drinking water for downtown residents. Interestingly, TianShuiJin Street in Xi’an was named after a well famous for its water sweetness.

TianShuiJin (meaning the Well containing sweet water), Xi’an City

Stele inscript (on left): The Well Feeds Endlessly

TianShuiJin (meaning the Well containing sweet water), Xi’an City
Stele inscript (on left): The Well Feeds Endlessly

Looking at the picture right above, think about why there is a strange device above the mouth of the well.

If the well extends deep underground, it will be very strenuous to directly fetch water. The windlass was invented to make it more convenient and easier to lift water from deep well.

The similar devices can also be found in the other end of the Silk Road.

In his book The Travel, Ibn Battuta recorded many wells which fed the cities and villages around the Mediterranean, and the people there might use similar devices to fetch water.

✻Level

10–12 years old

✻Objectives

Pupils should be able to:

1.Understand the working principle of axle

2.Apply axle to solve problem

✻Focus question(s)

Engineering problems: Place two tables 15cm apart, which looks like a well. Design a windlass to lift a keg filled with water from the ground between the tables to the tabletop. The keg is about 10cm long in diameter. The tabletop is about 80cm above the ground.

Some engineering questions for pupils to think about, as following:

1.What parts make up a windlass?

2.What is each part like?

3.What is each part made of?

4.What kind of structure can support the windlass?

5.Why is a piece of thick cylinder installed on the shaft? What materials can be used?

✻Inquiry

Materials

 disposable chopsticks	 sticwooden ks	 steel shaft
 connecting rods	 bobbins	 rubber bands
 cotton threads	 a keg	 glue gun

Procedure

1. Observation

i.Observe the pencil sharpener and tap. Discuss how these tools function.

ii.Can the sharpener work properly without using its handle? Can you turn on the tap without using the handle?

iii.Think about the functions of the crank of the pencil sharpener and the handle of the tap.

iv.What do they have in common?

2. Design

Please draw your design of windlass and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Test

i.Place two 80cm−high tables 15cm apart.

ii.Put water in a bucket and place it on the ground between two tables.

iii.Erect the windlass model on the table and make it stable.

iv. Put the keg into the bucket and fill the keg with water.

v. Turn the handle to life the keg. Count how many turns the handle need to make in order to lift keg from the well (i.e. the bucket) to the mouth of the well (i.e. the table top). Measure the force exerted on the handle.

vi.Directly lift the same keg from the well (i.e. the bucket) to the mouth of the well (i.e. the table top). Use a forcemeter to measure the force. Compare with the two force values.

5. Improvement and communication

i.If your windlass model doesn' t make much difference in the force used to lift the keg, how can you improve the model?

ii.If your windlass handle makes too many turns, which slows down the lifting, how can you improve it?

iii.If your windlass is broken when working, how can you improve it?

iv.Show your improved model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

Suggested methods

1.Use disposable chopsticks to build a bracket.

2.Insert a steel shaft through a bobbin and fix the structure firmly with tape or glue gun.

3.Fix the bobbin−shaft structure on the bracket, and cover both ends with rubber bands to keep them from moving.

4.Place a connecting rod with appropriate length to one end of the steel shaft as a handle, and use a glue gun to firmly fix the connecting rod to the position.

5.Take a long thread to wind round the bobbin with one end to fix on the bobbin and the other end attached to the keg.

6.Turn the handle, and the cotton thread is gradually wound around the bobbin to lift the keg.

✳Connectivity

Get the pupils to discuss:

1.In your country, what kind of tool is used to get water from deep wells? What is the working principle of the tool?

2.Could you find a shaft in your life?

✳Worksheet

Name: Class: Date:

Engineering problems: arrange two tables 15 cm apart to make a well. Design a windlass to lift a keg filled with some weights (books, paper, sand, water, and marbles) from the ground to the tabletop. The keg is10 cm long in diameter; the height is about 80 cm above the ground.

Draw your design.

Make your model and test it. Record your testing result, and modify if necessary.

The photo of the model	What do you find?

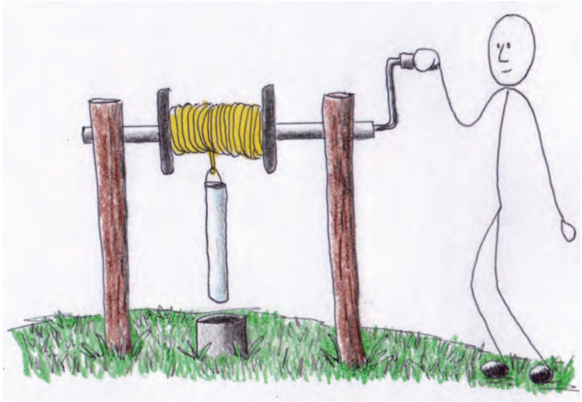
✳Reading materials for teachers

As early as in the 1000 BCE, people invented windlass. Windlass consisted of stand, bobbin, handle, rope, bucket, etc. The stand was erected on the mouth of a well. A shaft with bobbin installed on the stand was turned by a handle. The rope was wound around the bobbin with the other end attached to the bucket. As the rope was wound around or unwound off the bobbin when the handle was turned, the bucket moved up or down in the well.

The windlass was widely applied in agricultural irrigation which significantly facilitated the development of agriculture in ancient times. In addition, the windlass was also used in the underground construction and mining. There were historical records about the use of windlass to lift copper from shafts in Spring and Autumn Period of China about 2,500 years ago. Nowadays, windlass has gradually been replaced by electric water pumps.

✳Glossary

Axle: An Axle is a simple machine which consists of central shaft for a rotating wheel or gear, such as a screwdriver, a steering wheel, etc. An axle makes work easier.



✳Reference

https://www.education.com/activity/article/Wheel_And_Axle/

Activity1.2 The Water Wheel

✳Introduction

Going west further along the Land Silk Road, we arrive at the second stop: Lanzhou, a strategic city of the Land Silk Road. People have lived there since 5,000 years ago. Lanzhou is temperate continental climate with small precipitation yet rich water resources, and Yellow River runs through the city.

In 1556 CE, the first Lanzhou Wheel was installed by the northern bank of Yellow River. Thereafter, more and more farmers along both banks of Yellow River learned to use water wheel to irrigate farmlands. Lanzhou Wheel was a water conservancy facility driven by the flows of Yellow River. The diameter of its spoke was 16.5 meters long which was capable to lift water to 20 meters high. After water was moved to the top of the wheel, it was poured into the wooden groove to irrigate farmlands. It was the ancient automatic water supply system.

The water wheel and its variations were very popular inventions in West Asia and Northern Africa as well. They were often set up in the center of a garden or the fields. Ibn Battuta wrote that water wheels were not only used to irrigate the fields, but also to supply water to the fountains.

The famous Lanzhou water wheel, China

The famous Lanzhou water wheel, China

✳Level

10–12 years old

✳Objectives

Pupils will be able to:

1.Understand how to use axle to construct a water wheel

2.Understand the energy transformation process in a water wheel system

✳Focus question(s)

Engineering problems: Make a water wheel model. Driven by water flow, the water wheel is able to lift water to a position with the height of 15cm and then move the water into the groove, which is 50cm away from the water wheel.

Some engineering questions for pupils to think about, as following:

1.What parts make up a waterwheel?

2.How is the axle used to rotate the wheel?

3.How does the moving water work?

4.How is water drawn into the model and make the wheel to move?

5.How is the lifted water collected?

✳Inquiry

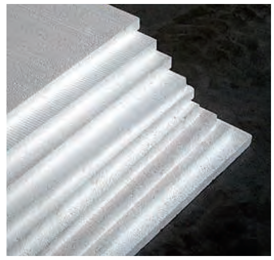
Materials

plastic water bottle

cap of plastic water bottle

big water groove

small water groove

 disposable chopsticks	 sticwooden ks	 foam board with 1cm thickness

Procedure

1. Observation

i.Observe the following windmill and fan, and discuss how their blades turn around.

ii.Watch the video about Lanzhou water wheel. From the video, what major structures does the water wheel have? Discuss how the water wheel works.

iii.Discuss the common features of fan, windmill, and water wheel. What structure do they have in common?

2. Design

Please draw your water wheel design and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Test

Use the water wheel model to draw the water into the groove and observe the status of the water wheel. Test the model to see whether it meets up with engineering requirements.

5. Improvement and communication

i.Is the water wheel able to operate smoothly?

ii.Is water flow able to drive the water wheel to rotate?

iii.Is the water wheel able to lift water to 15cm high?

iv.Show your model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

Suggested methods

1.Use wood sticks to build a bracket.

2.Cut the form board into circular shape to become the wheel.

3.Along the circular line of the wheel, fix several caps of water bottle on the wheel with a consistent distance between each other. The caps are used as buckets to lift water.

4.Insert a disposable stick through the center of the wheel and fix it as the central shaft. Install the wheel to the bracket.

5.Cross cut a plastic water bottle into half to make an open semicircular groove as diversion channel. Use wooden sticks to build the stand of the diversion channel. Place the diversion channel near the water buckets on the wheel to conveniently receive water from the wheel.

✳Connectivity

Get the pupils to discuss:

1.Is there similar facility in your country or region?

2.Besides water wheel, what other water conservancy facility is used to irrigate in your country or region?

✳Worksheet

For student

Name: Class: Date:

1、Observe the following windmill and fan, and find out how their blades turn around.

2、What are the major structures of water wheel?

3、What are the common features of fan, windmill, and water wheel? What are their common structures?

For students' group

Name: Class: Date:

Engineering problems: Make a model of waterwheel to meet up with the engineering requirement to move water from river to farmland nearby.

Draw your design

Make your model and test it. Record your testing result, and modify if necessary.

The photo of the model	What do you find?

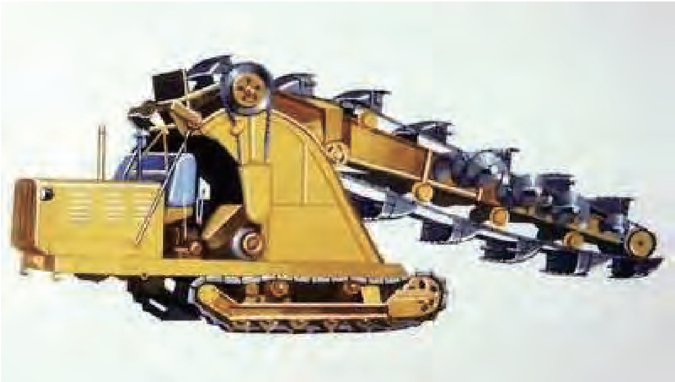
***Reading materials for teachers**

In ancient, people usually lived beside river or other water sources to get water easily. With the development of agricultural technology, people started to plant crops in large areas. Irrigation facilities like water wheel were hence invented to carry water from river to farmlands nearby. The earliest water wheel ever mentioned in Chinese historical records was in the 1st century CE.

Besides irrigation, people also used water wheels to do other hard work such as turning stone-made mills. There are many variations of water wheels like the ones operated by human feet or hands and the ones driven by bullocks or donkeys.

Feet-operated water wheel

Not until modern times, water wheels have gradually faded out of people's lives thanks to the wide use of agricultural water pumps. Nowadays, water wheels as an irrigation facility have been completely replaced by electric water pumps. However, its working principle is still applied in our lives. Look at the bucket excavator often used to dredge the waterway in the shores and ports. Its bucket used to excavate mud took shape from the lifting buckets of water wheel.



bucket excavators

※Glossary

Force effects: When a force acts on an object, it will change the move-ment of the object. When an object is affected by different thrust or pull, it may change the speed of object movement or make the object to start or stop.

※Reference

https://www.education.com/activity/article/simple-water-wheel/

Activity1.3 An Oasis in the Desert

✳Introduction

Let's go to next stop, Xinjiang. Xinjiang is mostly covered with deserts. The climate here is very dry. With very scarce surface water resource, the area is carpeted with yellow sands and sparse green plants. The melted snow water from Tianshan Mountains and Kunlun Mountains is one of major water supply sources in Xinjiang. However, collecting snow water is not easy because the water accumulated at the foot of the mountains evaporates or permeates underground in a short time. The Turpan Basin, in particular, the lowest and hottest area in China, is regarded as the "dry pole" of China. The amazing thing, however, is that this arid area has abundant produce (in local Uyghur language, the word Turpan means a prosperous and affluent place), famous for its grapes, cantaloupe, and cotton. Then, where does the water for irrigation in Turpan Basin come from?

Not only Xinjiang of China, but also the deserts across the areas from Central Asia to Northern Africa face the same challenge for irrigation. A water conservancy facility, karez, is widely used in these areas to channel underground water to farmlands. It is karez that nourishes the oases of the deserts.

The travelers like Ibn Battuta also benefited from karez. In his book, he described the construction process of a karez near the city of Medina.

✳Level

10–11 years old

✳Objectives

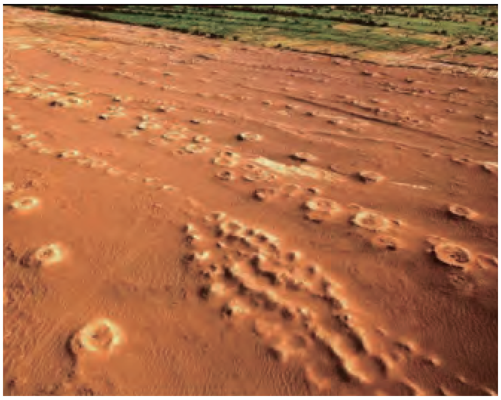
Pupils should be able to:

1.Understand gravity through historic contextual knowledge of karez

2.Understand the working principle of communicating vessels

✳Focus question(s)

How can the geographical advantages of Turpan Basin help to divert the melted snow water from surrounding mountains and underground water to supply fields? What kind of water system can channel underground water to the fields in the Basin? The following pictures taken by remote sensors are about a region of Turpan in Xinjiang. Have you ever seen such a water system? Do you know its name?

Engineering problems: Design and make a model of karez water system .

Some engineering questions for pupils to think about, as following:

1.What is a karez made up of?

2.What is it like if seen from the ground?

3.What is it like if seen from underground?

4.Which parts of karez are connected?

✳Inquiry

Materials

super light clay

knife

bamboo sticks

hardboard

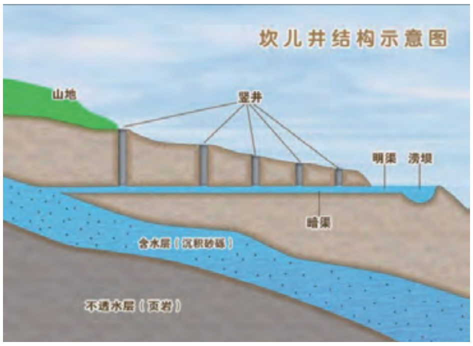
bamboo sticks

 super light clay or plasticine	 sticwooden ks	 hardboards

Procedure

1. Observation

i.Observe the picture below. What parts is a karez composed of?



ii.Talk about how a karez channels water to the oasis.

iii.Observe the structure of teapot, pay attention to the water levels of the pot body and the spout. What do you find?

iv.What do a karez and a teapot have in common?

2. Design

Please draw your design of a karez and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Communication

Show your model and explain how the model demonstrates the working principle of karez to channel water for irrigation use.

Suggested methods

1.Use the super light clay to make a model of mountainous region with one side higher and the other side lower. The higher side represents mountains while the lower side is the basin.

2.Cross cut the model to get a cross-section.

3.Use the blue clay to make an underground water layer (aquifer) and paste it onto the cross-section. The aquifer in the mountainous area shall have higher water level than the one in the basin area.

4.Press the bamboo sticks on the clay to make several vertical shafts in the mountainous model.

5.Use a bamboo stick to connect the bottoms of all vertical shafts to make a culvert. The end of the culvert extends to the surface and turns into open channel and flood dam (a small reservoir) on the ground. Be caution, in the basin area, both culverts and channels shall be located above the aquifer.

6.A karez model is finished.

✳Connectivity

Get the pupils to discuss:

1.Is there a water system like karez in your country or region?

2.How does you system channel water to the oasis? What is the working principle of the system?

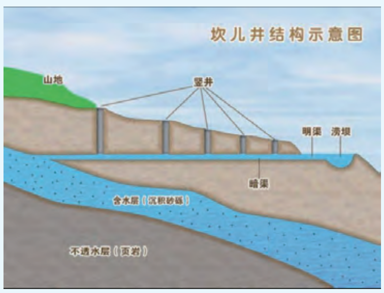
3.Besides teapots and karez, what other communicating vessels do you know in your life?

✳Worksheet

For student

Name: Class: Date:

1、Observe the picture below. What parts is a karez composed of?



2、Talk about how karez channels water to the oasis.

3、Observe the structure of teapot, pay attention to the water levels of the pot body and the spout. What do you find?

4、What do a Karez and a teapot have in common?

※Reading materials for teachers

Pearl necklace on the Silk Road ------ Karez

Imagine that when we traveled in the Central and West Asia, harsh sun above our head, dry sand under our feet, our throat burns like fire. At this time we might be eager to go back to the hotel to enjoy air conditioning and honey watermelon, or a lake suddenly appeared in the sight so that we can jump into and cool it. However, these are unattainable. But there is one thing that can make us be closer to the pleasantly cool dream.

It's not uncommon that in the dark orange rolling hills in the distance, there are numerous mounds about 20-30 meters apart from each other. In the middle of each mounds, there is a hole looking like the mouth of a well, however, below the hole it is not the still water just as in the ordinary well, but a stream flows just like a underground river.

Of course, at this time we can raise sweet water from the river. However, it is a clever way to walk along the direction of the underground canals flowing which will eventually come to the surface, and then we can enjoy the spring.

Going along the stream, we arrive at one village for which the necklace of pearl-like spring is prepared. The enthusiastic villagers take out the cooled fruits soaked in the spring water to entertain us from afar.

What's more, the air conditioner is no longer an extravagant hope. The spring's outlet is so spacious and comfortable that it surpasses the man-made air conditioner, sometimes it even looks like a pavilion under the ground. We can taste fruits while hear the elderly in the village telling us about the history of necklace (we call it karez or qanat), sitting on the octagonal railing.

This underground channel called karez, or qanat in some places, originates from Iran. It is said that as early as 4,000 years ago, the karez had been built in northeastern Iran's Khorasan. The ancient Greek historians

Herodotus, Polybius, etc. recorded the karez in Persia.

The karez technology subsequently spread from Persia westward and eastward to other places that lack surface water (such as rivers, lakes, etc.) but are rich in groundwater in nearby mountains. Nowadays, we can find karezs from east of Xinjiang, China to west of Morocco, North Africa, even in some parts of Western Europe and North America.

Starting from the wellhead where we are resting, we go down and see a pool that stores spring water flowing from the karez for irrigation and daily use by people and livestock.

Walking up the underground canals, every other distance you can see the shaft leading to the ground – that is, the mound we saw on the ground – at first the craftsmen went down the shaft and excavated the underground canals separately. These shafts can be used to maintenance after digging. The soil at the wellhead is dug out of the shaft, and it can be used to avoid the debris on the ground being washed into the underground canals.

Finally, we reach the last shaft, the mother well of karez, which is the first part of the entire water system. Through the characteristics of surface vegetation, experienced craftsmen guess that it is most likely to contain groundwater in this place and they set about to dig down from here.

Usually, the mother well is the deepest in the entire shafts, some up to 400 meters deep. Once excavating into the water table, the groundwater begins to infiltrate into the mother well, and it is necessary to dig groundwater canals in the direction of the village. The canals channel the water to the surface, taking advantage of the current provided by the gravity of the downward slope.

In order to channel water from the source to the village, some karezs are very long, and the world record of the longest underground canal is 70 kilometers long. Of course, it doesn't have to be so long from the beginning. As time goes by, people need more and more water. Therefore, we have to extend the karez upstream from the mother well, or to drill a karez as a branch.

