AETDEW
THE ACADEMY OF ENGINEERING AND TECHNOLOGY OF THE DEVELOPING WORLD

Wisma Vertitech,
No.17B, Jln Kenari 4, Bandar Puchong Jaya,
47100. Puchong, Selangor Darul Ehsan, Malaysia,
Email: secretariat@aetdew.org

One Belt One Road Virtual Museum Project : The Next Steps

By Academician Dato (Dr) Lee Yee Cheong, Malaysia
AETDEW President

1.0 Background

The InterAcademy Partnership (IAP) is the umbrella organisation of the national academies of sciences, engineering, and medicine in the world. The two most important tasks of IAP are (i) providing independent and authoritative science and technology advice to international and national governments and their agencies and (ii) promoting science education and science literacy throughout the world.

The latter task has been entrusted to the Global Council of the IAP Science Education Program (IAP SEP). I was elected the Chairman of IAP SEP Global Council in 2010 due to my active promotion of Inquiry-Based Science Education (IBSE) and STEM education for STEM school teachers as Chairman of the International Science, Technology and Innovation Centre for South-South Cooperation under the Auspices of UNESCO (ISTIC). ISTIC is an UNESCO Category 2 Centre hosted by the Government of Malaysia in Kuala Lumpur.

I was requested by IAP leaders to focus on the establishment of science centres and science museums in South countries. It was recognised by IAP leaders that science centres and science museums are important anchors to get the youth in South countries reoriented in STEM in their education and subsequent careers. We all pointed to China as the successful role model in her setting up children's palaces and science and technology museums throughout all her districts, towns, cities, provinces, as well as nationally. China's vast pool of knowledgeable and committed STEM human resources has been an important factor in making China the most advanced engineering and technology nation in all aspects of its national life in the world. However, most of the other South countries do not have the financial resources and political commitment towards setting up science museums

Or science centres. Their meagre financial allocations are devoted to the traditional national and provincial museums.

As an alternative, I have turned to the promotion of setting up virtual STEM museums as integral components of national museums in South countries. In view of China's impressive achievements in the application of virtual reality, robotics, AI, IoT and allied digital technologies in making museum exhibits more interactive and attractive to museum visitors, especially the young, I again turn to China in my latest endeavour. As I was President of the Belt and Road Interanational Science Education Consortium (BRISEC) under the China Association of Science and Technology (CAST), I considered the unifying theme that will get buy-in from all South countries to be the One Belt One Road Initiative (BRI) of President Xi Jinping. As an engineer deeply interested in development, I consider China's greatest achievement in human engineering has been lifting 800 million of her population out of poverty and becoming integral parts of its Community of Moderate Prosperity. The anchor has been the widespread physical and virtual infrastructure throughout the length and breadth of China, making even its remote rural communities part of the national supply chain and even the global supply chain. China has been sharing its development success with the other South countries through infrastructure development under the BRI.

However, in China, the great BRI success story of the global South is mostly told from the Chinese angle without giving credit to the contributions of other Belt and Road countries. In truth, without their active participation, the land Silk Road and maritime Silk Road could not have happened. I have therefore advocated that museums in China feature a BRI Exhibition that is focused on the Fusion of the Belt and Road Civilizations. This BRI Exhibition will also feature the important achievements of BRI in Belt and Road nations.

In essence, the virtual or digital exhibition of the Fusion of the Belt and Road Civilizations in Museums in China will assure the continued support of the Chinese people for the BRI. This exhibition will then be shared with all Belt and

Road countries in the Virtual Belt and Road Pavilion of their National Museums thus making the Fusion of Belt and Road Civilizations an unifying symbol of all Belt and Road countries. China can help Belt and Road countries in setting up the Virtual Belt and Road Pavilion in their National Museums by providing them with modern hardware and software systems. The BRI Exhibitions in Belt and Road countries will feature the civilizations and cultures of these countries and regions as well as the impact of BRI projects in social, economic, and environmental uplift of their countries.

I canvassed support from my AETDEW Fellows in China. There was positive reaction from all, but no follow-up action. I was then given a great opportunity to advance my advocacy by being invited by the China People Association for Friendship with Foreign Countries to the Museum Forum during the 2023 Nisham Forum of Classical Civilizations in Qufu in September 2023 (Annex No.2). The reaction from participants, mostly Directors of Chineses Museums, was very positive, again there was no follow-up action. Through my good friend Professor Jeffrey Sachs of Columbia University, New York, I was again given another chance to advance my advocacy to an international audience during the 2024 Aristotle-Confucius Symposum in Qufu and Beijing July 2024. My speech (Annex No 1) was well received, but again no follow-up action resulted.