Although many places use modern mechanical technology to drill wells, karez water system still has many advantages, such as stable volume of water all year round and the good water quality. Most importantly, the flow of karez is compatible with the amount of groundwater storage, and it would not drain the groundwater very quickly. It is ecologically friendly, and many karezs have been feeding humans for hundreds of years.

It takes a lot of money to excavate and maintain the karez, and dig underground is dangerous. However, it is worthy for developing human civilization in arid areas. Karez makes the social connections in these places closer. It is the product of the peaceful exchange and interaction of ancient civilizations.

For thousands of years, karez made contributions to human reproduction. Human beings value and appreciate the karez well system. Now the karez in Iran, Oman and other countries have been listed as a UNESCO Intangible Cultural Heritage.

Well, having enjoyed the fruit and water that the karez offers to us, we should embark on the Silk Road again.

The inspirations from karez:

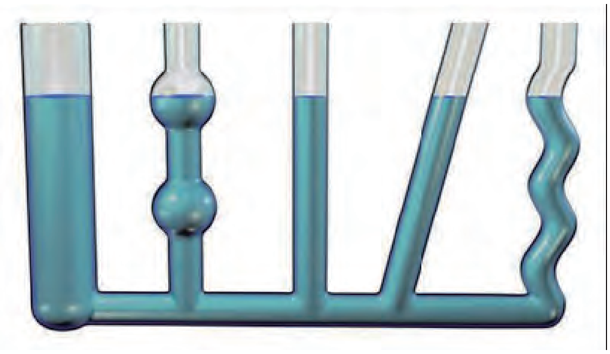
1. Human beings in adversity took actions corresponding to local circumstances, made up for the imperfect natural conditions, and created sophisticated civilizations. This spirit of never giving up and active mind are worth learning.

2. Water is very important for living. Without water, we can't harvest, and there won't be a big population in the world. However, fresh water resources on the earth are very limited. Drinking water is very valuable in many places, so it is necessary to have the habit of saving water. To cherish water resources is to cherish life and our planet.

3. It is not a big challenge to dig an ordinary well, but it takes efforts to transport water from the well to the distant villages. To build culverts along the downward slope is an efficient solution.

✳Glossary

Communicating vessels: Communicating vessels is a name given to a set of containers containing a homogeneous liquid. When the liquid settles, it balances out to the same level in all of the containers regardless of the shape and volume of the containers. If additional liquid is added to one vessel, the liquid will again find a new equal level in all the communicating vessels. For example, the teapot is a typical communicating vessel. After pouring tea, the water in the spout and the body reaches the same level again.



✳Reference

http://www.heritageinstitute.com/zoroastrianism/kareez/index.htm

Activity1.4 The Water Pump

✳Introduction

It has been a long time since the human started to figure out the ways to get the water to irrigate fields. Pump, one of the inventions, allowed us year around to draw up water from the rivers. Water was transported by canals, sometimes far away from the source for irrigation. Pumping machines took shape in Classic Ages and were improved in Middle Ages. Diverse civilizations along the Silk Road have made contributions to the development of pumping technology and its application.

The water pump was developed by the engineers like al-Jazari, more used by Portuguese as Ibn Battuta recorded.

✳Level

10-12 years old

✳Objectives

Pupils should be able to:

1.Understand the concept of atmospheric pressure

2.Use atmospheric pressure to solve practical problems

✳Focus question(s)

Water resources in arid areas are very scarce, and underground water mostly is in the deeper part. People obtain valuable water mainly by drilling deep. How shall the water be drawn up from the source to farmlands or high lands? What kind of tools can get water more easily?

Engineering problems:

Follow the working principles of suction and expulsion to design a water pump to transport the water from a basin on the floor to another basin on the table.

Some engineering questions for pupils to think about, as following:

1.How can a pump draw water by suction and expulsion?

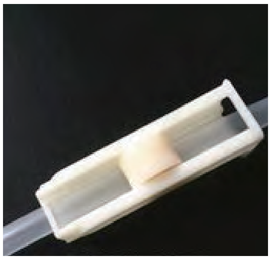
2.What is each part like?

3.What are the functions of syringe and three−way tube?

✻Inquiry

Materials

basins

 tap	 syringe
 three-way tube (matching plastic tubes)	 plastic tubes

Procedure

1. Observation

i.Observe a sucker hook and try to fix it against the wall, or use a plastic sucker to open a drawer or cabinet, think about how it works.

ii.Connect the syringe with a plastic tube. Pull the syringe, and draw the colored water into the tube. Observe the direction and speed of water stream.

iii.Observe the structure of the tap. What function(s) does it have?

2. Design

Please draw your design and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Test

i.Put a basin with full water on the ground, and an empty basin on the table.

ii.Use the model to get the water from the basin on the ground to the basin on the table.

iii.Observe the process.

5. Improvement and communication

i.If the water can't reach the table, how should you improve the model?

ii.If the pump is leaking, how should you improve the model?

iii.If the pump doesn't work smoothly, how should you improve the model?

iv.Show your model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

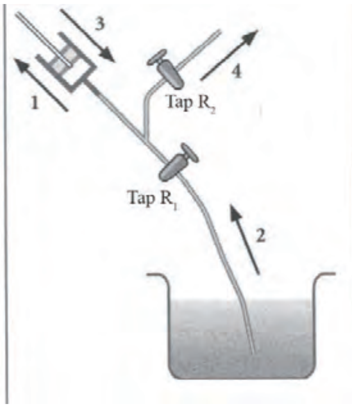
Suggested methods

1.Connect three plastic tubes to a three–way tube and form a T shape tube.

2.Add one tap on both left and right outlets of T–shape tube, and con–nect a syringe to the middle outlet of T–shape tube.

3.Switch on Tap 1 and place the connected plastic tube in the basin on the floor. Pull the syringe to suck water into the T–shape tube, then switch off Tap 1.

4.Switch on Tap 2, push the syringe to force the water out of the syringe and flow toward Tap 2 to the basin on the table



✳Connectivity

Get the pupils to discuss:

1.What does a water pump used in life look like?

2.What is the working principle of an electric water pump? What is it like and unlike the water pump explored in this activity?

✳Worksheet

For student

Name: Class: Date:

1、Observe a sucker hook and try to fix it against the wall, or use a plastic sucker to open a drawer or cabinet, think about how it works.

2、Connect the syringe with the plastic tubes. Pull the syringe, and draw the colored water into the tube. Observe the direction and speed of water stream.

3、Observe the structure of the tap. What function(s) does it have?

For students' group

Name: Class: Date:

Engineering problems: Make a device which can draw the water from a basin on the floor to a basin on the table.

Draw your design

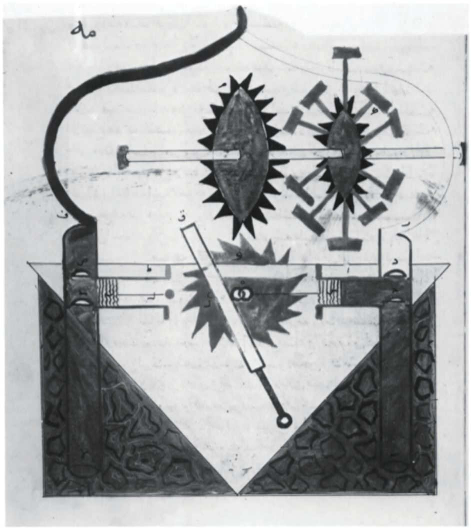
Make your model and test it. Record your testing result, and modify if necessary.

The photo of the model	What do you find?

✳Reading materials for teachers

Al-Jazari is considered as the most famous and innovative of Arabic engineers. He was born in the middle of the 12th century and served for a small court in the south of today Turkey. The king offered him nice research and development conditions to make mechanical innovations. He recorded 50 ingenious machines in his book. Among them the piston pump was one of the most significant.

Jazari’ s piston pump is driven by water wheel. Through a system of gears, two pistons are separately attached to a rod, which can move back and forth in one pipe. With the pistons, the pump can produce partial vacuum, and suck the water to outlet as high as 13.6 meters with the help of air pressure. This first known suction piston pump was even more advanced than the suction pumps appeared in 15th– century Europe.



※Glossary

Pressure is the amount of force applied at right angles to the surface of an object per unit area. The symbol for it is p or P. The IUPAC recommendation for pressure is a lower–case p. However, upper–case P is widely used. The usage of P vs p depends upon the field in which one is working, on the nearby presence of other symbols for quantities such as power and momentum, and on writing style.

※Reference

https://www.education.com/activity/article/water-uphill/

UNIT 2 Astronomy

In the history, people have two time-divided systems. In one case, we are now familiar with such a schedule:

You get up at 8:00 am, have lunch at 12:10pm, and watch cartoon at 4:30 pm.

Your every action is corresponding to an exact hour. And the time represented by the numbers or pointers in the clock is constant every day. Frequently, we would feel overwhelmed if we do not know the hour. However, this time-divided system is not common until in modern industrial society.

In another case, people use sunlight rather than alarm clock to wake them up. They divide the daytime into 12 hours, and the night into another 12. Many kinds of animals and plants, such as bats, cats and sunflowers, should welcome this system. So do the people living in traditional agricultural society. They work and study after the sunrise, rest and amuse themselves after the sunset.

From very early times, people have found the time of sunrise and sunset varied every day. The daytime is long in summer and short in winter. In spring and autumn, it is medium. In fact, the sun is important in ancient human' s spiritual life. Many religions request their followers to pray when the sun rises and sets.

How can the time be calculated conveniently? In many parts of the world, an instrument is employed to determine the time of rises and sets of sun, moon, and stars. It is the astrolabe.

There are several main parts in one ordinary astrolabe. You will learn this interesting ancient calculator in the following sections. The astrolabe also can be used to measure the height of the stars, so as to identify the position of the user. Therefore, it was very useful for travelers, besides telling them when to pray or have dinner.

Activity2.1 Astrolabe

✳Introduction

Muslims of Islam prays for five times at the Mosques every day. The prayer times differ every day to follow the movements of the sun. How is the time measured by tracking the sun? People invented the astrolabe. The astrolabe not only is able to find out the time of star rise but also tells the geographical position, height, date, and makes calendar.

Although Ibn Battuta was not an expert in Astronomy, he might have met many astronomers because there was one astronomer observing the astrolabe in every Mosque. As the astrolabe was often an elegant artware, Ibn Battuta might be the few who could see this expensive instrument. But the simplify edition of astrolabe is still useful for navigation.

✳Level

11–12 years old

✳Objectives

Pupils should be able to:

1.Understand the structure and function(s) of an astrolabe

2.Learn different ways to measure time

✳Focus question(s)

Engineering problems: Explore an astrolabe.

Some engineering questions for pupils to think about, as following:

1.What is an astrolabe?

2.How does an astrolabe work?

✳Inquiry

Materials

Photocopied parts of astrolabe: mould, tympanum, needle, and alidade

Photocopied spider (as a transparency)

Index card

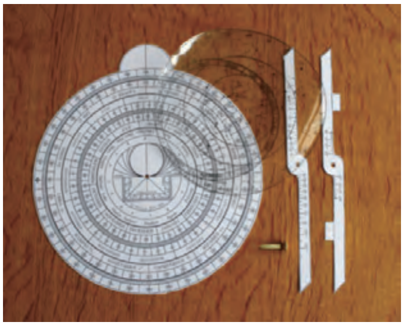
Glue

Scissors

Two eyelets

Paperclip

Parisian clip



Procedure

1. Observation

i.Research the information available about the astrolabe; get the pic-tures of the astrolabe.

ii.Write the information on by whom was it invented and then who per-fected it? Whom was it used for? What are its different elements?

iii.Share your findings and make a chronological freeze citing the Greek periods of the Islam and show that this instrument has been used for a very long time.

iv.Get information on the functions of an astrolabe.

2. Design and make

i.Give each group the materials to make a model of astrolabe.

ii.Discuss how to assemble the parts of an astrolabe.

3.Test

Test your model to find what you need and modify.

Suggested methods

1.Stick the back of the mould on the index card and cut out the disc.

2.Cut out the face of the mould and stick it on the other side of the index card.

3.Cut out the tympanum and stick on the face on the front of the mould, whilst aligning the south direction with the 12 notches (graduation) of the mould.

4.Stitch the needle and the alidade on the index card then cut off.

5.Cut out the outline of the spider following dotted lines (on the trans-parency).

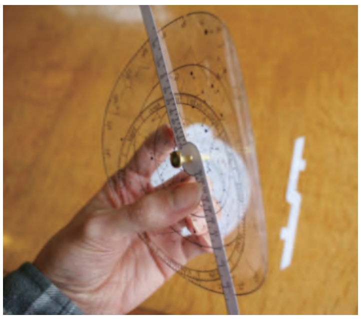
6.Superimpose these in order; the alidade, the mould (tympanum on the upper), the spider and the needle, and secure these with the Parisian clip in the centre.

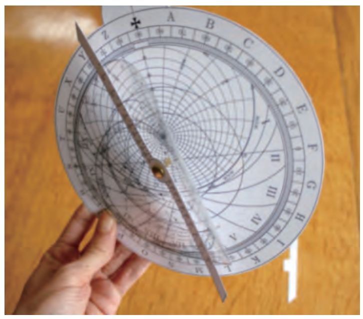
7.Stick a piece of straw on the length of the alidade.

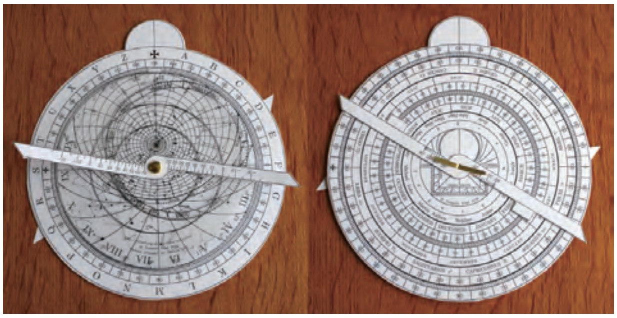
8.Punch the suspension hole, and reinforce it with the eyelets.

9.Put a paper clip in the hole.

10.Once the objects have been made, try them out as a group so that individual errors can be ironed out.







⁎Connectivity

Get the pupils to discuss:

1.What calendar(s) is your country or region using? How does each calendar measure dates?

2.What tools or methods did your country or region use to measure time?

⁎Worksheet

For students' group

Name: Class: Date:

1. Paste or draw the astrolabe you found in your research.

1)Name of inventor: ……………………………………………………..

2)When it was invented: …… …………………………………………….

3)Who improved it:……………………………………………

4)For whom it was invented:…………………………………..

5)Parts/elements of astrolabe:

i.--------------------------------

ii.--------------------------------

iii.--------------------------------

iv.--------------------------------

For student

Name: Group: Class: Date:

1. Chronological table on invention of astrolabe.

Year/century	Inventor	Place

2. Based on the information in the table of chronological above, what conclusions can you make about the invention of astrolabe?

3. List out the function(s) of an astrolabe.

For student

Name: Group: Class: Date:

1. Write down your steps in making your astrolabe model.

2. Do you think your astrolabe model could work? Give you reasons.

3. How could you improve your astrolabe?

✳Reading materials for teachers

What is an astrolabe?

One can say that astrolabe becomes the king of mathematical instruments, with multiple functions, from the measuring of time to the measuring of areas, easing mapmaking, topographical measurements and mechanical calculation of astronomical co-ordinates or trigonometry functions. More than a measuring instrument, the astrolabe is an instrument for calculation.

Astrolabe was developed for political and religious reasons in the second half of 8th century. Astrolabe is a word of Greek origin which means taker of the stars. What astrolabe takes about the stars is the angle of height, or the altitude, that it has in relation to horizon seen from the observer. To measure the height of a star, we have to read the angle of the height on the graded protractor on the astrolabe.

Astrolabe stimulates by projecting the movements of the stars and the sun. Midday would show the maximum height. It is used to measure the time and to resolve certain astrological problems. For the Muslims, it is used to determine prayer time and orientation towards Makkah and fix the calendar.

Parts of astrolabe include the rear face of the mould, front face of the mould, spider, the square of shadows and the sine quadrant. What are the functions of those parts?

The rear face of the mould

Here you can see the twelve months of the year represented in a circle (anticlockwise); for each month (with small gaps), you read the name of a constellation and children can easily recognize the names "signs" of the zodiac. You can also see the half square on which the word "shadow" is written: what does it means? The alidade turns and seems to aim thanks to the straw: what is it for?

Front face of the mould

There are many circles drawn on the tympanum; one of them in particular is graduated from 0 to 90 degree (even if the pupils do not know about the measurements of angles, you can tell them that a right angle has 90 degrees). You read: "latitude of Paris"; this astrolabe can therefore be used in mainland France, but it would be inaccurate at the North Pole or the equator, as was stated in the animation. The exterior ring is graduated in twenty four hours.

Spider

The piece has marks which represented the brightest stars in the sky (see animation); these stars are reached by the first letters of their names and we are going to try and identify them whilst observing the sky map for the brightest star.

✳Glossary

Altitude: This celestial coordinate system divides the sky into two hemispheres: the upper hemisphere, where objects above the horizon are visible, and the lower hemisphere, where objects below the horizon cannot be seen, since the Earth obstructs views of them. Altitude sometimes referred to as elevation, is the angle between the object and the observer's local horizon. For visible objects, it is an angle between 0° and 90°. In actual measurement, altitude may be negative, which means the object is under horizon. The altitude of Polaris equals the its degree of latitude.

Horizon: The horizon or skyline is the apparent line that separates earth from sky, the line that divides all visible directions into two categories: those that intersect the Earth's surface, and those that do not. In the horizontal coordinate system, the observer's local horizon as the fundamental plane. The altitude of the track is zero.

✳Reference

https://in-the-sky.org/astrolabe/index.php

https://www.education.com/activity/article/Horizon_Calendar/

Activity2.2 Telescope

✳Introduction

Just because you can’t see something doesn’t mean it isn’t there. Sometimes, you just need to look closer. This is where a telescope comes in handy. A telescope is an instrument that’s used to look at objects that are far away by gathering light. People generally use telescopes to look at objects in outer space, like planets, stars and comets. Sometimes, telescopes are used to observe things here on Earth, like ships, wildlife, from a distance.

In the time of Ibn Battuta, the Mongol rulers built great Observatory in the modern northwest of Iran. However, in fact, the astronomers could only use their naked eyes to observe the night sky until the telescope was invented in the early of 17th century. Therefore, one of the requirements to be an astronomer at that time was that you shall not be nearsighted.

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.Demonstrate cooperative learning

2.Understand how a telescope works

✳Focus question(s)

Engineering problems: Design and make a telescope by which you can have a clear view of objects in the distance.

Some engineering questions for pupils to think about, as following:

1.What’s the working principle of a telescope?

2.What materials are required to make a telescope? What is the use of each material?

3.What does each part look like?

✻**Inquiry**

Materials

PVC tube:

●Outer tube (diameter: 5 cm or 2 inches; length: 2 meters or 7 feet)

●Inner tube (diameter: 4 cm or 1.5 inches; length: 15.25 cm or 6 inches)

paper towel or toilet paper tube

extra cardboard

glue

scissors

lenses:

●Concave–convex lens: Diameter 49 mm, focal length 100 mm

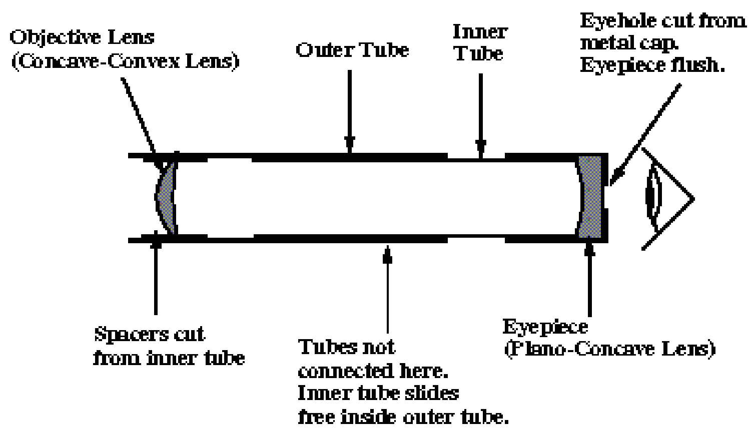
●Plano–concave lens: Diameter 47 mm, focal length 2000 mm

Procedure

1. Observation

i.Observe a telescope and use this telescope to observe objects.

a)What is good about a telescope?