Since the announcement of the Global Civilization Initiative by President Xi Jinping in 2023, I consider the BRI Exhibition should be a project under the Global Civilization Initiative.

I now realize that everyone has been very struck by the grandeur of the BRI Exbition Project. They are awed by its scale and the cost implication. They do not know how and where to begin.

2.0 The Next Steps

We must start with a script of the story we want to tell.

I suggest we start with the "Fusion of One Belt One Road Civilizations Education Curriculum" (Annex No. 3). To recapitulate, the Curriculum is presented in two parts. The first part comprises the Land Silk Road through the tales of the great traveler Ibn Battuta (1304-1369) of Morocco. The second part covers the Maritime Silk Road through the seven epic voyages of the famous Chinese Admiral Zheng He (1371-1435) from China to Southeast Asia, Arabia, and East Africa. The curriculum has many student-centered classroom activities based on "Learning by Doing" pedagogy-

We now update the Curriculum under the Global Civilization Initiative.

We now include:

(i) Zhang Qian (195-114 BC),

(ii) Xuanzang (602- 664 BC),

(iii) Marco Polo (1254-1324),

(iv) The Contribution from Central Asia

Without the commercially savvy Sogdian people of Central Asia trading between China and Europe, the Silk Road would not have become a reality. In fact, the Sogdians had a long association with China. The most famous Sogdian in Chinese history was An Lushan (703-757 AD), whose rebellion led to the decline of the Tang Dynasty.

(v) Aristotle (384-322BC)

(vi) Alexander the Great (356-323BC)

Alexander was the pupil of Aristotle. Through his Eastern conquest through Persia, Central Asia and the Indus Valley, he was instrumental in spreading Greco-Persia culture and philosophy to Central Asia, India and possibly China.

(vii) Samarkand, Capital of Sogdian

(viii) Quanzhou, Major Port for Arab and S.E. Asian traders. Visited by Ibn Battuta

(ix) Guangzhou, first city in China visited by Ibn Battuta.

(x) Hangzhou, impressively told in the Travels of Marco Polo and Ibn Battuta.

(xi) Confucius

(xii) Laotze

(xiii) Buddha

There are many publications, TV drama series, TV news reports, Museum displays in China on all the above.

The immediate step is the collation of relevant material for the script of the new edition of the Fusion of Belt and Road Civilization Education Curriculum. That can then be used as the basis for the BRI Exhibition in Chinese museums and the BRI Pavilion in National Museums in Belt and Road countries.

Academician Dato (Dr) Lee Yee Cheong
3 November 2024 Kuala Lumpur

AETDEW
THE ACADEMY OF ENGINEERING AND TECHNOLOGY OF THE DEVELOPING WORLD

Wisma Vertitech,
No.17B, Jln Kenari 4, Bandar Puchong Jaya,
47100. Puchong, Selangor Darul Ehsan, Malaysia,
Email: secretariat@aetdew.org

一带一路虚拟博物馆项目：下一步计划
作者：马来西亚拿督李怡章院士 AETDEW 主席

1.0 背景

国际科学院联盟 (IAP) 是世界各国科学院、工程学院和医学院的伞式组织。IAP 的两项最重要任务是 (i) 为国际和国家政府及其机构提供独立和权威的科学技术建议，以及 (ii) 在世界范围内促进科学教育和科学素养。

后一项任务已委托给 IAP 科学教育计划 (IAP SEP) 全球理事会。由于我积极推动基于探究的科学教育 (IBSE) 和 STEM 学校教师的 STEM 教育，并担任联合国教科文组织赞助的国际科学、技术和创新南南合作中心 (ISTIC) 主席，我于 2010 年当选为 IAP SEP 全球理事会主席。ISTIC 是马来西亚政府在吉隆坡主办的联合国教科文组织二类中心。

IAP 领导要求我重点关注在南方国家建立科学中心和科学博物馆。IAP 领导认为，科学中心和科学博物馆是让南方国家年轻人在教育和随后的职业生涯中重新定位 STEM 的重要支柱。我们都指出，中国是成功的榜样，她在所有地区、城镇、城市、省份以及全国范围内建立了儿童宫和科技博物馆。中国拥有大量知识渊博、致力于 STEM 的人力资源，这是中国成为世界上在国家生活的各个方面最先进的工程和技术国家的重要因素。然而，大多数其他南方国家没有建立科学博物馆 或科学中心的财政资源和政治承诺。他们微薄的财政拨款用于传统的国家和省级博物馆。

作为替代方案，我已转向推动建立虚拟 STEM 博物馆作为南方国家国家博物馆的组成部分。鉴于中国在虚拟现实、机器人、人工智能、物联网和相关数字技术的应用方面取得了令人瞩目的成就，这些技术使博物馆展品更具互动性，对博物馆参观者，尤其是年轻人更有吸引力，我再次将目光转向中国，这是我最新的尝试。作为中国科学技术协会（CAST）下属的"一带一路"国际科学教育联盟（BRISEC）主席，我认为所有南方国家都会认同的统一主题是习近平主席的"一带一路"倡议（BRI）。作为一名对发展深感兴趣的工程师，我认为中国在人类工程学方面取得的最大成就是使 8 亿人口摆脱贫困，成为小康社会不可或缺的一部分。其支柱是遍布中国各地的广泛物理和虚拟基础设施，即使是偏远的农村社区也成为国家供应链甚至全球供应链的一部分。中国一直在通过"一带一路"倡议下的基础设施建设与其他南方国家分享其发展成功。

然而，在中国，“一带一路”倡议的伟大成功故事大多是从中国的角度讲述的，而没有考虑到其他“一带一路”国家的贡献。事实上，如果没有他们的积极参与，陆上丝绸之路和海上丝绸之路就不可能发生。因此，我主张中国的博物馆举办以“一带一路文明融合”为重点的“一带一路”展览。这次“一带一路”展览还将展示“一带一路”项目在“一带一路”国家的重要成就。

从本质上讲，中国博物馆举办“一带一路文明融合”虚拟或数字展览将确保中国人民继续支持“一带一路”。该展览将在所有“一带一路”国家的国家博物馆虚拟“一带一路”馆中分享，从而使“一带一路文明融合”成为所有“一带一路”国家的统一象征。中国可以通过为“一带一路”国家提供现代化的硬件和软件系统，帮助它们在其国家博物馆建立虚拟“一带一路”馆。一带一路国家 BRI 展览将展示这些国家和地区的文明和文化，以及 BRI 项目对其国家社会、经济和环境提升的影响。

我争取到了 AETDEW 在中国的院士的支持。所有人都做出了积极的反应，但没有后续行动。随后，我得到了一个很好的机会来推进我的倡导，即应中国人民对外友好协会的邀请，于 2023 年 9 月在曲阜举行的 2023 年尼山古典文明论坛期间参加博物馆论坛（附件 2）。与会者（主要是中国博物馆馆长）的反应非常积极，但同样没有后续行动。通过我的好朋友纽约哥伦比亚大学的杰弗里·萨克斯教授，我再次有机会在 2024 年 7 月在曲阜和北京举行的 2024 年亚里士多德-孔子研讨会上向国际观众提出我的倡导。我的演讲（附件 1）受到了热烈欢迎，但同样没有后续行动。

自 2023 年习近平主席宣布全球文明倡议以来，我认为一带一路展览应该是全球文明倡议下的一个项目。

我现在意识到，每个人都对一带一路展览项目的宏伟感到震惊。他们对其规模和成本影响感到敬畏。他们不知道如何以及从哪里开始。

2.0 下一步

我们必须从我们想要讲述的故事的脚本开始。

我建议我们从“一带一路文明融合教育课程”（附件 3）开始。概括地说，课程分为两部分。第一部分包括通过摩洛哥伟大旅行家伊本·白图泰（1304-1369）的故事讲述陆上丝绸之路。第二部分涵盖了海上丝绸之路，即著名的中国郑和（1371-1435）从中国到东南亚、阿拉伯和东非的七次史诗般的航行。课程有许多以学生为中心的课堂活动，基于“边做边学”的教学法-

我们现在更新了全球文明倡议下的课程。

我们现在包括：

（i）张骞（公元前 195-114 年），

（ii）玄奘（公元前 602-664 年），

（iii）马可波罗（1254-1324 年），

（iv）来自中亚的贡献

如果没有精通商业的中亚粟特人在中国和欧洲之间进行贸易，丝绸之路就不会成为现实。事实上，粟特人与中国有着悠久的联系。中国历史上最著名的粟特人是安禄山（公元 703-757 年），他的叛乱导致了唐朝的衰落。