?

e objects,

objects in

mbined to

2. Design

Please draw your design and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Test

Test your model to find what you need modify.

5. Improvement and communication

i.If you can’t see clearly, how can you improve it?

ii.If the model doesn’t zoom in very well, how can you improve it?

iii.If your telescope is broken while it works, how can you improve it?

iv.Show your model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

Suggested methods

1.Use glue to fix a convex lens at the front of the outer tube to work as the object lens

2.Use glue to fix a concave lens at the rear of the inner tube to work as the eye lens

3.Nest the inner tube in the outer tube and adjust the length of the tele-scope

4.Test your telescope

✳Connectivity

Get the pupils to discuss:

1.Is there any other optical instrument like telescope? What is the in-strument used for?

2.What lenses is this optical instrument composed of?

✳Worksheet

For student

Name: Class: Date:

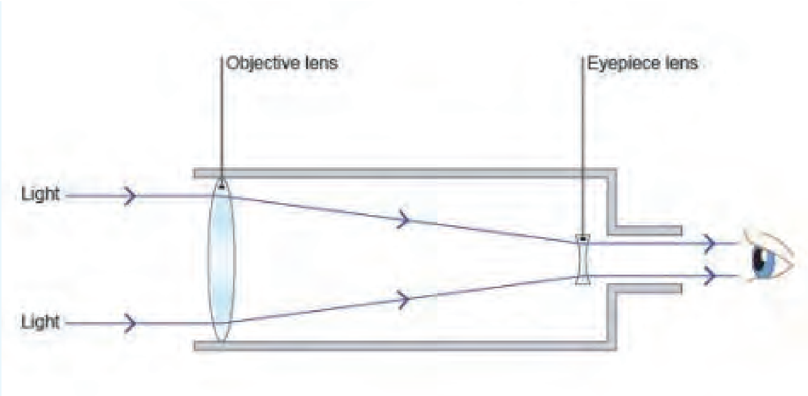
1、Use convex lens and concave lens respectively to observe objects, what do you see?

2、Combine convex and concave lenses together to observe objects in the distance, what do you find? How shall the lenses be combined to best zoom in on objects in the distance? Please draw down the respective positions of both lenses related to the eyes and objects.

For students' group

Name: Class: Date:

1. Sketch and label the telescope shown to you.



2. Have the group to consensus sketch your telescope design and label it.

3. What is the light property that a telescope demonstrates?

✳Reading materials for teachers

In 1608, a Dutch glasses merchant Lippershey happened to find that a combo of two lenses had a clearer view of far objects. He was inspired to make the first telescope ever in the world.

In 1609, Galileo made a big telescope with the diameter of 4.2cm and the length of 1.2m. He used the convex lens as object lens and concave lens as eye lens. Such an optical system was thereafter called Galileo–type telescope. Since then astronomy has entered the telescope period.

Galileo–type telescope

Astronomical telescope is the important tool to observe celestial bodies. It is not exaggerated to say, without the birth and development of telescope, there won’t be modern astronomy.

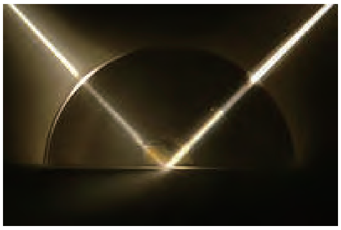
Since then, telescope has kept developing to have farther and clearer view and be applied for professional use. In 1611, German astronomer Kepler used two biconvex lens respectively for object lens and eye lens, which significantly improve magnification performance. This optical system was thereafter called Kepler–type telescope. Nowadays the refractive telescopes commonly used are still either of the two systems. The astronomical telescope is Kepler–type system.

From the birth of the first optical telescope to Hubbe Space Telescope and Chinese FAST (Five–hundred–meter Aperture Spherical radio Telescope), the biggest spherical radio telescopes in the world, telescope has improved performances in full swing, which has pushed the astronomy to develop greatly and impelled people to explore the universe further.

FAST(Five-hundred-meter Aperture Spherical Telescope)
in Guizhou China

✳**Glossary**

Reflection: It is the change in direction of a wavefront at an interface between two different media so that the wave front returns into the medium from which it originated. Common examples include the reflection of light, sound and water waves.

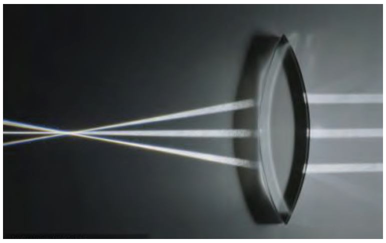


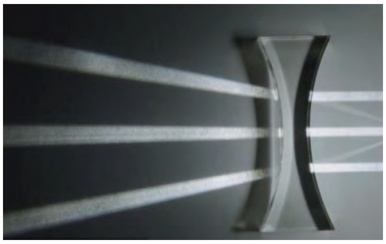
Prism: a solid geometric figure whose two end faces are similar, equal, and parallel rectilinear figures, and whose sides are parallelograms.

Lenses: A lens is a transmissive optical device that focuses or disperses a light beam by means of refraction. A simple lens consists of a single piece of transparent material, while a compound lens consists of several simple lenses (elements), usually arranged along a common axis. Lenses are made from materials such as glass or plastic, and are ground and polished or molded to a desired shape.

Convex lens and concave lens: Most lenses are spherical lenses.

Their two surfaces are parts of the surfaces of spheres. Each surface can be convex (bulging outwards from the lens), concave (depressed into the lens), or planar (flat).Lenses are classified by the curvature of the two optical surfaces. A lens is biconvex (or double convex, or just convex) if both surfaces are convex. If both surfaces have the same radius of curvature, the lens is equiconvex. A lens with two concave surfaces is biconcave (or just concave). If one of the surfaces is flat, the lens is plano-convex or plano-concave depending on the curvature of the other surface. A lens with one convex and one concave side is convex-concave or meniscus. It is this type of lens that is most commonly used in corrective lenses.


biconvex lens


biconcave lens

✳Reference

https://www.education.com/activity/article/keyhole-spy-glass/

https://en.wikipedia.org/wiki/Lens_(optics)#Types_of_simple_lenses

Activity2.3 Pinhole Camera

✳Introduction

The Chinese Scholar, Mozi (479–390 BCE), or his followers, recorded that the image would be inverted when light propagated through a pinhole. Later, the Greek, Roman and Arabic scientists conducted many experiments to explore the characteristics of light propagation. Gradually they realized that eye functions like a camera. As the pupil working as a pinhole, the retina on the inside back surface of the eye ball is the film of the camera. When light propagates through the pupil, the outside view takes on an inverted image on the retina. Ibn Haytham from Basra, Iraq around 965 CE was the first to build a darkroom used for developing photographs from the films taken by camera. His camera model was the early ancestor of modern camera.

✳Level

10–11 years old

✳Objectives

Pupils should be able to:

1.Compare the pinhole camera with our eyes

2.Know how the pinhole camera works

✳Focus question(s)

Engineering problems: Design and make a pinhole camera

Some engineering questions for pupils to think about, as following:

1.What is the working principle of a camera?

2.What materials are required to make a camera? What is each material used for?

3.What does each part look like?

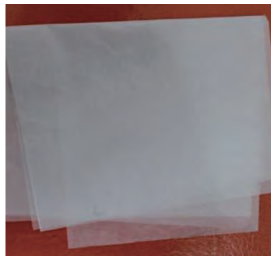
✻**Inquiry**

Materials

A sharp pencil

A pencil knife

Scissors

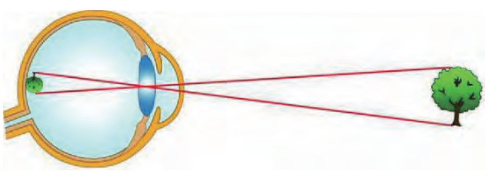
 a shoe box with a lid	 wax paper

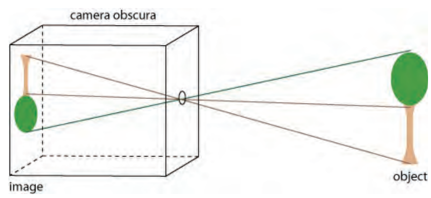
Procedure

1. Observation

i.Find out the information about pinhole camera from Internet.

ii.Observe the structural diagram of eyeball, compare with the schematic diagram of pinhole camera, and find out the same features of both.





2. Design

Please draw your design and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Test

Test your model to find what you need modify.

5. Improvement and communication

i.If you can’t see clearly, how can you improve it?

ii.If the model doesn’t work very well, how can you improve it?

iii.Show your design model to other classmates, discuss what you found in the process of making the model, and how you solve the problems you have met.

Suggested methods

1.Make a circular space (with the diameter of 10cm) on the lid of the shoe box, cover the space with wax paper and leave it stable.

2.Dig a small hole (with the diameter of 1mm–3mm) on the bottom of the shoe box.

3.Put the small hole on the bottom of the box against a bright room, street or other objects.

4.Cover your head and the shoe box with a blanket, leaving the hole on the bottom of the shoe box exposed.

5.You will see a colorful inverted image on the wax paper on the lid of the shoe box.

✳Connectivity

Get the pupils to discuss:

1.What is the imaging principle of modern camera?

2.What features do a modern camera and a pinhole camera have in common?

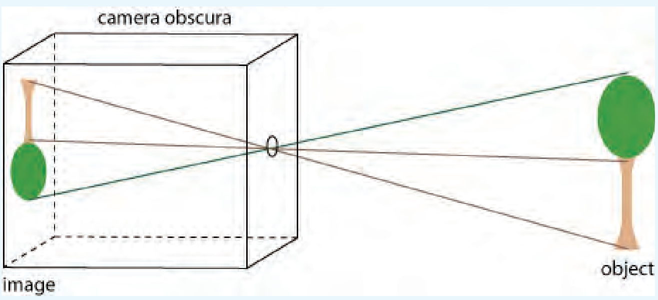
✳Worksheet

Name: Class: Date:

1. Observe the structural diagram of eyeball, compare with the schematic diagram of pinhole camera, and find out the same features of both.

Pinhole camera	Our eyes	Function
screen	retina	Where image is formed
pinhole	cornea	Focusing the light

2.Sketch your pinhole camera and label it



3. Explain what is happening to the light?

✳Reading materials for teachers

How do we see?

Many of us take our vision for granted, but have you ever wondered how this fascinating organ actually works? How do our eyes allow us to see objects as small as a human hair, or as far away as the Andromeda Galaxy. People know that the eye functions like a camera, with an image of the outside world formed on the retina on the inside back surface of the eye ball. But this concept was very hard to understand. The most respected thinkers of the ancient civilization: Plato, Aristotle, Euclid and Galen, had all explained, in their own different ways, for an incorrect theory of vision, until Ibn Haytham from Basra, Iraq around 965 CE came out with his new model of sight that had been proven by the experiments. Ibn Haytham was the first to explain that vision occurs when light bounces on an object and then is directed to one' s eyes. Ibn Haytham' s concept of light was agreed explicitly by a Renaissance scholar, Johannes Kepler, centuries later.

Ibn Haytham was the first to study the phenomenon of the pinhole camera. The concept of a pinhole camera is simple: a box with a tiny hole on one side is able to project an image of whatever is outside onto a side of the box on the inside. Those familiar with the way modern cameras work will notice that that is how cameras work in general, but today with the addition of lenses. Ibn Haytham was able to build these pinhole cameras hundreds of years before the modern development of photography as we know it.

✳Glossary

Rectilinear propagation of light: Light propagates in straight lines in homogeneous media. This rule is the important foundation of geometrical optics, which explicitly explains the image formation. Human' s eyes identify the positions of objects or images through the rectilinear propagation of light.

✳Reference

https://www.education.com/activity/article/Pinhole_Projection/
https://www.education.com/activity/article/pinhole-camera/

UNIT 3 Architecture

In his the Travel, Ibn Battuta always amazed at the magnificent architectures. Indeed, the Egyptian pyramids, the lighthouse in Alexandria, the Grand Cathedral in Constantinople and the Palace in Khanbaliq (now in Beijing), not only shocked the travelers seven hundred years ago, but still are great miracles now.

Building is an old topic. Building first evolved out of the dynamics between needs (shelter, security, worship, etc.) and means (available building materials and attendant skills). As human cultures developed and knowledge began to be formalized through oral traditions and practices, building became a craft, and "architecture" is the name given to the most highly formalized and respected versions of that craft. It is widely assumed that architectural success is the product of a process of trial and error, with progressively less trial and more replication as the results of the process proved increasingly satisfactory. What is termed vernacular architecture continues to be produced in many parts of the world. Indeed, vernacular buildings make up most of the built world that people experience every day. Early human settlements were mostly rural. Due to a surplus in production, the economy began to expand resulting in urbanization thus creating urban areas which grew and evolved very rapidly in some cases.

The countries along the Belt and Road have strong cultural characteristics, especially in architecture. East Asian and Southeast Asian countries are dominated by wooden structures due to its rich and long history. Muslim buildings in Central Asia have strong national and religious features. While the other end of the Silk Road–the Western countries, show different architectural style.

The course teaches pupils the unique architectural elements and building techniques in the countries along the Belt and Road, the science in the architecture, the building materials, so that they can design and build on their own.

Activity3.1 Pillars

✳Introduction

People must have shelter to survive. They will die without protection from the sun, rain, wind and cold. The upper part of a building is a roof, while the lower part is a pillar. The Acropolis of Athens, built in 580 BCE, now contains the remains of several ancient buildings but the marble columns still stand.

The remains of Acropolis, Athens

✳Level

10–11 years old

✳Objectives

Pupils should be able to:

1.Observe the shape of pillars

2.Explore the load capacity the pillar can bear

3.Learn about the supporting structure of buildings

✳Focus question(s)

Scientific experiments: Explore the load–bearing capacity of columns with different cross–sections. The building' s weight is mainly supported by the pillar. What kind of pillar can better support?

Some engineering questions for pupils to think about, as following:

1.How shall the experiment be conducted to ensure scientificity?

2.What variables should be consistent in the experiment?

✳Inquiry

Materials

A4 size paper

double–sided tape

books

Procedure

1. Observation

i.Observe the pillars in the picture below. Are these pillars same in shape?

ii.Draw the cross–sections of these pillars, predict which pillars have the strongest load–bearing capacity.

Square column

Hexagonal Prism

Column

2. Experiment procedure

Make triangular prisms, quadrangular prisms, columns, or other shape of pillars with the same A4 size paper. Note: do not cut the paper or add anything.

3. Test and record

Count the number of books each shape of pillar can bear. Write down your results.

✳Connectivity

Get the pupils to discuss:

1.Do you have pillars in your country or region?

2.What materials are used to build pillars? What do pillars look like?

✳Worksheet

Name: Class: Date:

1. Drawing the pillars to be tested.

2. Record the test result.

Form of pillar	The numbers of books the pillar can bear
Triangular prism	
Quadrangular prism	
Column	

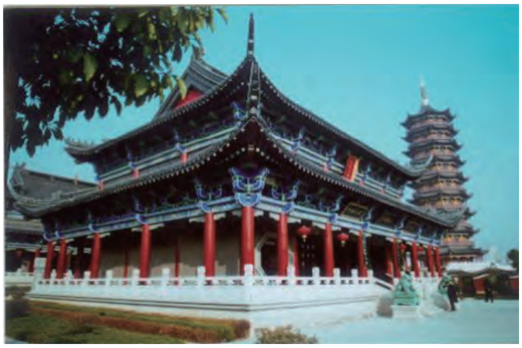
3. What do you find?

✳Reading materials for teachers

A column or pillar in architecture and structural engineering is a structural element that transmits, through compression, the weight of the structure above to other structural elements below. In other words, a column is a compression member. The term column applies especially to a large round support (the shaft of the column) with a capital and a base or pedestal, which is made of stone or appearing to be so.

The western column originating in ancient Greece, is the most important legacy of ancient Greek architecture. Western columns are mainly decorated by prisms, reflecting changes in light and shade. In color, it reflects the texture of the stone itself. The most decorative thing is the capital that can attract people's attention.

Oriental architecture has traditionally been typified by wooden structures. Since ancient times, carved beams and painted pillars were popular in China and the red was the most common color on the column. Western people prefer to decorate the capital, while Chinese people prefer to decorate pedestal. There are a variety of pedestals, such as lotus column base, circular column base, and square column base.



The columns in oriental building

The pedestals of columns

✳Glossary

Column: Column is usually a structure to support the building, such as beams, trusses, floors, etc. According to the shapes of cross-sections, columns can be divided into square columns, hexagonal prisms, cylinders, rectangular columns, etc. In general, the more edges the cross-section has, the stronger load capacity the column bears. Therefore, cylindrical columns are the best choice.

Activity3.2 Roof

✳Introduction

During his travel, Ibn Battuta often slept on or under the roof, as there was not enough room in the caravanserai. So he had many chances to watch different styles of roofs. Of course, the roofs of buildings were very attractive in many cases.

A roof is part of a building envelope. It is the covering on the upper-most part of a building or shelter which provides protection from animals and weather, notably rain or snow, but also heat, wind and sunlight. The shapes of roofs differ greatly from region to region. The basic shapes of roofs are flat, mono-pitched, gabled, hipped, butterfly, arched and domed. Do they have some practical uses?

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.Observe the ancient Chinese architecture

2.Understand the upturned eaves

3.Explore the brachistochrone curve

✳Focus question(s)

Scientific experiment: When rain water hits the roof, will the roof slope impact the speed of water sliding out of the roof?

✳Inquiry

Materials

corrugated board

glass ball
stopwatch
metric scale
protractor

Procedure

1. Observation

i.Observe the following buildings from four different regions and discuss the differences of their roofs.

Turpan buildings, Xinjiang

villages, in north part of China

Mongolian Yurt

Malaysia buildings

ii.Can you find the connection between the roof slope and local precipitations?

2. Experiment procedure

Use corrugated board to make a roof and use glass ball to slide down like rain water. Measure the slope of the corrugated board with the metric scale. Measure the speeds at which the glass ball slides down different slopes.

3. Test and record

Record the slope and the time of the glass ball slides out. On which slope does the glass ball slide most quickly? Write down your results.

✳Connectivity

Get the pupils to discuss:

1.What are the features of the eaves in your country or region?

2.What functions does this kind of roof have? Is there any connection between such design and local climate?

✳Worksheet

Name: Class: Date:

1.Observe the buildings from four different regions and discuss the differences of their roofs. Can you find the connection between the roof slope and local precipitations?

2. Use the corrugated board to make a roof and use a glass ball to slide down the roof as rain water does. Find out whether the sliding speeds are varied by slopes of the roof. Have a group discussion and plan out your experiments.

3. Record experiment results

Slope	Time Duration for Sliding

4. What do you find?

***Reading materials for teachers**

The appearances and building materials of residential architecture vary by regions. Due to different natural environments, residential buildings of different regions have significant local features.

In the regions with small precipitation, the buildings pay special attentions to heat insulation and mostly use flat roof or gentle incline. In the regions with significant precipitation concentration, residential buildings have strong capabilities for ventilation, heat-dispersion, and rain water discharge.