（v）亚里士多德（公元前 384-322 年）

（vi）亚历山大大帝（公元前 356-323 年）

亚历山大是亚里士多德的学生。通过征服波斯、中亚和印度河流域，他为将希腊-波斯文化和哲学传播到中亚、印度甚至中国发挥了重要作用。

（vii）粟特首都撒马尔罕

（viii）泉州，阿拉伯和东南亚贸易的主要港口。伊本·白图泰曾到访过泉州

（ix）广州，伊本·白图泰访问的第一个中国城市。

（x）杭州，马可·波罗和伊本·白图泰的游记中令人印象深刻地描述了这座城市。

(xi)孔子

(xii)老子

(xiii)佛陀

中国有许多关于上述内容的出版物、电视剧、电视新闻报道、博物馆展览。

当务之急是整理新版《一带一路文明融合教育课程》脚本的相关材料。然后可以将其作为中国博物馆的一带一路展览和一带一路国家国家博物馆的一带一路展馆的基础。

拿督李怡章院士
2024-11- 3　吉隆坡

ANNEX 1　附件 1

尼山世界文明论坛2024 年 7 月
10-11 日， 曲阜
一带一路文明融合： 博物馆数字化展
览马来西亚李怡章院士
发展中世界工程技术学院院长

1.0 消除贫困和基础设施发展

发展中世界工程技术学院 AETDEW 于 2017 年在马来西亚成立。 AETDEW 的目标是帮助发展中国家在 2030 年前实现 17 项联合国可持续发展目标 (UN SDGs)。 在我看来， 最重要的可持续发展目标是第一个目标“消除贫困”， 因为贫穷国家不具备实现联合国可持续发展目标所要求的社会和经济发展所需的资源。 我们必须先满足生活的数量：“衣食住行”， 才能享受生活的质量：“琴棋书画”。AETDEW正在帮助发展中国家学习中国帮助 8 亿人脱贫的辉煌成就， 这是人类历史上前所未有的。 中国小康社会已经 能够满足广大人民群众的温饱、 义务教育， 基本医疗服务和安全住房等需求， 即使在最偏远和几乎人迹罕至的农村地区也是如此。 在此过程中， 中国和她的人民一 直在改善环境并保护其动植物。 事实上，中国比 2030 年提前了 10 年实现了可持续发展目标 。

中国消除贫困的成功离不开全面、 包容的实体和虚拟基础设施， 这些基础设施遍及全中国 。有了这样的基础设施， 即使是中国最偏远的社区， 也不仅成为了中国经济的一 部分， 也成为了世界供应链的一部分。 习近平主席经常引用一句老话：“要想富先修

路”。

中国制造和工程建设中的一些世界领先的科学、 工程和技术例子 ：

(i) 高速铁路网络；

(ii) 跨海桥梁；

(iii)多用途水资源水坝和水库；

(iv)南水北调工程；

(v) 隧道；

(vi)宽带 5G 网络；

(vii)超级计算机；

(viii)火箭、 宇宙飞船、 火星探测器和空间站的航空航天开发；

(ix)现代化机场；

(x)现代化港口；

(xi) 船舶建造和运输；

(xii)稀土产业；

(xiii)太阳能光伏、 风力涡轮机和核电反应堆；

(xiv)机器人；

(xv)无人机；

(xvi)电动汽车和电池 。

工程建设的速度和效率以武汉在 10 天内建成 2 家 Covid-19 医院为例， 工程设施管理以 2022 年北京冬奥会为代表。 正是中国运行良好的基础设施和智能制造， 是中国经济社会成就的基础, 支撑中国成为“中国特色世界工厂” 和 “ 中国特色世界市场” 。

2.0“一带一路”倡议（BRI）

中国通过“一带一路”与发展中国家分享发展成果。 对我来说，“一带一路”倡议是 发展中国家摆脱贫困、 成为人类共同繁荣共同体成员的平台, 也是习主席”全球发展倡议” 的平台 。

自习主席 2013 年在哈萨克斯坦宣布“一带一路”倡议以来， 中国按照中国工程标准建设的实体和虚拟基础设施项目充满在发展中国家。 一带一路” 倡议下的中国国外的实 体和虚拟基础设施项目在全球范围内都是可见且出色的设施。 他们对提升发展中世界普通公民的社会和经济地位的贡献受到发展中世界的赞赏。 没有什么比中欧货运铁路服务更能象征 “一带一路” 了， 用火车代替骆驼。 自 2011 年 3 月首列中欧班列在中国西南地区的重庆开出，备受西方嘲笑以来， 到 2024 年 2 月底， 这中欧班列已经连接了 120 个中国城市和25 个欧洲国家的219 个城市。 中欧班列已完成 9 万列， 运输货物超过 870 万个集装箱， 价值超过 3800 亿美元。 中欧货运班列服务已成为全球物流中最可靠且最经济的选择。 它确实是中亚, 东欧乃至西欧内陆国家的生命线.