Thus, the residential buildings in south part of China and Southeast Asia widely use an elevated base and the roof structure with deep slope and double layers. For example, Malaysian traditional residence is called floating foot building. Its skeleton is wooden columns whereas the walls, the ceiling, and the floor are all constructed by bamboo planks and bamboo splints. It usually has a pitched roof covered by leaves (or wooden planks nowadays). The pitch is deep and long to ensure the fast discharge of rain water out of the roof and keep out strong sunlight. The floor is several feet above the ground to keep from moisture and invasions of snakes and mice.

There is some gap between the pitched roof and main part of the building to allow air flow.

Malaysian traditional residence

✳**Glossary**

Slope: a number to describe both the direction and the steepness of an incline. It is often used to represent the steepness of hills, roofs, and ramps. The roof slope has effects on water draining and thermal radiation.

Activity3.3 Tower

✳Introduction

In the time of Ibn Battuta, the great lighthouse in Alexandria, which was one of the seven wonders of the world from ancient time, had been broken for many years. No one could image many skyscraping towers are constructed after several hundred years.

Kuwait, a country along the Silk Road, is generally low lying, with the highest point being 306 m (1,004 ft) above sea levels. The flat, sandy Arabian Desert covers most of Kuwait，so people’s daily drinking water is mainly from desalinated water. Water from the desalination facility is pumped up to the tower. The Kuwait Towers were officially inaugurated in March 1979 and are regarded as the landmark and symbol of modern Kuwait.

✳Level

10–11 years old

✳Objectives

Pupils should be able to:

1.Learn about the structure of the Kuwait water tower

2.Build a tower model and explore the stability

✳Focus question(s)

Engineering problems: Build a water tower with 3 sheets of A4 size paper and 1paper cup. The height of the tower is more than 40 cm. The tower needs to have a platform to hold a table tennis ball on the top. The tower should have a certain degree of wind resistance and earthquake resistance.

Some engineering questions for pupils to think about, as following:

1.What are the structures of the water tower you want to build?

2.What is the bottom of the tower?

3.What is the shape of the tower body?

4.How shall each part be connected ?

5.How tall will your tower be?

✳Inquiry

Materials

3 sheets of A4 size paper

1 paper cup

double–sided tape

table tennis ball

scissors

Procedure

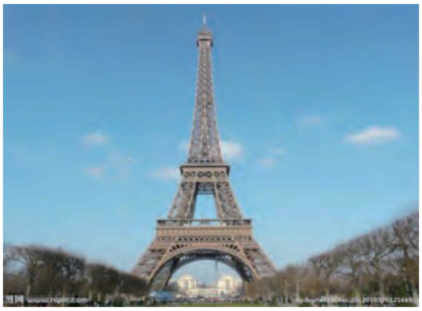
1. Observation

i.The characteristics and structure of the tower

a.Observe the tower in the picture below and think about the basic characteristics of the tower.

Oriental Pearl Tower, Shanghai of China

Kuwait Water Tower



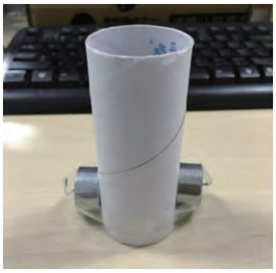

Eiffel Tower, Paris　　Porcelain Tower, Nanjing of China

b.What are the structures of a tower? What is the most essential structure?

ii.The center of gravity of the tower

a. Gently push a paper tube by hand. Is it easy to push it down?

b. Attach two weights at the bottom of the paper tube and try again.



c.Turn the roll upside down so that the weights are above the roll and try again.

According to the experiment results, what is the most stable position?

2. Design

What kind of water tower do you want to make? Draw your designs.

3. Make

Following your design, build the water tower with your partners.

4. Test

i.Measure the height of the tower, and ensure its structural integrity, and whether the cost is within 20 RMB.

ii.Place the water tower on a table and test whether it can stand stably without any external assistance.

iii.Place weights on top of the tower to test if it can hold 1KG weight without shaking or collapsing.

iv.Remove the weight and fan the tower. Test its wind resistance.

v.Spray water against the tower with a spray bottle and test its rain resistance.

vi.Gently shake the table and test its earthquake resistance.

vii.If your tower passes the above tests, you can continue to add weights on it to challenge the maximum weight it can hold.

5.Improvement and communication

i.If your tower’s height does not meet the requirement, or the structure of the tower is incomplete, please redesign the size and structure.

ii.If your tower does not have enough load-bearing capacity, check if the tower is not strong enough, or the area of the platform is too small. If so, please redesign and select materials accordingly.

iii.If your tower is shaken or collapsed by the wind, check if the shape of the tower is unstable. Please adjust the main structure of the tower.

iv.If your tower is likely to collapse when it is shaken, check if the base of the tower is too small, or the center of gravity is not appropriate, and redesign.

v.If your tower meets the basic requirements, improve the appearance to look better.

vi.Show your model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

✳Connectivity

Get the pupils to discuss:

1.What are the featured towers in your country or region?

2.What materials are used to build these towers? What are they different from other towers?

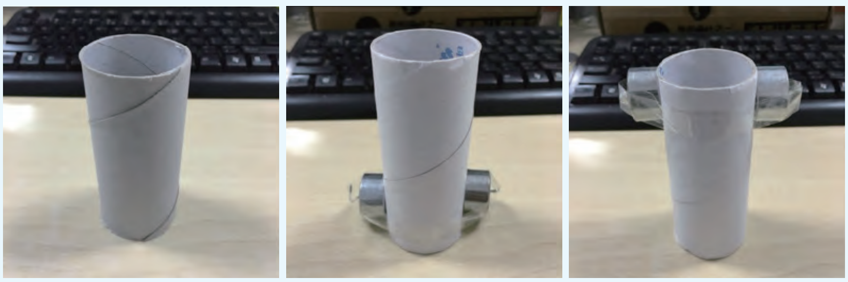
✳Worksheet

For student

Name: Class: Date:

1、What are the structures of a tower?

2、According to the experiment results, what is the most stable position?



3、What can the findings from the experiment help us to build a stable high tower?

For students' group

Name: Class: Date:

Engineering problems: Build a water tower with 3 sheets of A4 size paper and 1paper cup. The height of the tower is more than 40 cm.

Draw your design

Make your model and test it. Record your testing result, and modify if necessary.

The photo of the model

What do you find?

✳Reading Materials for Teachers

The tower-structure building traced back to Ancient India when it was called Stupa referring to towery buildings in Buddhist architecture. Along with propagation of Buddhism in oriental regions, Stupa style architecture was very popular and tower became the featured traditional architecture in oriental areas.

With the development of technologies, towers have played roles in many ways as follows:

Military defensive

The towers offered a better view of the surrounding areas and was used to survey the circumstances in real time. Towers were constructed on defensive walls, or rolled near a target (i.e. siege tower). Today, such towers are still used at prisons, military camps, and defensive perimeters.

Potential energy

By using gravity to move objects or substances downward, a tower can be used to store items or liquids like a storage silo or a water tower, or aim an object into the earth such as a drilling tower. Ski-jump ramps use the same idea, and in the absence of a natural mountain slope or hill, can be human-made.

Communication enhancement

In history, simple towers like lighthouses, bell towers, clock towers, signal towers and minarets were used to communicate information over greater distances. In more recent years, radio masts and cell phone towers facilitate communication by expanding the range of the transmitter. The CN Tower in Toronto, Ontario, Canada was built as a communications tower, with the capability to act as both a transmitter and repeater. Its design also incorporated features to make it a tourist attraction, including the world' s highest observation deck at 147 stories.

Transportation support

Towers can also be used to support bridges, and can reach heights that rival some of the tallest buildings above-water. Their use is most prevalent in suspension bridges and cable-stayed bridges. The use of the pylon, a simple tower structure, has also helped to build railroad bridges, mass–transit systems, and harbors. Control towers are used to give visibility to help direct aviation traffic.

✳Glossary

Tower: A tower is a tall structure, taller than it is wide, often by a significant margin. Towers are distinguished from masts by their lack of guy–wires and are therefore, along with tall buildings, self–supporting structures.

Factors that affect building stability: There are many factors that can affect building stability, such as the center of gravity, the shape of columns we have explored before, and stable bases, symmetrical structures, etc. Now buildings have solid foundation, so they can build even higher. Most buildings are symmetrical. Pillars and shape of tower top you would build must be symmetrical so that the weight can be evenly on each pillar.

✳Reference

https://www.education.com/activity/article/building-towers/

Activity3.4 Dome

✻Introduction

China's historical records Weishu, Suishu–Notes on the Western Regions have described the charms of the three ancient cities of Shiva, Bukhara and Samarkand on the Silk Road. The medieval Islamic architecture in Uzbekistan is brilliant, especially the blue dome.

Ibn Battuta met many domes along his trip. As the domes represented the existence of Mosques or palaces, it also served as a kind of spiritual hometown for the travelers.

The blue dome in Islam

✻Level

11–12 years old

✻Objectives

Pupils should be able to:

1.Explore how the material, load, and shape affect the stability

2.Design and build a dome model independently

✻Focus question(s)

Engineering problems: Build a big dome model with cardboards, in which 1–2 people can stay.

Some engineering questions for pupils to think about, as following:

1.If a combo of two shapes can make a dome, what are they?

2.Guess what is a stapler used for when you build the dome model?

✳Inquiry

Materials

a sharp knife

meter ruler

cotton thread

pencil

glue

scissors

an adult to help you

 large sheets of strong cardboard	 stapler

Procedure

1. Observation

i.Do you think egg shells are strong or fragile? When is it easy to break? When is it not?

ii.Wash 4 eggs, break the eggs gently into two halves for each. From those, select 4 half shells. Use scissors to trim each half shell gently to make it smoothly flat.

iii.Put the four eggshells upside down, leaving the flat plane on the table. Place books on the tip of shells. Observe how many books the eggshells can hold.

2. Design

Please draw your design and calculate the dimensions.

3. Make

Select materials for your design and make. When you make the model, please note any changes to the original design on your diagram. If you have any difficulty, ask others for help.

4. Test

Test your model to find what you need to modify.

5. Improvement and communication

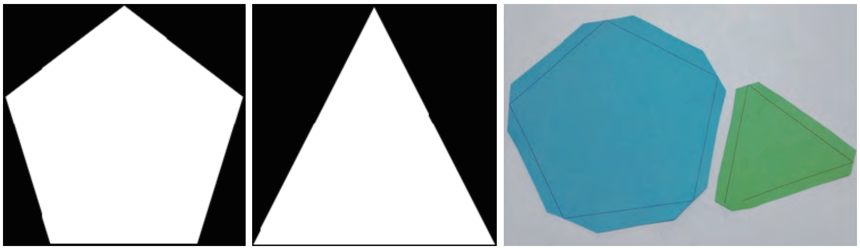
i.Does you model look like a dome?

ii.Is your model big enough to contain one person?

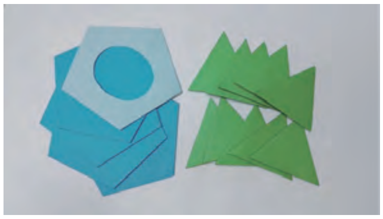
iii.Show your model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

Suggested methods

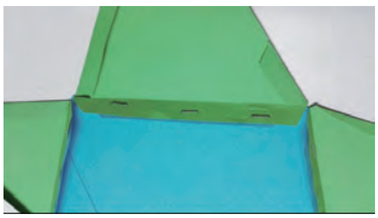
1.With an adult, measure and cut out the shapes below. The sides of each shape should measure 2 feet (about 61cm). You will need ten triangles with flaps on each side, and six pentagons. Put one pentagon aside to be the roof.



2.Cut a large hole in one of the remaining pentagons to make a door.



3.Join a triangle to one side of each of the five remaining pentagons. Fasten the pieces together with screws and wing nuts. Use the awl to make holes for the screws.



4.One by one, stand the shapes up and join the free edge of each tri–angle to one of the pentagons. Continue until five pentagons are joined in a circle.

5.Join the remaining triangles between the upper side edges of the pentagons.

6.Finally, fasten the last pentagon in place to finish your igloo.

✳Connectivity

Get the pupils to discuss:

1.Is there a dome building in your country or region?

2.What does the dome look like? What materials are used to build it?

✳Worksheet

Name: Class: Date:

1. Record what you find in the eggshell experiment.

2. Take photos with your model of dome.

3. What do you find about a dome?

※Reading Materials for Teachers

The dome is like an upside-down bowl. Unlike voussoir arches, which require support for each element until the keystone is in place, domes are stable during construction as each level is made a complete and self-supporting ring. The upper portion of a masonry dome is always in compression and is supported laterally, so it does not collapse except as a whole unit and a range of deviations from the ideal in this shallow upper cap are equally stable. Because voussoir domes have lateral support, they can be made much thinner than corresponding arches of the same span. For example, a hemispherical dome can be 2.5times thinner than a semicircular arch, and a dome with the profile of an equilateral arch can be thinner still.

The space inside the dome looks lofty, rounded, spacious, and palatial. It makes people feel solemn and peaceful, in tune with the religious atmosphere. Therefore, the domes not only have practical uses but also have art value and representation in religion. A well-known Islamic Mosque, the Dome of the Rock, is a holy site of Islam and one of the most famous landmarks in Jerusalem. The Dome of the Rock is one of the oldest existing Mosques in the world. The dome is 54 meters high with the diameter of 24 meters. Since constructed in 7th century CE, the dome has been renovated for several times in the past thousand years. Its dome has changed from original wooden structure into gorgeous golden appearance today, representing the devotion and vigor of the Muslims.

The Dome of the Rock, JerusalemThe Dome of the Rock, Jerusalem

✳Glossary

Dome: A dome (from Latin: domus) is an architectural element that resembles the hollow upper half of a sphere. The precise definition has been a matter of controversy. There are also a wide variety of forms and specialized terms to describe them. A dome can rest upon a rotunda or drum, and can be supported by columns or piers that transition to the dome through squinches or pendentives. A lantern may cover an oculus and may itself have another dome.

✳Reference

http://www.pbs.org/wgbh/buildingbig/dome/index.html

Part 2 Maritime Silk Road

Overview

Maritime Silk Road or Maritime Silk Route refers to the maritime section of historic Silk Road that connects China to Southeast Asia, Indonesian archipelago, Indian subcontinent, Arabian Peninsula, Somalia, Egypt and finally Europe, that flourished between 2nd-century BCE and 15th-century CE.

The early Middle Ages saw an expansion of this network, as sailors from the Arabian Peninsula forged new trading routes across the Arabian Sea and into the Indian Ocean. Indeed, maritime trading links were established between Arabia and China from as early as the 8th century AD. Technological advances in the science of navigation, in astronomy, and also in the techniques of ship building combined to make long-distance sea travel increasingly practical. Lively coastal cities grew up around the most frequently visited ports along these routes, such as Zanzibar, Alexandria, Muscat, and Goa, and these cities became wealthy centres for the exchange of goods, ideas, languages and beliefs, with large markets and continually changing populations of merchants and sailors.

The trade route encompassed several seas and ocean; including South China Sea, Strait of Malacca, Indian Ocean, Gulf of Bengal, Arabian Sea, Persian Gulf and the Red Sea. The maritime route overlaps with historic Southeast Asian maritime trade, Spice trade, Indian Ocean trade and after 8th century—the Arabian naval trade network.

Travellers along the Silk Roads were attracted not only by trade but also by the intellectual and cultural exchange that was taking place in cities along the Silk Roads, many of which developed into hubs of culture and learning. Science, arts and literature, as well as crafts and technologies were thus shared and disseminated into societies along the lengths of these routes, and in this way, languages, religions and cultures developed and influenced each other.

Although the silk trade was one of the earliest catalysts for the trade routes across Central Asia, it was only one of a wide range of products that was traded between east and west, and which included textiles, spices, grain, vegetables and fruit, animal hides, tools, wood work, metal work, reli–gious objects, art work, precious stones and much more.

Admiral Zheng He and Maritime Silk Road

A long time ago, one of the greatest Admiral in the ancient world was born in Kunyangzhou, Yunnan Province, China. Born in 1371, Zheng He was destined to be the finest senior commander of the Ming Dynasty.

Zheng He was a Chinese Muslim. He came from a great line of ancestry from Bukhara (now Uzbekistan). His great–great–great grandfather, Sai–yid Ajall Shams al–Din was a politician and the personal guard of Genghis Khan. Inspired by his father and grandfather, his greatest wish was to make his pilgrimage to the holy city of Mecca. Zheng He also had an added ad–

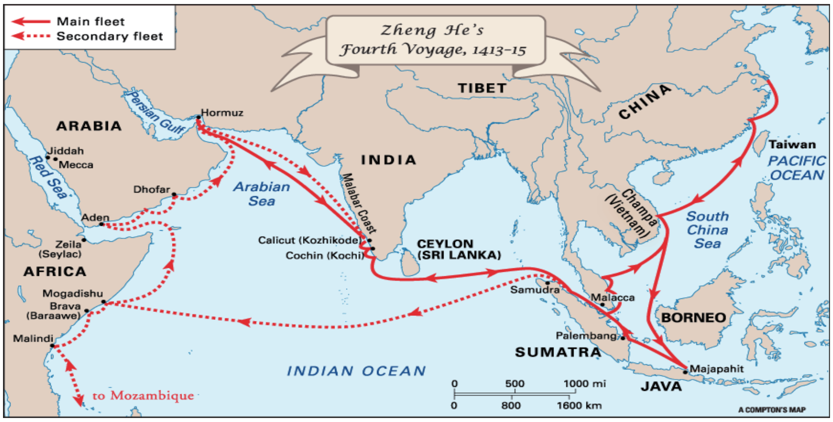
vantage, due to his Muslim ancestors, his family could speak Arabic. This became valuable during his voyages as many of the regions he explored had Muslim rulers. With his ability to communicate with them, he was always welcomed by them.

Zheng He loved going on adventures to foreign lands. He dreamed of becoming a navigator for the Chinese Emperor. To realize his dream, he worked hard to develop his knowledge, skills and experience to achieve his dream. With his strong will and dedication, Zheng He became a well-known strategist who specialized in foreign manners and customs. He was also respected for his knowledge of sailing and the latest technologies of navigation.

His dream finally came true when the Ming Dynasty wanted to expand China's economies and political relations. The then ruler, Emperor Cheng-Zu, chose Zheng He as his Admiral.

Zheng He first set sail in 1405. He began his voyages from Liujia Harbor. He visited Vietnam and later Sulu in the Philippines. He sailed down in Cambodia and visited the Angkor temple. He made another stop in Siam (now Thailand). Later, he continued to Brunei and Java and then sailed up to Palembang. One of his significant voyages was when he sailed to Malacca. He built a good relationship with Malacca's ruler, Parameswara by helping him to build his kingdom.

Trade winds across the Indian Ocean brought ships carrying cardamom, cinnamon, ginger, turmeric, and especially pepper from Calicut, gemstone from Ceylon, as well as woolen carpet. More precious stones from Hormuz (Persian Gulf) and Aden (Red Sea) and agricultural products from the north and east Africa also made their way to China.



Zheng He then sailed to NaKu Er in northern Sumatra. The people here produced ambergris, which was valuable. The ambergris was very popular to revitalize energy, improve blood circulation and remove phlegm. Phlegm is the thick viscous substance secreted by the mucous membranes of the respiratory passages during a cold. Zheng He did not stay there for long due to the unstable political situation.

In his next destination, Zheng He stopped at Bangla, now known as Bangladesh. Bangla had links with China as early as in Han dynasty. The king had great respect for China and a very warm welcome was extended to him and his troop during his visit. The king also made several royal visits

and gave the emperor a Qilin.

Qilin is a giraffe and is a common animal found in Africa too. But in China, it has been mystified and regarded as an auspicious animal. Emperor Yongle commisioned Shen Du to make this painting of the tribute giraffe, presented by Bengal.