3.0 一带一路教育课程融合（OBOR 课程）

一带一路项目的成功很大程度上归功于一带一路国家文化和文明的相互理解。 我发现包括中国在内的一带一路国家的人民对一带一路国家的文化和文明的贡献知之甚少。 这种情况需要纠正， 从所有一带一路国家的年轻人开始。 一带一路文明融合教育课程（OBOR 课程）就是这样一种尝试 。

https:// www. interacademies. org/ publication/ obe- belt- one- road- fusion- civilisations -education - curriculum

https:// www. interacademies. org/ publication/ one- belt- one- road- fusion- civilisations -education -curriculum - chinese -version

“一带一路”课程项目是我在担任国际科学院联盟科学教育计划全球理事会主席时发起的. “一带一路”课程项目历时四年， 工作组在吉隆坡（三次）、北京、伊斯兰堡、 南宁、 南京和曼谷举行了工作会议。 草案在中国、 马来西亚、 印度尼西亚和巴基斯坦的选定学校进行了测试， 并根据教师的反馈进行了修改 。

“一带一路课程”分为两部分。 第一部分包括陆上丝绸之路， 讲述了伟大的穆斯林摩洛哥旅行家伊本·白图泰（1304-1369） 在陆上丝绸之路的故事。 第二部分涵盖海上丝绸之路，

讲述了著名的中国海军上将郑和 （ 1371-1435 ） 从中国到东南亚、 阿拉伯和东非的七次史诗般的航行 。

为了加深学生对一带一路文明融合的兴趣和理解，“一带一路”课程注重以学生为中心的课堂活动,采用“边做边学” 的方法. 例子如下:

第 1 部分 陆地丝绸之路 概述 第一单元 水资源 活动 1.1 辘轳 活动 1.2 水车 活动 1.3 沙漠中的绿洲 活动 1.4 水泵 第二单元 天文 活动 2.1 星盘 活动 2.2 望远镜 活动 2.3 针孔相机 第三单元 建筑 活动 3.1 柱子 活动 3.2 屋顶 活动 3.3 塔 活动 3.4 穹顶 2 第 2 部分 海上丝绸之路 概述 第一单元 北极星和航海工具 活动 1.1 寻找北极星 活动 1.2 恒星的亮度 活动 1.3 制作自己的指南针 活动 1.4 现代导航工具 活动 1.5 让我们设计一条自行车路线 第二单元 风与导航 活动 2.1 风向标 活动 2.2 季风及其重要性 活动 2.3 季风的影响 活动 2.4 季风对航海的影响 第三单元 帆船 活动 3.1 如何让船漂浮 活动 3.2 水位线 活动 3.3 水钟 活动 3.4 了解你的帆船 活动 3.5 让你的帆船走得更快 第四单元 香料 活动 4.1 我喜欢的食物中的香料 活动 4.2 食物保存实验 活动 4.3 测试我自己的叻沙(东南亚面食)配方 .

我们的经验， 不仅学生喜欢“一带一路 ” 课程的故事和活动， 老师和其他成年人也喜欢阅读它以了解更多关于 “ 一带一路 ” 的历史文化 . 我敦促你们下载它以了解有关 “ 一带一路 ” 的。 如果你们喜欢它， 请把它介绍给你们认识的学校.

3.0 全球文明倡议与一带一路课程的缺陷

随着中国国家主席习近平于 2023 年宣布“全球文明倡议”， 呼吁尊重文明多样性， ”一带一路”课程的不足之处被暴露为仅仅讲述两位伟大的丝绸之路旅行者的故事， 而没有哲学 基础 。 Professor Jeffrey Sachs 杰弗里·萨克斯教授的”亚里士多德、 佛陀、 孔子”(Aristotle, Buddha, Confucius)倡议及时地纠正了一带一路课程的这一缺陷 .

“一带一路”课程在陆上丝绸之路部分的一个不足之处是， 它只关注中国向西扩张， 如汉朝张骞 （公元前 195-114 年） 向塔吉克斯坦扩张， 唐朝玄奘公元前602-664 年） 向印度求经。 事实上， 直到 13世纪蒙古入侵东欧之前， 没有中国商人冒险走出中亚。 如果不是精通商业的中亚粟特人在中国和欧洲之间进行贸易， 陆上丝绸之路就不会成为现实。 粟特人与中国有着悠久的联系。 中国历史上最著名的粟特人是安禄山 （公元 703-757 年），他的叛乱导致了唐朝的衰落。

“一带一路”课程的另一个严重遗漏是亚历山大大帝 （ 公元前 356-323 年. 他的帝国向东延伸至波斯、 中亚和印度。 亚历山大大帝渴望知识， 热爱哲学， 是艺术和科学的赞助人 。这归功于他受过伟大的哲学家和博学者亚里士多德 （ 公元前 384-322 年） 的教育。 亚里士多德热爱知识的哲学早在公元 7 世纪伊斯兰征服中亚之前就成为中亚文明的持久精神。 阿拔斯(Abbasaid)王朝统治下的伊斯兰黄金时代起源于中亚呼罗珊 (Khorasan), 当时

大多数伟大的哲学家和科学家都来自波斯和中亚。 这最终导致了公元 14 世纪欧洲文艺复兴。 在我看来， 以亚里士多德为代表的希腊哲学一定已经传入中国并影响了中国文明 。

我参观过中国最著名的三个石窟， 即敦煌莫高石窟、 洛阳龙门石窟和大同云冈石窟. 云冈石窟最具西来样式， 即胡风胡韵浓郁。 其中既有印度、 中亚艺术元素， 也有希腊、 罗马建筑造型、 装饰纹样、 像貌特征等等。 还有指导当今中国治理的标语：“实事求是”和“摸着石头过河”， 非常具有亚里士多德风格。

5.0 儒家思想和中国文明

中国历史上最伟大、 最具影响力的哲学家是孔子（公元前 551-479 年）。 儒家思想在中国流传了 2500 年， 这是因为一些最杰出的中国哲学家在各个朝代对其进行了革新， 使其更符合当时的社会规范。 儒家思想以 5000 年的连续中国文明为基础， 具有包容和吸收国内外其他哲学元素的巨大能力。 最引人注目的例子是道教和佛教。 今天的儒家思想包含了许多道教和佛教的教义。 一个很好的例子是恒山悬空寺三教殿， 供奉孔子、 释迦牟尼和老子 。三大哲学或宗教的创始人被供奉在这座拥有 1500 年历史的古寺的同一殿堂里 。

中国许多城镇都有供奉这三位伟大哲学家的三教会。 这是中华文明包容、 吸收的伟大典范 。我敦促中国有关部门提升

“一带一路”课程， 将亚里士多德、 佛陀、 孔子和老子等伟大哲学家对中国和其他“一带一路”文明的影响纳入其中。 “一带一路”课程将改成”一带一路” 文明融合项目.

6.0 一带一路文明融合数字化展览

当今的年轻人对数字化展览的吸引力远远大于纸质文本。 TikTok 在全球的流行和抖音在中国的流行充分证明了这一点。 ’’一带一路’’文明融合数字化展览应成为中国对全球文明倡议的贡献 。

近年来， 特别是新冠肺炎疫情期间， 中国各大博物馆通过采用人工智能、 虚拟现实、 机器人、 物联网和 5G 加速了博物馆数字化转型。 中国博物馆展览用这些数字技术为参观者带来了高清、 三维、 互动和虚拟现实体验。 这些展品也可通过 5G 在学校和家中观看。 鉴于曲阜是孔子思想的宝库， 崂山是道教的发源地之一， 我建议将‘‘一带一路文明融合’’展览的制作任务委托给山东， 并由萨克斯教授和他来自希腊的的同事输入亚里士多德的贡献 。

‘‘一带一路文明融合’’数字化展览在中国博物馆测试后， 可以提供给一带一路国家的国家博物馆。 只需要在博物馆内配备一个数字视听硬件和软件的大厅。 我相信它将使一带一路国家的许多国家博物馆焕发活力 。

目前， 西方一直保持着其帝国主义心态： ‘‘我的是我的， 你的也是我的’’， 并鼓励政客和媒体妖魔化中国： ‘‘世界上所有正确的事情都是我们的成就， 世界上所有错误的事情都是中国干的!’’。 当务之急是让西方人民， 特别是他们的年轻人， 了解中华文明和中国文明对其他文明的积极态度， 并在整个中国历史上向他们学习。 西方人民必须明白， 这种中华文明包容心态是中国当前惊人发展的支柱 。

Confucius-Aristotle Symposium

8-12 July 2024, Qufu and Beijing

Digital Exhibits on Confucius, Buddha and Laozi and their Impact on Fusion of One Belt One Road Civilizations

By Academician Lee Yee Cheong, Malaysia

President, Academy of Engineering and Technology of the Developing World (AETDEW)

1.0 Poverty Eradication and Belt and Road Initiative

The UN General Assembly in 2015 unanimously adopted the 2016 - 2030 Development Agenda with the 17 Sustainable Development Goals (SDGs). In my opinion, the most important SDG is the first goal, "Zero Poverty", because poor countries do not possess the resources needed to achieve social, economic and environmental development as required by the UN SDGs. Most countries are not on track to eradicate poverty. The exception is China in her spectacular success in lifting 800 million of her people out of poverty in 2021. The foundation of China's success in eradicating poverty is her extensive and inclusive physical and virtual infrastructure that makee even her most remote villages part of the global supply chain. "If you want to get rich, build roads first" (要想富先修路). China has been sharing her success in eradicating poverty with South countries through her "Global Development Initiative." with the Belt and Road Initiative (BRI) as its platform.