After Bangla, he sailed and stopped at Ceylon, now in Sri Lanka. Ceylon was where Buddha preached and attained nirvana. It was one of the places with flourishing Buddhist culture. Zheng He presented many gifts to local Buddhist temples and he erected a tri-lingual stone inscription in Chinese, Tamil and Persian to remember the event and to express his respect for all kinds of religion.

From Bangla, he sailed to Liu Shan. Today, Liu Shan is the Republic of the Maldives which is also known as Maldive Islands. It had friendly relations with China. Zheng He's main and sub-fleets would pass through the Maldives on their way to visit countries in East Africa.

Next was Cochin which was very popular in the history of the Zheng He's voyage. Cochin had frequent cultural and trade exchanges with China since the late Tang dynasty. Even today the local fishermen still use the Chinese-style fishing net to catch fish.

Zheng He's fleet sailed and stopped at Hormuz. Hormuz in present Iran was a major country in the western ocean. People believed in Islam and its culture, science and technology were more advanced than its neighbouring countries. It had also been a major waterway along the east-west route and a key port of call for foreign trade with Hormuz. After several years, Zheng He travelled to Zuo Far Er. Now, it is known as Dhufar in Oman, The King of Dhufar had ordered all his people to take out their goods to trade with the Chinese fleet.

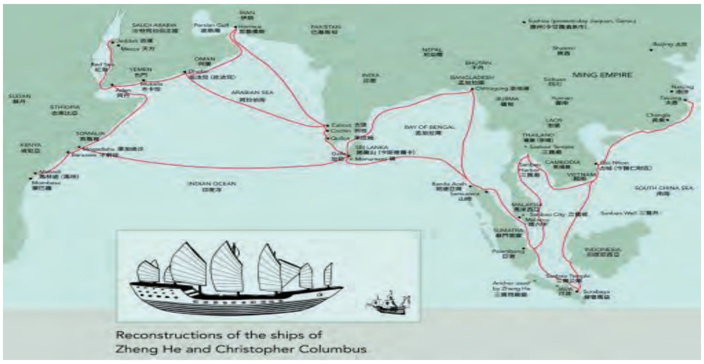
Stellar Diagram with instructions for navigation from Hormuz to Calicut

From Oman, Zheng He visited other countries like Calicut, Aden, Makkah, Mogadishu and a few in East Africa like Brava and Giumbo (now is Braawe and Chisimayu in Somalia), and Mombasa in Kenya. It is believed at that time, Zheng He started to use Stellar Diagram as his reference and sailing guide. Zheng He also sent his interpreters like Hong Bao, Ma Huan and a few others to make a separate trip to Makkah. A painting of Ka' ba, which they drew, was brought back so that the Chinese Muslims living thousands of miles away could see the scene of the pilgrimage around the Ka' ba and in the grand mosque in Makkah.

While he and his men were in East Africa, he gave cotton seeds to the people in Somalia and Kenya and also taught them cotton planting. The Chinese also showed them how to sew and use wooden poles to construct a prototype of a weaving machine so that they could produce cotton cloth.

While Zheng He was in Kenya, he also visited the kingdom of Malin, now known as Malindi located in the east of Africa. Chinese porcelain and silks exported there were very popular. The king had sent envoys to visit China on board Zheng He' s ships. The king also presented a Qilin to the Ming emperor as a gift.

In the 5th year during the reign of Emperor Xuande (1430), as envoys of foreign countries hardly came to China, the Emperor ordered Zheng He to make an expedition to the western ocean like what he did during the reign of Emperor Yongle. This was Zheng He's last voyage. He erected inscrip-tions in Taicang and Changle respectively documenting the journeys of his seven expeditions. He also explored new route as well.



Zheng He's explorations and expedition

Table: The Journey of Zheng He's Seven Voyages

Table: The Journey of Zheng He's Seven Voyages

Order	Time	Regions along the way
1st voyage	1405–1407	Champa, Java, Palembang, Malacca, Aru, Samudera, Lambri, Ceylon, Qulion (Kollam), Kollam,Cochin, Calicut
2nd voyage	1407–1409	Champa, Java Siam Cochin, Ceylon, Calicut
3rd voyage	1409–1411	Champa, Java, Malacca, Samudera, Ceylon, Quilon, Cochin, Calicut, Siam, Lambri, Kayal, Puttanpur
4th voyage	1413–1415	Champa, Kelantan, Pahang, Java, Palembang, Malacca, Samudera Lambri, Ceylon, Cochin, Calicut, Kayal, Hormuz, Maldives, Mogadishu, Baraawe, Malindi, Aden, Muscat, Dho-far
5th voyage	1417–1419	Ryukyu Champa, Pahang, Java, Malacca, Samudera, Lambri, Bengal, Ceylon, Sharwayn, Cochin, Calicut, Hormuz, Maldives, Aden, Mogadishu, Baraawe, the Lamu Islands, and Malindi.
6th voyage	1421–1422	Champa, Bengal, Ceylon, Calicut, Cochin, Maldives, Hormuz, Djofar, Aden, Mogadishu, Baraawe
7th voyage	1430–1433	Champa, Java, Palembang, Malacca Semudera, Andaman and Nicobar Islands Bengal Ceylon Calicut, Hormuz, Aden Ganbali (possibly Coimbatore), Bengal, Laccadive and Maldive Islands, Djofar, Lasa, Aden, Mecca, Mogadishu, Baraawe

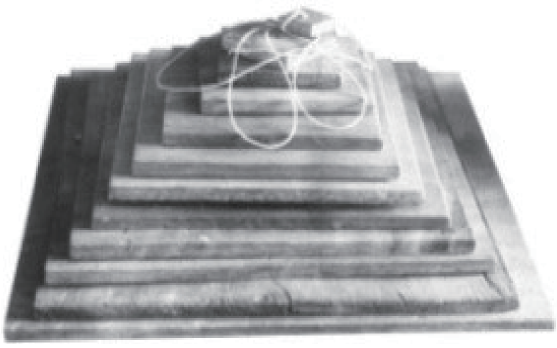
At the beginning of the Ming Dynasty, the naval technology reached its glorious peak, which could not be matched by any in the world. This achieve-ment was attributed to the large shipyards, skilled shipyard workers and finely tuned naval technology from the previous dynasty. Emperor Yongle gave orders to build even larger ships that were necessary for the voyages. This was to fulfill his dream to give a huge impression of the Ming dynasty power upon the world and to show off china’s resources and importance.

ZhengHe’s fleet was equipped with state-of-the-art navigation equipment and devices available at that time. The fleet employed the following three methods to determine its position: water depth positioning, landscape marker positioning and astronomical positioning.

UNIT 1 Stars and Navigation Tools

The compass, also known as Luo-pan was a Chinese invention to tell the ship's position in relation to the magnetic north. The application of the compass with directional points and magnetic needle by Chinese navigators was several hundred years earlier than in the west.

During their voyages beginning ninth century, the Chinese seafarers used their magnetic compasses aboard ships to navigate their sailing. When the skies are clear, they are also able to navigate by the stars using printed manuals with star charts and compass bearings that had been available since the eleventh and thirteenth century respectively. The use of stars in navigation was an important part in the training to be a sailor



The great Zheng He left many important treasures in the form of navigation maps. His Star Navigation Maps (Mao Kun Map) was used by sailors to calculate the geographical coordinates and position of the ship. This technique would guide the ship to its destination and ensured the safety of the fleet in voyages. Nautical Stars drawing from the navigation map of Zheng He has been remarked as the oldest scientific navigational map by a British Scientist, Joseph Needham. The map contains more than 540 places of China and foreign countries as well as a detailed record of each directional position (longitude and latitude), sailing speed, route, depth and height.

Activity1.1 Looking for Polaris

✳Introduction

A long time ago, people used stars as their guide in to travel. People who travelled depended on the North Star to direct their way. The North Star is also called Polaris. The North Star is the last star at the end of the handle in the constellation named Little Bear. Constellation is a group of stars in the sky. They look like patterns when seen from the Earth. Each group has special name. Why do travellers depend on Polaris to guide them? When the earth rotates, the stars appear to move across the sky. Polaris is located above the Earth’ s North Pole, so it remains in the same spot through the night. We will learn how to identify the Polaris in the night sky.

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.Identify and name the constellations

2.Identify Polaris

3.State how Polaris helped the travellers to show directions in the old days

4.Appreciate the contribution of astronomers in naming the stars and constellations

✳Focus Question(s)

1.Why do people use stars to guide in their travels?

2.Which stars did people use to guide them?

✳Inquiry

Materials

Constellation work sheets filled with star points of Big Bear and Little Bear constellations.

Sky map

Procedure

1.Start a group discussion by prompting students to tell what they see in the sky at night. Get them to imagine the sky without stars.

2.Guiding questions

What do you see in the sky at night?

Do you think people on the other side of the globe see the same stars and constellations as we do?

3.Give the pupils observation worksheet. Let pupils study and identify the Little Bear constellation within those points in the worksheet.

4.Connect the points.

5.Once the points of the constellation are joined, find the North Star, Polaris and label the Polaris.

6.Ask them to describe the shape of the constellation.

7.Let the pupils find other constellation(s). They may refer to the sky map.

✳Connectivity

Get the pupils to discuss: Can the Polaris still be used as the guide in showing the direction in modern day travel? Why?

✳Worksheet

Worksheet 1

Name: Class: Date:

Identify any constellation you have observed before.

Sky map

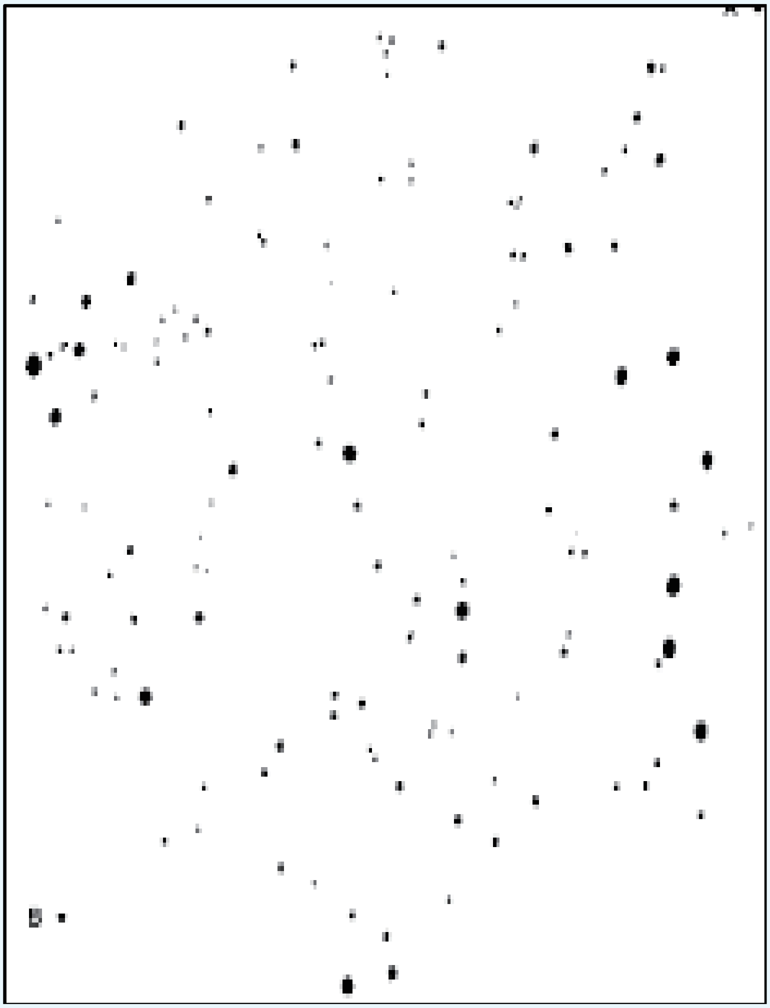
Worksheet 2

Name: Class: Date:

a.Identify the Little Bear constellation.

b.Join the dots and identify Polaris.

c.Find other constellation(s) and joint the dots



Worksheet 3

Name: Class: Date:

1.Draw the Little Bear constellation in the box.

2.Describe the shape of Little Bear.

____

____

3.Why do people use Polaris as their guide during travelling?

____

____

Worksheet 4

Name: Class: Date:

Southern Stars

1.Look for Southern Stars in the sky map. Draw the Southern Star in the box.

2.Describe the shape of Southern Star.

____

____

3.When do people who travel use Southern Star as their guide?

____

____

Activity1.2 Brightness of Stars

✳Introduction

Stars are huge shining spheres of hot gas that exist in all galaxies across the universe. All stars are made of gases and other elements. The stars we see with our naked eye in the night sky all belong to the Milky Way galaxy. Milky Way is a huge system of stars that contains our solar system. It contains hundreds of billions of stars, star clusters, and clouds of gas and dust. The star closest to us is the Sun.

When we look at the night sky, we will see many stars. At first glance, all the stars seem to have the same brightness. Do the stars in the sky have the same brightness? In this activity, we will observe the stars and determine if they have the same brightness.

✳Level

11–12 years' old

✳Objectives

Pupils should be able to:

1.Observe the brightness of stars

2.Make conclusion about brightness of stars

3.Work together during observation of the stars.

✳Focus Question(s)

1.Do all stars have the same brightness?

2.What are the factors that determine the brightness of the stars?

✳Inquiry

Materials

Telescope or

Binoculars

Worksheets

Procedure

1.Let the pupils predict if all stars have the same brightness.

2.Get the pupils to observe stars at night when they are at home. They may use telescope, binoculars or using naked eyes to observe the stars. Ask them to record their observation.

3.Get them to discuss their observation of stars and find information from the internet the factors affect the brightness of the stars.

4.Let them talk about their findings and make their conclusions.

✳Connectivity

In the past, even before Zheng He' s exploration, explorers navigated by referring to natural signs such as the position of a star in the sky. They read map manually. Even then, it could not necessarily determine where the current position is. In the digital era, the presence of GPS that stands for Global Positioning System makes the navigation process much easier, faster and more accurate.

Will modern technology in navigation such as the GPS make the stars less useful to people?

Find out more information about GPS and discuss its contribution to the fusion of civilization.

✳Worksheet

Name: Class: Date:

Brightness of the stars

What I want to find out?	
My previous experience	My observation
My Analysis 1.Do the stars have the same size? 2.Why do some stars look smaller than others? 3.Why some stars look brighter than others? 4.What is the relationship between distance and brightness of the stars? 5.List the factors that you think affect the brightness of the stars. Which star do people choose to guide them in their travel? The bright star or the less bright?	
My conclusion	

Activity1.3 Make Your Own Compass

✳Introduction

The compass, also known as Luo−pan was a Chinese invention to tell the ship’ s position in relation to the magnetic north. The application of the compass with directional points and magnetic needle by Chinese navigators was several hundred years earlier than in the west.. We will learn how a compass works.

✳Level

10−12 years old

✳Objectives

Pupils should be able to:

1.Read compass;

2.Find directions.

3.Find information on the location of the objects/places.

✳Focus Question(s)

How does a compass work?

✳Inquiry

Materials

Magnet

Pin/needles

Basin of water

Cardboard

Modern compass

Procedure

1.Teacher and pupils work together to create a simple compass using magnet and needles.

2.Teacher ask pupils to name the directions of important places around the school.

3.Teacher assign pupils to read the subtitle “Navigation tools: from the short story “The Great Navigator”.

4.Teacher and pupils discuss how Zheng He used navigation tools in his voyages.

5.Teacher and pupils explore the usage of a modern compass.

6.Teacher divide the pupils into 4 groups and assign them to a treasure hunt.

✳Connectivity

Get the pupils to discuss that the compass is a great invention in the past that helped the voyagers. Do ships now still use the compass to help show the way? Why?

✳Worksheet

Name: ································ ······Class: Date:······ ···

TREASURE HUNT

Using the compass, find the objects/places:

	Object/Places	Location on the Compass
1		
2		
3		
4		
5		
6		

Activity1.4 Modern Day Navigation Tools

✳Introduction

Advancement in technology has made navigation in the ocean easier. Today, a ship officer has various marine navigation equipment, which make his work a lot easier and simpler. Moreover, nowadays they are trained to know the functions and operation of all modern navigational equipment that has made the voyage at ocean faster, smoother and safer.

With modern technology, a ship today has several advanced navigation equipment systems, which give accurate data for the voyage.

✳Level

11–12 years old

✳Objectives

Pupils should be able to:

1.List some of the modern tools and equipment for maritime navigation.

2.State the functions of the tools and equipment

3.Communicate and share their findings.

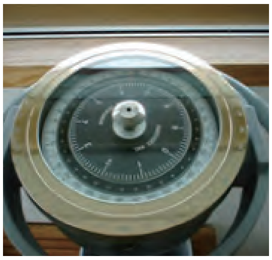
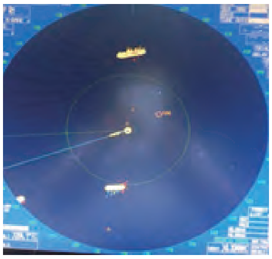
✳Focus Question(s)

1.What are the new tools and equipment for maritime navigation available today?

2.What are their functions?

✳Inquiry

Materials

 Gyro compass	 Auto Pilot
 Radar	 Speed and Distance Log Device

Notes: Teacher may also suggest other tools or equipment

Procedure

1.Teacher list down and introduce photos of few modern maritime navigation tools and equipment used today.

2.Divide the class into small groups. Each group will be assigned to search more photos and information on one navigation tool from the internet.

3.Let pupils discuss their findings and prepare a power point presentation to share their report finding, if computer and the application is available at school or at home. Teacher may help the pupils use the application.

4.Pupils may also prepare a simple poster to report and present their findings if computer is not available.

5.Teacher has to guide pupils with the report. The report may include:

i.Project name

ii.Project objectives

iii.Findings, relevant photos, functions of tool

iv.Conclusion

Teacher may add other aspects for the pupils to report on their project.

✳Connectivity

"Is technology good or bad?"

Get the students to discuss and debate on the statement.

Help pupils to state the good side of technology and how to overcome the bad side of technology and how this is related to harmony in society

Activity1.5 Let's Design a Bicycle Route

✳Introduction

Cycling is a good exercise. However, do you know that the majority of bicycle– related accidents can be linked to car traffic? It is very important to know the safe ways for cyclists in order to reduce accidents and injuries. The GPS system has enabled engineers to gather ground information more efficiently than traditional techniques. In this activity, we will use GPS tech– nology to carry out a survey around our school area to learn how to track our paths leading to the design of safe bicycle routes.

✳Level

11–12 years old

✳Objectives

The pupils should be able to:

1.Identify the safe route for bicycles

2.Use GPS application to design bicycle route around the school

3.Value safety in everyday life and consideration for others.

✳Focus Question(s)

1.Is the bicycle route in your school safe for pupils?

2.How can a survey be carried to track the safe bicycle route using GPS application?

✳Inquiry

Materials

GPS device (Cellular phone equipped with GPS).

BikeGPX (app for putting GPX route files on your phone and following them on your bike. (Teacher may guide the pupils to download it for iP–

hone and Android).

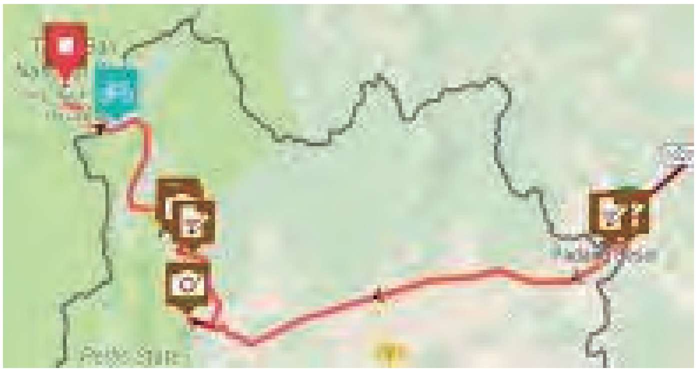
Bicycle

Procedure:

1.Use your GPS with a tracking GPX program to track your route, explore the school area.

2.Assess the terrain and other obstacles. While on your route make notes (mentally or physically) of obstacles along the way. Is there an area where it is more difficult to pass? Are there areas that are safer than others?

3.Take your data and map it using your GPX files (Figure 1).



Example of a GPX file overlaid on a terrain map.

4.Based on your observations from step #2 design a bicycle route.

✳Connectivity

Discuss with pupils the importance to have the safe bicycle route in their neighbourhood.

✳Glossary

Constellation: A group of stars that forms a certain pattern

Direction: path, route

Brightness: the quality of reflecting light

Shining: very bright when reflecting light

Cluster: a group of things

Advancement: being improved

Navigate: plan and direct the way of ship to sail

Voyage: long journey

Accurate: correct in every aspect

Survey: examine and record

Track: follow the trail/path

Unit 2 Winds and Navigation

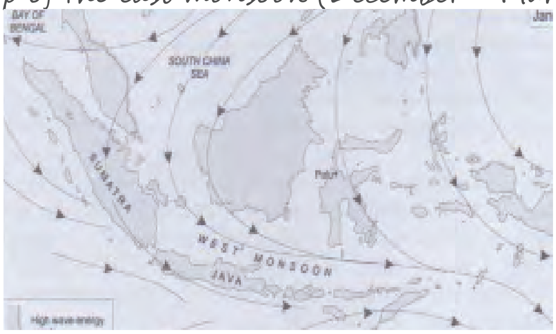
Malaka (now Malacca in Malaysia) is strategically located at the throat of the east-west sea route. From a small fishing village with its strategic location, Malacca developed into one of the busiest port in the 15th century. Hundreds of merchants from Arabia, Persia, India and China as well as Indonesian regions flocked together every year in Melaka.

Due to its strategic location, it was frequently invaded by the neighbouring kingdom. Malaka's ruler, Parameswara asked China for help. The Emperor of China instructed Zheng He to visit and help Parameswara with his kingdom. Zheng He's fleet sailed to Malaka to help Paramewara. Parameswara was very grateful and supported Zheng He by allowing him to set up a stockade (trading station) to store goods. This historic site can still be found today and is known as the Zheng He Cultural Museum.

The Embarkation Point of Admiral Zheng He in 1405 in Malacca

The trade activities at that time heavily depended on sailing ships and seasonal winds. The West Monsoon (May – September) brought traders to the spice islands and the East Monsoon (December – March) took them to Sumatera and to the port on the straits.

Map of the east monsoon (December – March)



Map of the west monsoon (May – September)

In May, the Indian Merchants sailed to Melaka and remained there until January when they returned to India with cargo from China. Merchants from Java and the archipelago came in May–September. Malacca bloomed as a meeting point of trade for these merchants.

Parameswara built a port and warehouses to serve the trading and provided security of warehouse goods and set up facilities for different communities. To ensure its safety, Parameswara formed a relationship with the Ming Dynasty for protection. Admiral Zheng He's maritime expeditions to the west helped to bring about local peace and harmony. Zheng He's fleet passed through Malacca when it sailed to the Indian Ocean.

Activity2.1 The Windsocks

✳Introduction

Windsocks are used to tell wind speed and the direction of the wind speed itself. Windsocks typically are used at airports to indicate the direc–tion and strength of the wind to pilots and at chemical plants where there is risk of gaseous leakage. They are sometimes located alongside highways at windy locations. At many airports, windsocks are lighted at night, either by floodlights on top surrounding it or with one mounted on the pole shining inside it. In this activity we will make a windsock to observe the direction of winds. A windsock is a conical cloth tube which resembles a giant sock. Windsocks can be used as a basic guide to know the wind direction and speed, or as decoration. How can it be used in voyages?

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.State that the winds determine the direction the ships will take;

2.State that the winds influence the trader’s sails and routes in South–east Asia ports.

3.Describe how the early voyagers use their knowledge on the mon–soon to plan their voyages.

4.Appreciate that natural phenomenon have great benefit to humankind

✳Focus question(s)

A sail hangs from the mast of a sailing boat, so the wind can blow the boat sail to push the boat forward. How does sailor know the direction and power of the wind? And how does he use the direction and power of wind to keep the boat in the right position and direction?

Engineering problem: make a device to measure the direction and power of wind. Questions for engineer:

1.How to measure the power of wind?

2.How to measure the direction of wind?

3.How to identify the different power of wind?

4.What kind of materials can be used to make a windsock?

✳Inquiry

Materials

Straw

Pin

Paperboard

Scissor

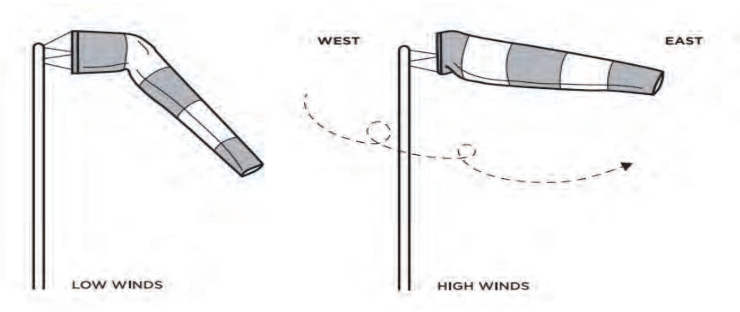
Double–sided adhesive tape

Cloth

Procedure

1.Observe

Observe a windsock at your school during the windy season or on a windy day. If a windsock is not available in your school, provide pupils with a picture of a windsock or try to make them by referring to information in the internet.



2.Design

Discuss the structure of windsocks. Design your windsock.

3.Make

Procedure:

i.Cut the paper square and fold it in half.

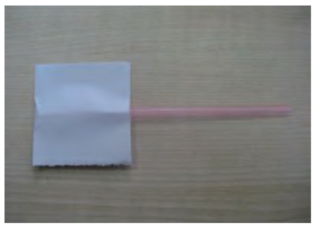
ii.Fasten the piece of paper to the straw with double-sided tape.

iii.Trim the paper with scissors to form the shape of arrows.

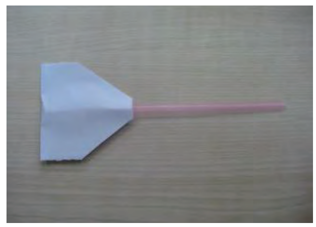
iv.Place the finished part on your finger to find the balance point and Insert the pin into the balance point

v.When using, insert the pin into a vertical straw to determine the direction of the wind.

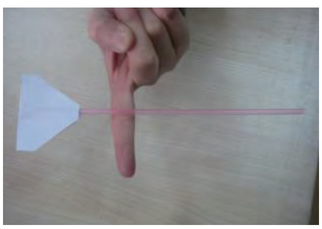
①



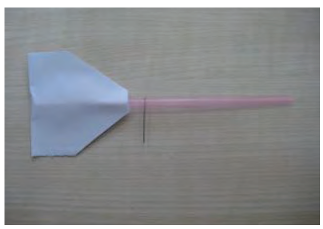
②



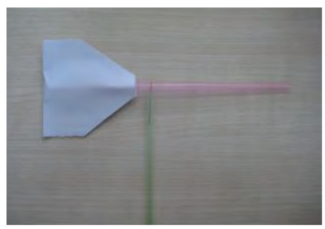
③



④



⑤



⑥

vi.Paste an inverted protractor along the straw and hang a cloth strip in the middle of the protractor

vii.Fix the top of the cloth strip

4.Test

i.Place the windsock outdoor, for example on the playground or the top of teaching building, observe the rotating of the paper arrow and fluttering to the cloth strip ii.Use an electric fan to blow the windsock to test.

iii.Observe and record the apply result of windsock by using different levels of the electric fan.

5.Improvement

i.Is your windsock pointing correctly? If inaccurate, please modify it.

ii.Can the windsock keep firm? If not, reinforce it.

iii.If the cloth strip does not move, why and how can you improve it?

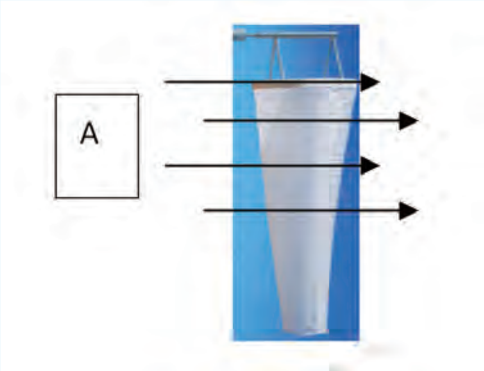
*Connectivity

Get the pupils to discuss about the concept of seasonal winds and how this knowledge helped the earlier voyagers to travel around the world.

*Worksheet

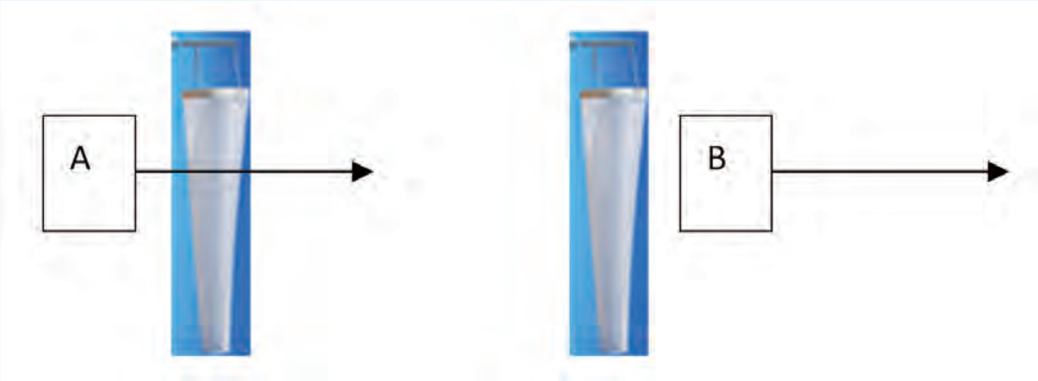
Name : Class: Date:

1.Draw the position of windsock when the wind blows through it from A.



2.If the wind blows from the east, the tip/end of windsock will point to the

3.Strong wind blows to windsock from A. Weak wind blows to windsock from B. Draw the windsock as the wind blows through the windsock. Describe your drawing.



4.If Zheng He wanted to sail to the west, he would be sailing when the monsoon blows from

Activity2.2 The Seasonal Winds and its Importance

✳Introduction

Zheng He's fleets depended on their junks that needed winds to push them forward. The directions of the wind changed with the season known as the monsoon. The West Monsoon (May – September) brought traders to the Spice Islands and the East Monsoon (December – March) took them to Sumatera and to the port on the straits. In May, the Indian Merchants sailed to Melaka and remained there until January when they return to India with cargo from China. We will learn how knowledge of the monsoons helped Zheng He plan his trips.

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.Name the seasonal monsoons.

2.Identify the opposite direction of the monsoons

3.State the importance of the monsoon to the traders.

4.Appreciate that natural phenomenon has benefit to humankind.

✳Focus Question(s)

Relate the location of Malacca and the seasonal winds which provide information to traders the best time to come to Malacca.

✳Inquiry

Materials

Worksheets

Southeast Asia's Map showing the monsoons

Procedure

1.Let the pupils study the map that shows all the countries along the Maritime Silk Road and the seasonal winds.

2.Ask them to identify all the countries and predict if the countries are affected by the seasonal winds.

3.Identify the port in the countries that can be reached by the maritime route

✳Connectivity

Get the pupils to discuss: do big ships stop at Malacca port for trading now? Why?

✳Worksheet

Name: Class: Date:

Tasks:

Using the map, identify the port in the countries that can be reached by the maritime route

	Port	Country
1	e.g.: Malacca	Malaysia
2		
3		
4		
5		
6		
7		

Activity2.3 The Effects of Monsoon

✳Introduction

Regions with a monsoon climate have wet and dry seasons and they are likely to suffer from floods and droughts, both of which are harmful to health. Farmers in the monsoon regions depend on the wet summer months to grow crops. However, the summer monsoon does not always bring the same amount of rainfall. During the wet season farmers could not plant their crops, farm animals do not have food, and some might die.

During the summer monsoons, heavy rainfall can cause flooding. Floodwaters can drown victims and damage buildings, leaving people without homes. Floods can cause damage to water purification systems, and diseases like cholera can spread through unclean drinking water. Mosquitos that carry disease can breed in open containers that are filled with rainwater - from large water barrels and ponds to small coconut shells. This would lead to more mosquitos during the monsoons because there are more places to breed. That would bring about more mosquito bites which can spread diseases. Mosquitos that spread malaria, dengue, and chikungunya are common in the tropics.

✳Level

11–12 years old

✳Objectives

Pupils should be able to:

1.State the effect of monsoons on their country and people.

2.State the safety measures that should be taken during the monsoons

3.Discuss the importance of helping each other during the monsoons

✳Focus Question(s)

1.What are the effects of monsoons to the people?

2.What are the safety precautions that people should take during the monsoon season?

✳**Inquiry**

Materials:

Worksheet (mind map)

Pictures showing situations during monsoons

Procedure

1.Teacher introduce to pupils the situations that shows a monsoon by showing pictures or video on heavy rains or rainy seasons and their effects.

2.Let pupils share their experiences during the monsoon.

3.Get them to discuss:

i.the effects of monsoons on people’s health and agriculture

ii.some safety precautions taken by their families during the monsoon

iii.In what way their families help their neighbours

4.Ask the pupils to do a mind map about monsoons that they have discussed.

✳**Connectivity**

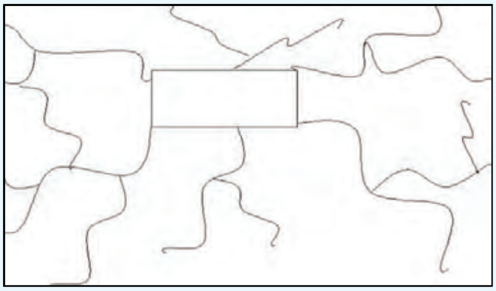
Discuss the importance of the countries in a region in working together and helping each other during the monsoon seasons. How could people from other states or countries help those who are affected by the monsoons?

✳Worksheet 1

Name: Class: Date:

Tasks:

Use the mind map to show what you know about monsoons and their effects.



My Monsoon Mind Map (sample)

Activity2.4 Monsoon for Voyages

✳Introduction

Over 600 years ago, Zheng He, a Ming dynasty navigator, made seven voyages over 28 years and visited more than 30 Asian and African countries and regions. This had never happened before him. During that ancient pe–riod, how did Zheng He select the ship route? What kinds of regional ocean conditions affect the navigation of ships?

✳Level

11–12 years old

✳Objectives

Pupils should be able to:

1.Read a map

2.Explain how such a large ship sail manage to sail away without steam engine or electric engine.

3.Work together to find and arrange information gathered.

✳Focus question(s)

Zheng He's Junk was a very big sailing ship. According to research, the largest vessel of Zheng He's Junk was 148 meters long and 60meters wide. It was the largest ship in the world at that time. How did such a large ship sail away without steam engine or electric engine?

※Inquiry

Materials:

Mao Kun Map

World monsoon map

Reading materials

Procedure:

1.Observe the Mao Kun Map, what can you find?

2.Observe the world monsoon map in summer and winter, what can you find?

3.Read the world map and name the countries and location of Zheng He’s voyages on the map.

4.Read the texts on monsoon, understand what is monsoon, what kind of monsoon will affect voyages?

5.Find more stories to illustrate the role of monsoon for voyages on the sea.

6.Make a presentation or poster to illustrate what have discussed and learned.

※Connectivity

Let the students find information on other navigator(s) besides the Chinese navigators that construct monsoon timetable that other voyagers had used and referred to in their voyages.

※Reading material for teachers

Monsoon and Ibn Majid

Our best information for using the monsoon comes from a master navigator called Ibn Majid. He came from what is now the United Arab Emirates/ Oman and sailed and wrote in the 15th century. As well as describing the Arab methods of navigating using the stars, Ibn Majid reported the routes around the Indian Ocean and listed the times of the year when ships should depart certain ports in order to arrive safely at their destination. The constant nature of the monsoon over recent millennia means that his timetable or departures can also be used to understand earlier eras, e.g. that of the Romans.

From Ibn Majid’s work, we can construct a seasonal timetable whereby ships departed from ports in the Gulf like Siraf and south–western India during the autumn, sailing to East African ports like Zanzibar on the north–easterly monsoon and returning during the spring on the first winds of the south–westerly monsoon. Ships from Red Sea ports like Aylah would sail south in late summer, using the tail–end of the south–westerly monsoon to sail to south–western Indian ports, returning again in December and January when they would have the favourable winds of the north–easterly monsoon. The voyage between the Red Sea and East Africa could be made using a combination of the two monsoons and a stopover at a port such as Aden in modern Yemen.

Voyages even further eastward, to south–east Asia and China, probably via the straits of Malacca, also fitted within this timetable. Ships could leave southern India in late December, arriving in the China Sea in April or May with an arrival in Canton for the summer. The return voyage would depart in the autumn and cross the Bay of Bengal in January. A ship sailing from a Gulf port might take a year and a half to complete the round trip to China and back.

In all the examples above, and for ancient as well as medieval eras, voyages could be made directly, or by stopping to trade at ports along the way. In this way, the two monsoons provided the sailors of the Indian Ocean with a means to sail from place to place with a degree of relative certainty and reliability, arriving in specific ports at specific times, and leaving them during designated periods depending on the next destination. This regular timetable derived entirely from the combination of available sailing technology, in conjunction with the predictable monsoon weather systems. It provided a contrast to the seafaring of more northern seas where the technology was broadly similar, but where the weather was far more unpredictable.

✳Glossary

Seasonal winds: wind that blow in a certain direction during certain months of the year

Navigation: activities or process to identify the one’s position when planning and following a route

Ports: harbour/ place where ships stop

Monsoon: is traditionally defined as a seasonal reversing wind accompanied by corresponding changes in precipitation, but is now used to describe seasonal changes in atmospheric circulation and precipitation associated with the asymmetric heating of land and sea. Usually, the term monsoon is used to refer to the rainy phase of a seasonally changing pattern, although technically there is also a dry phase.

Mao Kun map, usually referred to in modern Chinese sources as Zheng He’s Navigation Map, is a set of navigation charts published in the Ming dynasty military treatise Wubei Zhi.

Wind direction: is the opposite of the direction in which the windsock is pointing

UNIT 3 Sailing Ships

The Chinese dynasty had continuously extended their powerful influ–ence out to the sea for more than 300 years. The Chinese shipbuilders constructed double hulls divided into separate water tight compartments. This provided protection for the ships from sinking if they knock against each other. In addition, these talented shipbuilders also created a method of stor–ing fresh water for passengers and animals as well as tanks to keep freshly caught fishes during the voyages.

The treasure shipyard was in Nanjing, where Zheng He’s huge fleet was built. A Chinese treasure ship was a type of large wooden ship in the fleet of Admiral Zheng, who led seven voyages during the early 15th cen–tury as far as East Africa and Middle East between 1405 and 1433. Zheng He’s treasure ships were big in size with nine masts and four decks, able to carry more than 500 passengers, as well as a large amount of cargo. Some of the ships were said to have been 137 meters (450feet) long and 55 meters (180 feet) wide, which was at least twice as long as the largest European ships of that time.

Zheng He’s ships had more than 200 large and small ships, spreading out over ten miles. The ships were divided into five types. The treasure ship was for passengers and storage of goods. Warships were for defence and grain ships were for storing food like rice and vegetables. The water ship was for storing fresh water, the horse ship was to guide while small boats were for communications. Communications were through flag signals, lanterns, cannon, pigeons and gongs and drums, a combined method of the Chinese and other sailor around the world.