2.0 Fusion of One Belt One Road Education Curriculum (OBOR Curriculum)

The success of BRI projects owes much to the mutual understanding of the cultures and civilizations of Belt and Road countries. I have found that peoples in Belt and Road countries including China have little knowledge of the cultures of Belt and Road countries and the contributions ofother civilizations to their own. This needs to be rectified, starting with the youth ofall Belt and Road countries. The Fusion ofBelt and Road Civilizations Education Curriculum (OBOR Curriculum) is one such attempt.

[https://www.interacademies.org/publication/obe-belt-one-road-fusion-civilisations-education- curriculum](https://www.interacademies.org/publication/obe-belt-one-road-fusion-civilisations-education-curriculum)

[https://www.interacademies.org/publication/one-belt-one-road-fusion-civilisations-education-curriculum- chinese-version](https://www.interacademies.org/publication/one-belt-one-road-fusion-civilisations-education-curriculum-chinese-version)

The OBOR Curriculum is presented in two parts. The first part comprises the Land Silk Road through the tales ofthe great Muslim traveler Ibn Battuta (1304- 1369) of Morocco. The second part covers the Maritime Silk Road through the seven epic voyages ofthe famous Chinese Admiral Zheng He (1371- 1435) from China to South East Asia, Arabia and East Africa. The curriculum has many student-centred classroom activities based on “Learning By Doing” methodology.

3.0 Global Civilization Initiative and Deficiency in OBOR Curriculum

With the pronouncement by Chinese President Xi of the "Global Civilization Initiative" in 2023, OBOR Curriculum's deficiency was exposed as merely recounting the tales of the two great Silk Road travellers without philosophical underpinning. Professor Jeffrey Sachs ' Aristotle, Buddha, Confucius Initiative is most timely in rectifying this shortcoming ofOBOR Curriculum.

One of the shortcomings of the "Belt and Road" curriculum is that it focuses only on China's interactions to her West, such as: Han Dynasty Zhang Qian (195- 114 BC) to Tajikistan and Tang Dynasty Xuanzang (602-664 BC) seeking Buddhist scriptures in India. In fact, until the Mongol invasion of Eastern Europe in the 13th century, no Chinese merchant ventured further West than Samarkand. Ifnot for the commercially savvy Sogdians with their capital in Samarkand trading between China and Europe, the Land Silk Road would not have become a reality. In fact, the Sogdians had a long association with China. The most famous Sogdian in Chinese history was An Lushan (703-757 AD), whose rebellion led to the decline ofthe Tang Dynasty.

The other serious omission in OBOR Curriculum is that ofAlexander the Great (356- 323BC) ofGreece whose empire stretched East through Persia, Central Asia to India. He had a great desire for knowledge and a love for philosophy and was a patron ofboth the arts and the sciences. This was attributed to his education under the great philosopher and polymath Aristotle (384-322BC). The Aristotelian philosophy oflove for knowledge became the abiding psyche in the civilization of Central Asia well before its Islamic conquest ofthe 7th Century AD. In my opinion, Greek philosophy as typified by Aristotle must have reached China and influenced Chinese civilization from Central Asia. The great Buddhist "Yungang" Grottos ofDatong in Shanxi Province date from 5th Century AD and some grottos have Greco-Roman features in architecture, sculpture and dress. The slogans that guide the governance ofpresent-day China: " See king Truth from Facts" 实事求是 and " Crossing the River by Touching the Stones" 摸着石 头过河are tomevery Aristotelian.

4 .0 Confucianism and Chinese Civilization

The greatest and most influential philosopher in Chinese history was Confucius (551- 479BC). The fact that Confucianism has endured in China for 2500 years is due to its being renovated by some ofthe most brilliant Chinese philosophers from dynasty to dynasty to make it more aligned to societal norms in those times. Confucianism is underpinned by 5000 years ofcontinious Chinese civilization with its great capacity to embrace and absorb elements of other philosophies from home and abroad. The most striking example has been Daoism and Buddhism. Confucianism today contains many tenets from Taoism and Buddhism. A great example is the Three Religion/Philosophy Hall ofHengshan Xuankong Temple 恒 山 悬 空 寺 三 教 殿 that is dedicated to Confucius, Sakyamuni and Laozi. The founders of the three great philosophies or religions have been venerated in the same hall of the 1500 year old temple. There are three philosopher associations venerating these three philosophers in many cities and towns in China. It is a great story ofthe tolerant, embracing and absorptive underpinning of Chinese civilization.