Different types of Zheng He's fleet

The Horse Ship	•to guide the fleet
The Treasure Ship	•To carry passengers. •Storage of valuable goods.
The War Ship	•To protect and defend the fleet.
The Grain Ship	•To store food like rice and vegetables.
The Water Ship	•to store freshwater

The Chinese shipbuilders were very creative in inventing new technologies. At the same time, they also successfully combined borrowed and adapted technologies from seafarers of the South China Seas and the Indian Ocean within their inventions. The shipbuilders constructed ships that had three and four masts and were designed to achieve the best results with the winds. The Chinese added lug and then lateen sails adapted from the Arab seafarers. This allowed the voyages to avoid the banks of rowers and during their sail against the prevailing winds.

The most significant invention of the Chinese shipbuilders was the sternpost rudder fastened to the outside rear of the ship. With the stern–

post rudder, they could raise and lower the sternpost rudder according to the depth of the water. They were also able to navigate closer to shore, in crowded harbors and narrow channels.

Zheng He’s junk was a ship design that was pioneered about 2,200 years ago. A junk is an ancient Chinese sailing ship. These junks are fast, possess good handling, and can be sailed against the wind. There were also the first ship in history to make use of the stern post rudder, an innovation that only reached Europe after centuries of use in China. For centuries, this southern Chinese territory’s unique geography and landscape contributed to many of the elements that made the junk so innovative for its time.

By the time of Zheng He’s voyages between the continents, the junk had grown not just in sophistication but in size as well. The Santa Maria that Columbus used to reach America was 62 feet with 3 masts. The largest ships of the 15th century Chinese fleet were giants and were 400 feet long. Nine masts held the sails used to push these grand vessels.

Despite its utility, the junk remained a mystery outside East Asia and had little impact on Western shipbuilding. The Chinese knew that the junk was an excellent design and guarded its secrets carefully. Emperors passed laws banning the sale of junks to foreign buyers, and for a long time this vessel allowed Chinese merchants to dominate Indian and Pacific Ocean sea lanes.

Activity3.1 How to Make a Ship Float

✳Introduction

Compared with other ships, treasure ships were wide in ratio to their length which helped them achieve stability. The hull was V−shaped, the keel long and the weight heavy. Treasure ships also used floating anchors cast off the sides of the ship in order to increase stability. Watertight compart−ments were also used to add strength to the treasure ships. The ships also had a balanced rudder, which could be raised and lowered, creating addi−tional stability like an extra keel. They were built to withstand rough seas, to be easy to maneuver and to move quickly. The strong build of these junks allowed Chinese explorers to sail far.

✳Level

11−12 years' old

✳Objectives

Pupils should be able to:

1.Identify parts that make up a sail boat

2.Tell what each part is like

3.Tell what each part is made of

4.Identify suitable materials for making a boat

5.install the sails on the hull

✳Focus question(s)

If you want to take a voyage, you need to make a stable sailing ship. What kind of ship can harness the power of wind?

✳Inquiry

Materials:

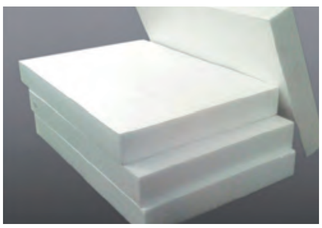
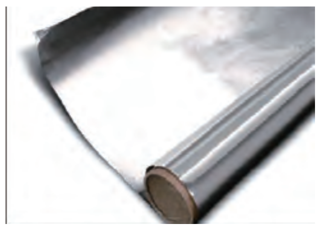
foam board
empty cans
mineral water bottles
ice cream sticks
disposable chopsticks
disposable tray
scissors
knife
super glue
any other material you would like

Procedure

1.Observation

i.A ship is a large watercraft that travels the oceans. What materials are suitable for making boats?

ii.What materials can successfully float on water?

 Form Board	 Building Block	 Aluminum Foil
 Empty beverage bottle	 Pebbles	 Ice cream sticks

iii.Think about what they have in common.

iv.How do the sails propel the boat?

Fan the paper at different angles. Let it go, observe the distance when the paper is blown by the wind. And Consider how to harness the wind to fly the furthest.

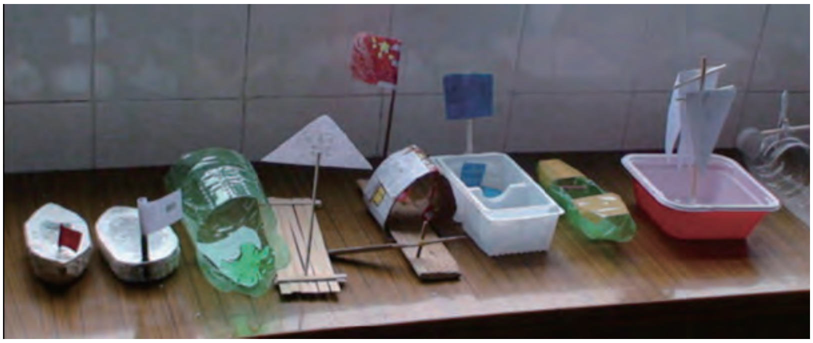
2.Design the kind of sailing ship you want to make. Draw your designs.

3.Make a boat with waste materials such as disposable lunch boxes, milk cartons, disposable trays, etc



4.Add the mast and sail to the boat.

5.Finally, do not forget to decorate your boat.



6.Test

i.Take a basin with water. Put the sailboat into the water and observe whether the boat sinks or not.

ii.If the boat does not sink in 5 minutes, fan the boat and observe the stability.

iii.Try to propel the boat forward by wind.

7.Improvement

i.If your boat sinks, observe whether the boat is leaking or the material is suitable. Think about how to improve it.

ii.If your boat is shaking violently in the wind, the hull is unstable. Think about how to improve it.

iii.If your boat cannot be propelled by wind, check the durability of the sail and change the wind direction. Think about how to improve it.

✳Connectivity

What kinds of materials are now used in building modern day ships? Are they different from those that were used in building ships in the early days? How do modern ships sail?

✳Reading material for teachers

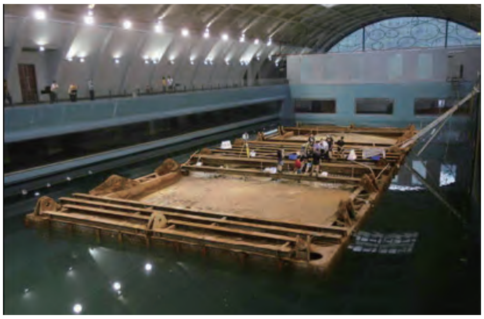
An old Chinese saying goes, "People invented boats by floating leaves and other principles." This reflects the early human understanding of some objects that can float. Perhaps it is because of this natural phenomenon that it caused people to set sail. If a person rides on a log, he can float in the water; if he holds a piece of wood, he can row. If the wood is hollowed out, people can sit comfortably inside. This is the earliest boat - a canoe. Afterwards, people gradually acquired the raw materials, and manufactured simple, stable raft of large-size, such as rafts, bamboo rafts. About 3,000 years ago, the plank boat started to appear in China, which lays the foundation for the development and improvement for ships.

Chinese sailing ships are quite famous in the world. As early as the Qin Dynasty, people could build a large-scale sailing ship that was 30 meters long, 6-8 meters wide, and capable of carrying 60,000 kilograms. By the time of the Han Dynasty, a ship can be made about a hundred feet long. By the time of the Song Dynasty, large ships carrying more than 200,000 kilo-grams were built. China's Ming dynasty assembled one of the largest and most powerful naval fleets in the world for the diplomatic and power projection voyages of Zheng He. It is claimed that the largest of these ships was 137 m (450 ft) by 55 m (180 ft).

Activity3.2 The Water Line

✳Introduction

The main trade goods in the Maritime Silk Road were silk, tea, porcelain, spices, and glass. The Nanhai One, also called South China Sea No. 1, was a Chinese merchant ship which sank off the south China coast during the Southern Song Dynasty between 1127 and 1279. In 2007, China began to raise the ship and its artifacts. When the wreck was first found, about 13,000 pieces of porcelain from the Song Dynasty were recovered. The ship was 30 meters long and carried about 80 tons. It can be seen that in ocean commerce, the carrying capacity is a very important indicator.



✳Level

11–12 years old

✳Objectives

Pupils should be able to:

1.Understand that some objects float and some sink

2.Understand that float materials can be made sink

✳Focus question(s)

Why should the hull of a ship be painted in two different colors? What is the horizontal line drawn on the front part of the ship or prow? What is the relationship between these lines and the carrying capacity of the ship?

✳Inquiry

Materials

measuring cups
water
aluminum foil
plastic trays

Procedure

1.Observation:

i.Take a glass and fill some water to the point where it will overflow. Put a square block into the water and observe what happens. Think about why water overflows.

ii.Make a flat-bottom boat with aluminium foil, which is slightly smaller than the diameter of the glass.

iii.Take the same full glass of water, put the boat on the water, observe the distance from the surface to the bottom of the boat, and mark the surface of water with a pen. Put the square block carefully into the boat, observe the overflowing, and mark the surface of water again.

iv.Think about why we mark two lines on the boat. How do they work?

2.Take a glass and fill some water to the point where it will overflow.

3.Make a flat-bottom boat with aluminium foil, which is slightly smaller than the diameter of the glass.

4.Put the boat on the water and the toy model into the boat carefully (pay attention to keeping the boat balanced and preventing the boat from turning), and mark the surface of water on the hull with a pen.

5.Take out the toy model from the boat, place proper weight.

6.Use an electronic scale to weigh the toy model and compare it with the experiment record to see if it is accurate.

Activity3.3 Water Clock

✳Introduction

In navigation, we must measure latitude and longitude to determine the exact position and heading of the ship. Latitude is calculated by observing with a quadrant or astrolabe the height of the sun or of charted stars above the horizon, but measuring longitudes is more difficult. Therefore, explorers estimate their relative position only by the speed of ship. There is no other physical principle determining longitude directly but with time. Since there are 24 hours in a day and 360 degrees in a circle, the sun moves across the sky at a rate of 15 degrees per hour (360° ÷24 hours = 15° per hour). Thus, longitude at a point may be determined by calculating the time difference between that at its location and Coordinated Universal Time (UTC). We need timekeeping devices for ocean navigation.

✳Level

7–8 Years old

✳Objectives

Pupils should be able to:

1.Understand the tools that can be used to tell the time

2.Design a simple device to measure time

✳Focus question(s)

The measurement of time on the sea is very important. Because of the accurate timing, you can know the speed and distance of sailing. So what kind of device can measure the time? Design and make a water clock that can work 15 minutes. Questions for the engineer:

1.What kind of water clock are you going to make?

2.How do you plan to control the factors affecting the water clock?

3.How to divide the scale scientifically?

✻Inquiry

Materials

4 transparent plastic cups

awl

tape

stopwatch

rigid backboard (plank or plastic plate longer than 45 cm)

white paper

cotton thread

water

Procedure

1.Observation:

i.Find a narrow−mouthed bottle. Fill it with water and then let it stand up−side down to let the water flow out. At the same time, use a stopwatch to record the time when the water flows out fully.

ii.Repeat the activity several time to compare the time taken for the wa−ter to flow out. What did you find?

2.Design

What kind of water clock do you want to make? Draw your designs.

3. Make

iii.Cut 3 cotton threads, about 10 centimetres long

iv.Use the awl to poke one small hole at the bottom of each plastic cups and pass the cotton thread through the hole.

v.Pour some water into the cup to check if the water in the cup can smoothly drop through the cotton thread. If it fails, enlarge the small hole slightly.

vi.Stick three plastic cups on the hard board vertically with the tape and mark them as No. 1, No. 2 and No. 3 from the top down.

vii.Paste a plastic cup under No. 3 cup and name it No. 4. A simple water clock is now ready

4. Test

i.Place 100ml of water into No.1 cup. Note the time, check the water in No.4 cup every 5 minutes, and draw the line on the cup as the scale.

ii.According to the amount of water dropped for the first time, guess how long does it take all the water to drip into No. 4 cup.

iii.Record the time that all the water actually needs to drip into the last cup.

iv.Test: One student time 15 minutes with a water clock. Another student time by a watch to check the accuracy of the water clock.

5. Improvement

i.Is your water clock accurate? Why?

ii.According to the result, mark the time scale on No.4 cup.

✳Connectivity

What are other methods that are used to measure time? Find out if water clocks are still used now and why.

✳Reading material for teachers

A water clock or clepsydra is any timepiece in which time is measured by the regulated flow of liquid into (inflow type) or out from (outflow type) a vessel where the amount is then measured.

Water clocks are one of the oldest time-measuring instruments. The bowl-shaped outflow is the simplest form of a water clock and is known to have existed in Babylon and in Egypt around the 16th century BCE. Other regions of the world, including India and China, also have early evidence of water clocks, but the earliest dates are less certain. Some authors, however, claim that water clocks appeared in China as early as 4000 BCE.

The Chinese water clock used the flow of water to measure time. There are two types of water clocks: inflow and outflow. In an outflow water clock, a container is filled with water, and the water is drained slowly and evenly out of the container. This container has markings that are used to show the passage of time. The water clocks went through several improvements and the water clock created by Su Song in 1088, which took ten years to build, was the most sophisticated. It was powered by an 11 foot water wheel with 36 buckets of water and only turned 100 times a day. Therefore, it was able to keep the time quite accurately. Su Song's clock not only kept time but allowed people to observe constellations that were important to Chinese astrology.

Some water clock designs were developed independently and some knowledge was transferred through the spread of trade. These early water clocks were calibrated with a sundial. The water clock was the most accurate and commonly used time keeping device for a long time, until more accurate pendulum clocks in 17th-century Europe replaced it.

The water clock and the fire bell

Activity3.4 Know Your Junk

✳Introduction

A junk is an ancient Chinese sailing ship. The sails of the junks were arranged in a certain way, so that they could direct wind into each other, al–lowing the junks to sail into the wind and to travel in heavy winds and rough seas. We will identify parts of a junk.

✳Level

4–7 years old

✳Objectives

Pupils should be able to:

1.Identify parts of a junk

2.Label the parts of a junk

3.State the function of each parts of the junk

✳Focus Question(s)

What are parts of a junk?

✳Inquiry

Materials

A model of a junk

Marker pen

Post–it

Procedure

1. Allow pupils to investigate a model of a junk.Teacher may guide with few leading

What is a junk?

Have you seen a ship?

Do ships have many shapes?

2. Get pupils to find the information about the junk and a modern day ship from the internet.

3. Ask pupils to identify parts of a junk and a ship, by labelling the parts.

4. Discuss the functions of each part.

5. Get pupils to present the findings to the class.

✳Connectivity

Get the pupils to discuss about the Chinese junk that has an excellent design and whose secret was carefully guarded for hundreds years from other civilizations. Can you find modern day ships having similar features as the Chinese junk?

✳Worksheet

Name: Class: Date:

1.Draw a junk

2.Label parts of the junk using these words

Hull, sails, rudder, mast, beam

3.Explain what is the function of each part

	Parts of the junk	functions
1		
2		
3		
4		
5		

Activity3.5 Make Your Junk Go Faster

✳Introduction

Zheng He’ s treasure ships were huge in size with nine masts and four decks, can bring more than 500 passengers, as well as a large amount of cargo. Some of the ships were said to have been 137 meters (450 feet) long and 55 meters (180 feet) wide, which was at least twice as long as the largest European ships of that time. Zheng He’ s fleet has many types of designs and sizes for different purposes. We will investigate the different design of junks mast.

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.Make hypothesis

2.Control the variables

3.Stating that the different materials have different characteristics

4.Demonstrate cooperative learning

5.Apply IBSE model

6.Appreciate the contribution of discoveries

✳Focus Question(s)

1.What is the number of mast to make a ship goes faster?

2.What type of materials can make a better mast?

✳Inquiry

Materials

A model of a junk

Card names of parts of a junk
Empty mineral water bottles of the same shape but different size
Tracing paper
Muslin cloth
Bamboo skewers
Hot gun glue
Drinking Straws
String
Table Fan
Stopwatch

Procedure

1. Discuss what you would want to change if you want to make your junk go faster.

2. List all the things that your group think will make the junk go faster.

3. Get the group’s agreement on the factor that you want to change. Sketch your junk and label it.

4. Present your group’s design to the class. Listen to the comments from the class and discuss how to answer the comments.

5. Have another group discussion, consider the suggestions given by the class. Redesign your junk if needed, sketch and label it.

6. Get only the materials needed to build your junk, please consider the others.

7. Divide the task among the group members.

8. When your junk is ready, test it on the setting prepared by the teacher. Use the stopwatch to measure the time taken for your junk to move from one end to another. Record your data

9. Back in your group, replace the part of the junk you want to change that will make your junk goes faster

10.When your junk is ready, repeat the test on the same setting. Mea–sure the time taken for your junk to move from one end to another. Record your data.

11.Each group can repeat 3 times by changing the same part that your group has decided earlier. Record your data each time.

12.Present your findings to the class.

Suggested procedure

1. Show pupils how the test is to be carried out in order to determine the faster junk.

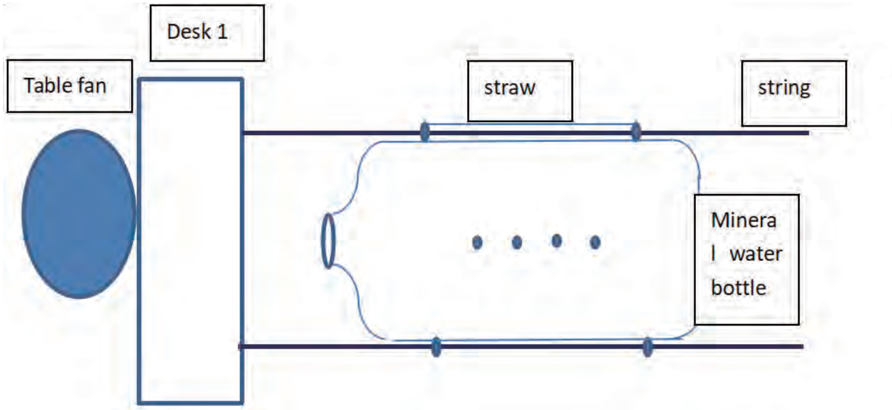
2. Ask pupils what they wish to change in a junk shown to them and why they want to change it

3. Pupils discuss in their groups and present it to the class

4. The other members of the class can ask questions or give sugges–tions. All members of the group help each other in answering the questions or defending their idea.

5. When the group agrees to a design, they have to discuss, redesign (if possible) and decide the materials needed

6. Teachers have to prepare and provide the materials needed.



✳Connectivity

Get the pupils to discuss the characteristics of the Chinese junks that are the same and used in:

1.modern shipbuilding.

2.other civilizations such as Europe (Santa Maria)

✳Worksheet

Name: Class: Date:

1. List all the things that your group think will make the junk go faster.

2. Have the group consensus the factor that you want to change. Sketch your junk and label it.

3. Write down the factor and the hypothesis from each group.

Changes to be made	Reasons (hypothesis)
Example:Add the number of sails	The junk will go faster, to catch the wind more effectively.

Name: Class: Date:

Experiment: Building a Junk

Purpose – what do you want to know	
Write a hypothesis	Materials - what do you use:
Experiment- how are you going to test your hypothesis	
Prediction (time taken for your junk to reach the final end)	Observation (actual time taken for your junk to reach the final end)
Conclusion- what did you find out?	

Name: Class: Date:

Analysis:

1. What do you change in the experiment?

____

2. What do you keep the same in the experiment?

____

3. What do you want to observe in the experiment?

____

4. Why do you have to keep the same certain factors for each experiment?

✳**Glossary**

Mast: a tall upright post, on a ship or boat, carrying a sail or sails.

Hull: the main body of a ship

Sail: a piece of material extended on a mast to catch the wind and propel a boat or ship

Rudder: a primary control surface used to steer a ship

Cargo: the quantity of things that can be carried out in the ships

Buoyancy (upthrust): an upward force exerted by a fluid that opposes the weight of an immersed object. If the force of the boat's weight is equal to the upthrust of the water, the boat floats. If the boat weighs more than the upthrust of the water, it sinks.

Methods for time measurement: To measure time through uniform motion is accurate without advanced measurement instruments. Therefore, time-keeping in ancient time is mainly by the dripping water, the burning of candles or incense sticks, or the flow of sand. Since the time interval between every two drops of water from the dripping timekeeper is fixed, the ancients used this for timing.

Unit 4 Spices

The period of the sailing ships by seasonal winds brought about valuable trade, which transformed many ports in the straits including Malacca and Penang into cosmopolitan centres.

In the case of Malacca and Penang, as trade flourished both states began to have a multi-ethnic population originating from various places such as the Coromandel Coast, the Malaya-Indonesian Archipelago, China and Europe. Aside from trading goods, these traders had also inter-married with the locals, thus creating new ethnic and cultural groups. This further added more interesting features to the existing complex trading society, which led to the fusion of civilization practice in the region.

Besides providing trading facilities, Malacca also offered goods from natural products such as camphor, sandalwood, spices, fish eggs and seaweed. Malacca collected cloves, nutmeg and mace from the spices island. Cloves were exported from Melaka.




From China came ginseng, lacquerware, celadon, gold and silver, hardwoods and other tree products; ivory, rhinoceros horn, kingfisher feathers, ginger, porcelain and silk. Whereas from Korea and Japan – horses and oxen; from Vietnam and Siam – sulfur and tin; from Sumatera, Java and Moluccas – cloves, nutmeg, batik fabrics, pearl, tree resins, bird plumes.




Activity4.1 Spices in My Favorite Food

✳Introduction

Spices can be found in every kitchen of every home. People have been using spices since a long time ago. Spices were very important items, which were bought and sold everywhere all over the world. The needs and uses of spices keep increasing until the present day. People all over the world use spices for many reasons. One of the most common uses of spices is to give the food taste more delicious. Let us find out more information about spices and the spices in your favorite food.

✳Level

Age 10–12 years old

✳Objectives

Pupils should be able to:

1.Identify the name of spices.

2.State the importance of the spice(s).

3.State the origin of the spice(s)

4.Respect each other’s cultures and different food .

✳Focus Question(s)

1.People use spices for different purposes

2.What are spices used for?

3.What are the spices in your favorite food?

4.How many types of spices are there?

5.Why are spices so important to us?

✳Inquiry

Materials

Sample of spices (such as tumeric powder, cloves, black pepper and car–away).

Sampel of recipe (must have spices)

Procedure

1.Let the pupils touch, smell, see and taste (if necessary and with teach–er monitoring) a few types of spices that are available locally such as tumeric powder, clover, black pepper and caraway.

Note: teacher may add other spices in the observation

2.Give pupils opportunity to write briefly about their favourite food and share with their friends. Teacher may guide pupils with few leading questions to guide them.

What is your favourite food?
Why you love the food?
What ingredients in the food that make the food taste good

3.Give the pupils samples of recipe that have spices in the recipe. Let the pupils read and study how a recipe is written. Let them identify the spices in the recipe.

4.Let the students find the information on the recipe from the internet of their favourite food and identify the spice(s) used.

5.Ask the pupils to find out the importance and origin of the spices.

✳Connectivity

Discuss with pupils that different spices originate from different places, but the spices and the use of spices have been spreading to other parts rapidly through trading. This shows that people from different countries and regions are dependent on each other for better living.

✳Worksheet

Name: Class: Date:

1.Using your senses record your observation in the table below:

	Spices	Observations using the senses
1		Smell: Taste: Sight : Touch:
2		
3		
4		
5		

2.From your observation, what can you conclude about spices?

Name: Class: Date:

My Favourite Food

Analysis:

1.List the spice(s) found in your favourite food.

____

2.State the importance of the spice(s) in the table below.

	Spices	Importance
1		
2		
3		

3.Name the place or country of the origin of the spices.

	Spices	Origin
1		
2		
3		

Activity4.2 Food Preservation Experiment

✳Introduction

In any exploration, travellers would bring enough food to last the whole voyage. They brought plenty of raw and preserved food, enough to feed everyone throughout the. Spices and other mixtures are used to preserve food. People from different parts of the world use different methods to preserve their food. In this activity, you will find more information on a variety of food preservation methods and try to experiment your preservation method of the food given.

✳Level

10–12 years old

✳Objectives

Pupils should be able to:

1.State a few methods to preserve food.

2.Design an experiment on food preservation.

3.Carry out experiment on food preservation

4.Discuss the importance of preserving food/not to waste food.

5.Work and help each other in groups.

✳Focus Question(s)

1.How do people preserve their food?

2.Why do we need to preserve food?

3.What is the property of spices that enabled them to be used to preserve food?

(emphasise the antibacterial and anti–micro bacterial property)

✳nquiry

Materials

Pickles
Dried fruits/fish
Salted food/fish
Salt
Sugar
Honey

※Procedure

1. Let the pupils observe some preserved food such as pickles, dried fruits/fish and salted fish. The observation may include tasting the food but with safety precaution taken by the teacher.

2. Give opportunity to pupils to share how they preserve food at home.

3. Let them discuss and find the information from various resources on how the food is preserved. Let them do research on a few methods of preser–vation.

Notes:

Teacher may guide pupils with some leading questions to guide them.

- Does salt help reserve food? How does salting work?
- Does dehydration help in preserving food? How does it work?
- Does pepper help preserve food?
- Which works better – dehydration, salting or spices?
- What other spices might be suitable to preserve food?

4. Give pupils the materials for the experiment and explain the purpose of the experiment.

5. Let pupils work in small groups.

6. Let them discuss what they want to test and formulate their hypothesis, determine the controlled variables, manipulated variables and responding vari–able.

7. Let the pupils test their hypothesis and make their conclusion.

Suggested Procedure:

i.Prepare some suitable food containers. Label the food containers accordingly.

ii.Prepare 3 small slices of mango (of the same weight) for each container.

iii.Put one container in a fridge.

iv.Put one container in an oven with the tempreture 600C for 5 minutes.

v.Add 10 cm3 of liquid to other containers. Pupils may choose liquids from these solutions: distilled water, dilute sodium chloride solution, concen-trated sodium chloride solution, dilute sugar solution, concentrated sugar solution, vinegar, honey and tumeric solution).

vi.Cover the food containers.

vii.Predict what will happen to the mango slices after 48 hours.

viii.After 48 hours examine the containers and record the appearance of the mango and solutions

✳Connectivity

Teacher discuss with pupils:

1. The importance of food preservation.

Note: Teacher may guide pupils with some guided questions:

Why do we need to preserve food?

What happens to the food if it is not preserved?

What will happen to the food supply if food is not preserved?

2. The methods of preserving food have been practiced since a long time ago until today (to show the link between civilizations). The methods have been improved and more methods have been discovered (such as using artificial preservatives)

✻Worksheet

Name: Class: Date:

Samples of preserved food Observation using the senses

	Samples of preserved food	Observation using the senses
1		Smell- Taste- Touch- Sight
2		Smell- Taste- Touch- Sight
3		Smell- Taste- Touch- Sight
4		Smell- Taste- Touch- Sight

Name: Class: Date:

Food Preservation Experiment

Purpose – what do you want to know	
Create a hypothesis	Materials - what do you use:
Experiment- how are you going to test your hypothesis	
Prediction (for each container)	Observation (for each container)
Conclusion- what did you find out?	

Name: Class: Date:

Analysis:

1.What do you change in the experiment?

2.What do you keep the same in the experiment?

3.What do you want to observe in the experiment?

4.Why use three slices of mango in each container?

5.Explain briefly what do you think happened in each container.

Activity4.3 Testing My Own Laksa Recipe

✻Introduction

Laksa is a spicy noodle soup popular in Malaysia, Singapore, Indonesia and Southern Thailand. Laksa consists of rice vermicelli or rice noodles with chicken, beef, prawn or fish, served in spicy soup based on either rich or spicy curry coconut milk or on sour asam (tamarind or gelugur or kokum). It has a yellowish sauce but there is also the whitish laksa sauce as found in Sarawak.

Where does laksa come from? There are many stories about the origin of laksa, however the historians believed that the dish began when there was inter-marriage of cultures between Chinese coastal settlements and local cooking practices in the maritime route of Southeast Asia. Currently there are many varieties of laksa recipes across the regions, because of the variation in seasoning and condiments (spice added after food is served) which influence the taste. Let us find out more about laksa and make your own laksa recipe at home.

✻Level

Age 10-12 years old

✻Objectives

Pupils should be able to:

1.Make a new recipe using spices

2.Testing their recipe

3.Appreciate the variety of food from the different cultures.

✻Focus Question(s)

1.What spices give more flavours to laksa?

✻Inquiry

Materials

Based on sample laksa recipes

Procedure

1. Let pupils share their experiences on the laksa they have eaten, the spices used to make the laksa.

2. Let them list out the criteria to differenciate between the types of laksa in Malaysia such as asam laksa, curry laksa and Sarawak laksa. State the differ– ences between them.

3. Give the pupils the samples of laksa recipes from different countries (In– donesian laksa, Singapore laksa, Malaysian laksa and Thailand laksa). Teach– er may also show the video on people eating laksa.

4. Let the pupils discuss what spices they can add to the recipe to give the laksa more flavour.

5. Pupils may try the new recipe at home with the assistance of their par– ents.

6. Students record their findings and share with the class.

✳Connectivity

Teacher may discuss with pupils how foods links the civilizations and cul– tures from different parts of the world. Teacher may ask questions to guide the pupils:

1.Where does the noodle originate from?

2.Where does the spices come from?

3.What do we need to prepare laksa?

✻Worksheet 1

Name: Class: Date:

1. State the differences between the types of laksa.

Criteria	Asam Laksa	Curry Laksa	Sarawak Laksa
Example: If coconut milk is used	Coconut milk is used	No coconut milk used	Coconut milk is used

2. Write your own laksa recipe.

✻Reading Materials for Teachers

Nowadays, there are many variety of laksa such as Katong Laksa (Singapore) Nyonya Laksa (Malaysia), Batavia Laksa (Indonesia) and Laksa Gai (Thailand). They have different recipes, taste and types of servings, even the type of food and drinks that accompany. They produce different sensations when we eat ⋯...but simply irresistible⋯.

Here in the basic laksa based upon the soup base used in its recipe; either rich and savoury coconut milk, fresh and sour asam (like in Malaysian Laksa) or the combination of the two. There are three basic types of laksa: curry laksa, asam laksa, and other variants that can be identified as either curry or asam laksa. Curry laksa is a coconut milk curry soup with noodles, while asam laksa is a sour, most often tamarind–based, soup with noodles. Thick rice noo–dles also known as laksa noodles are most commonly used, although thin rice vermicelli (bee hoon or mee hoon in Chinese language) are also common, and some recipes may create their own rice noodles from scratch. Some variants might use other types of noodles; Johor laksa for example uses spaghetti, while a fusion recipe might use Japanese udon noodle.

The general differences between curry laksa, asam laksa, and Sarawak laksa are as follows:

Curry laksa	Asam laksa	Sarawak laksa
Coconut milk is used	No coconut milk used	Coconut milk is used
Curry-like soup (*includes curry as one of its ingredients*)	Fish paste soup, tastes sour due to tamarind (*asam*)	Red curry-like soup (*does not use curry*)
Except for bean sprouts, no other vegetable is used	Pineapple, shredded cucumber, raw onions may be used	Except for bean sprouts and fresh coriander as garnish, no other vegetable is used.
Bean curd puff is used	No bean curd puff used	No bean curd puff used
Served with thick or thin rice vermicelli (usually thick). Occasionally served with *yellow mee*.	Served with thick or thin rice vermicelli (usually thick)	Served with thin rice vermicelli only

Hard-boiled egg may be added	No hard-boiled egg added	Sliced omelette is used
Slices of fish cake and either prawns or chicken are used	Fish, usually *kembung* (mackerel) is used	Whole prawns and serrated chickens are used
Variants • Laksa lemak • Katong laksa • Nyonya laksa • Johor laksa	Variants • Asam Laksa • Penang laksa	Variants (none)

Batavia Laksa Recipe

Materials:

- 400 ml of water
- 250 g chicken breast
- 2 orange leaves
- 3 bay leaves
- 2 lemongrass stems, spread
- 2 tablespoons of cooking oil
- 200 ml of coconut milk from 200 g of coconut
- 4 vegetable star fruit
- 100 g of grated coconut, roast, puree
- 1 tablespoon of salt
- 2 tablespoons of sugar

Seasoning, puree:

- 4 cloves garlic
- 5 onion grains
- 4 candlenut
- 4 cm turmeric

- 3 cm ginger
- 4 cm mango meet

Complementary:

- 100 g of vermicelli, dip in boiling water
- 100 g of sprouts, dip in hot water
- 2 eggs, boil, cut 4
- 6 basil leaves
- 1 tablespoon of fried onion
- Red pepper to taste, mash

How to make:

- Boil water. Add chicken, orange leaves, bay leaves and lemon-grass. Cook until the chicken is tender. Lift the chicken, shreds, set aside.
- Saute the spices until fragrant, then put in the boiled chicken water. Add coconut milk, star fruit, and coconut, cook until the starfruit is tender and coconut milk thickens. Add salt, sugar, stir. Lift.
- Fill the bowl with vermicelli, bean sprouts, eggs, basil, and chicken. Pour chicken sauce. Sprinkle fried onions. Serve with crushed chili.

✳Glossary

Delicious: very pleasant and nice taste

Ingredients: any of the foods or substances that are combined to make a particular dish.

Spicy: flavored with spices

Seasoning: spices or flavoring added to enhance the flavor of food

Condiments: substance such as salt, pepper added to improve the taste

Preserve: to treat food to prevent it from going bad or to add something to food to make the food last longer in good condition

Mixture: different materials being mixed together to form another substance

PART 3 ASSESSMENT

✪Assessment for OBOR Fusion of Curriculum

Assessment is an integral part of teaching and learning. Teachers need to know the outcomes of using this module. Pupil performance need a standard measuring guide to help teachers assess their pupils. Assessment can be carried out after each unit or each activity depending on teachers. Below are the suggested rubrics to guide teachers in assessing their pupils after using this module.

1. To identify the knowledge and scientific process as the common way to

Item	Nearing Proficient 1	Proficient 2	Advanced 3
OBSERVING: Making use of the senses to collect qualitative and quantitative data about objects and events.			
PREDICTING: Using a pattern of evidence to make a logical guess about an outcome. A hypothesis is a type of formalized prediction.			
MEASURING: Determining quantitative properties (length/ area, volume, mass/weight, time etc.) of objects and changes during events.			
CLASSIFYING: Imposing order based upon observations of similarities, differences, and interrelationships in order to sort objects or events.			
INFERRING: Creating explanations based upon previous experiences and observations. The process of inferring includes continually constructing and modifying knowledge.			
SOLVING PROBLEMS: solving different problems in a variety of ways			

COMMUNICATING: Oral, written process of describing an event, action or object. To organize ideas using text, graphs, and/or other visual representations and mathematical equation in solving problem/ task given.			
Score			

2. To describe development and connection between the early inventions to present day innovations.

Item	Nearing Proficient 1	Proficient 2	Advanced 3
Differentiate the early invention to their invention			
Justify the improvement made on the early invention to the present day invention			
Score			

3. To appreciate the contribution of discoveries from various civilizations.

Item	Nearing Proficient 1	Proficient 2	Advanced 3
Give examples of the creations from different civilisations			
Identify the immersion from different civilisations in a creation			
Justify the value of the work from the various civilisations			
Score			

4. To demonstrate teamwork for promoting peace and harmony.

Item	Nearing Proficient 1	Proficient 2	Advanced 3
Members express thoughts, feelings, and ideas freely.			
Members feel free to voice differences and do not fear ridicule or reprisal.			
Members readily change procedures in response to new situations.			
Each member's abilities, knowledge, and experience are fully utilized.			
Score			

References

1.Tan Ta Sen (2010). Cheng Ho Penyebar Islam dari China ke Nusantara. Kompas Penerbit Buku, Jakarta.
2.Sen, T. (2014). Cheng Ho and Malaya. Melaka, Malaysia: Cheng Ho Cultural Museum
3.www.newworldencyclopedia.org/entry/Zheng_He
4.https://www.khanacademy.org/partner-content/big-history.../exploration.. ./zheng-he
5.http://en.m.wikipedia.org/wiki/Qilin
6.https://maddy06.blogspot.com/2008/07/zheng-he-sheng-ho-in-calicut.html?m=1
7.https://en.m.wikipedia.org/wiki/Zheng_He#Malacca
8.UTube : Chinese Treasure Fleet Adventures of Zheng He Documentary.
9.http://www.lhschools.org/ScientificInquiryScienceProcessskills.aspx
10.https://teaching.berkeley.edu/sites/default/files/value_rubric_packet.pdf
11.https://www.cmu.edu/teaching/designteach/teach/instructionalstrategies/groupprojects/tools/index.html
12.https://www.aacu.org/value/rubrics
13.www.newworldencyclopedia.org/entry/Zheng_He
14.https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-h
15.www.eiu.edu/eiutps/Constellations.pdf
16.www.skymaps.com/downloads.html
17.https://www.windows2universe.org/?page=/the_universe/Constellations/.../ursa.
18.https://www.space.com › Skywatching
19.www.newworldencyclopedia.org/entry/Zheng_He
20.https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-he
21.https://www.britannica.com/biography/Zheng-He

22.https://study.com/academy/lesson/food-preservation-experiments.html
23.www.newworldencyclopedia.org/entry/Zheng_He
24.https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-he
25.https://www.spicesinc.com/t-list-of-spices.aspx
26.https://www.asian-recipe.com/china/china-information/story-of-zheng-he.html
27.https://www.britannica.com/biography/Zheng-He
28.https://study.com/academy/lesson/food-preservation-methods-lesson-for-kids.html
29.https://study.com/academy/lesson/food-preservation-experiments.html
30.http://moocs.southampton.ac.uk/shipwrecks/2014/10/02/maritime-rhythms-indian-ocean-monsoon/
31.Wynne Harlen (2013) Assessment & Inquiry Based Science Education. Global Network of Sciecen Academies (IAP) Science Education Programme, TWAS – Strada Costiera, Trieste. Italy
32.www.newworldencyclopedia.org/entry/Zheng_He
33.https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-h
34.www.eiu.edu/eiutps/Constellations.pdf
35.www.skymaps.com/downloads.html
36.https://www.windows2universe.org/?page=/the_universe/Constellations/.../ursa.
37.ttps://www.space.com › Skywatching

InterAcademy Partnership (IAP)

Under the umbrella of the InterAcademy Partnership (IAP), some 140 national, regional and global member academies work together to support the vital role of science in seeking evidence-based solutions to the world's most challenging problems. In particular, IAP harnesses the expertise of the world's scientific, medical and engineering leaders to advance sound policies, improve public health, promote excellence in science education, and achieve other critical development goals.

Among IAP's goals is to "Build a scientifically literate global society." The Science Education Programme (SEP), established in 2003, is the main mechanism used by IAP to help achieve this goal. IAP SEP activities are guided by a Global Council made up of experts nominated by IAP member academies. Since the start of the programme, major efforts have been focused on promoting inquiry-based science education (IBSE), especially in primary schools. In 2013, the IAP Executive Council also charged the SEP Global Council with developing activities in the area of science literacy.

With the support of:

ISTIC
INTERNATIONAL SCIENCE, TECHNOLOGY AND INNOVATION CENTRE FOR SOUTH-SOUTH COOPERATION UNDER THE AUSPICES OF UNESCO

ECOSF
ECO Science Foundation

CYSC

AKADEMI SAINS MALAYSIA

SEAMEO Regional Centre for QITEP IN SCIENCE

อพวช. NSM