5.0 Virtual Exhibit ofthe Fusion of One Belt One Road Civilizations

Present day youth is much more attractive by virtual exhibits rather than texts on paper. This is amply demonstrated by the global popularity ofTikTok; and Douyin 抖音 in China. A virtual exhibit ofthe Fusion of One Belt One Road Civilizations should be made as China's contribution to the Global Civilization Initiative. In recent years, especially the COVID- 19 years, major museums in China have accelerated their digital transformation by the adoption of AI, Virtual Reality, Robotics, Internet ofThings and 5G. These digital technologies in museum exhibits in China have brought high-definition, three-dimensional, interactive and virtual reality experiences for visitors. In view of Qufu 曲阜being the storehouse of Confucius knowledge and Laoshan 崂 山 being a cradle of Daoism, I suggest the task of creating the virtual exhibit ofthe Fusion ofOne Belt One Road Civilizations be entrusted to Shandong 山 东 with Professor Sachs and his colleagues from Greece inputting the contributions of Aristotle.

The Digital Exhibit ofthe Fusion ofOne Belt One Road Civilizations can be offered to national museums in Belt and Road countries. All is required is a hall in the museum equipped by modern digital audio-visual hardware and software. The digital exhibit in National Museum should feature her own civilization as the centrepiece. I believe by the application of digital technologies, it will revitalize many national museums in Belt and Road countries.

Currently, the West has encouraged the demonization of China by her politicians and media : “All that is right with the world is due to us, all that is wrong with the world is due to China!” . The urgent task is for the peoples of the West, especially their youth, to learn about Chinese civilization and the welcoming of other cultures and civilizations throughout Chinese history. They must understand that this Chinese civilization psyche nurtured by 5000 years of continuous civilization anchors the current spectacular development ofChina.

ANNEX 2　附件 2

2023 Nishan Forum on Classical Civilizations

Museum Forum

26 September 2023

“Virtual Belt and Road Civilization Museum”

By Academician Dato Ir. (Dr) Lee Yee Cheong, Malaysia

President, the Academy of Engineering and Technology of the Developing World AETDEW

1.0 Global Civilization Initiative

Chinese President Xi Jinping proposed the Global Civilization Initiative on 15 March 2023. This is the third major global initiative of President Xi after the Global Development Initiative in 2021 and the Global Security Initiative in 2022.

President Xi called for respecting the diversity of civilizations, advocating the common values of humanity, valuing the inheritance and innovation of civilizations, and strengthening international people-to- people exchanges and cooperation.

The Global Civilization Initiative, Global Development Initiative and Global Security Initiative are derived from China's successful experiences of modernization. China's 5,000-year civilization is the backbone of these great initiatives.

2.0 The Belt and Road Initiative (BRI)

The consciousness in developing countries about the common values of different civilizations was awakened by the Belt and Road Initiative (BRI) that was pronounced by President Xi in Kazakhstan and Indonesia in 2013.

The BRI has delivered fruitful outcomes and won widespread support and participation in the developing world. It has created jobs, improved infrastructure and promoted common development, social and economic uplift, especially in developing countries.

The outstanding example of the success of BRI has been China herself. In 2021, China announced the spectacular achievement of lifting 800 million of her population out of poverty. This is without parallel in human history!

What is even more amazing is that the 800 million people have joined China’s society of moderate prosperity (小康社会). China has thus been able to take care of all the basic needs of her population like clothing, food, housing and transport (衣食住行) as well as access to education, medical services, and gainful employment even in her remotest rural regions.

China has been improving her environment in turning desert into forest and farmland, cleaning up her rivers and lakes, and conserving her wetland, thus protecting its flora and fauna.

China’s poverty eradication success has been anchored by the building of physical and virtual infrastructure throughout the length and breadth of China.

There is an old Chinese saying often quoted by President Xi Jinping: “To get rich, Build road first” (要想富先修路).

As the Chinese people have become more prosperous, they have devoted their resources on improving their quality of living as per Chinese saying (琴棋书画) or “music, chess, book, painting”.

There has been a widespread nationwide learning, study and research of Chinese civilization as a major contributing factor to China’s modernization success.

The contributions of other B&R civilizations to Chinese civilization through the ages are also being acknowledged in China.

3.0 Role of Museums in Education in China

In China's current national preoccupation with the learning, understanding and research into her rich civilization which is the only uninterrupted civilization of more than 5000 years in the world, the role of museums is very important.

The Chinese Ministry of Education and the National Cultural Heritage Administration co-released a Guideline in October 2020 to illustrate better use of museum resources for schools. As the Guideline states, schools are urged to design new activities related to history, natural science and technology, based on collections in local museums. Syllabuses like Chinese language, history, geography, fine arts, physics, chemistry, biology etc will include museum content.

The booming development of Chinese museums after the reform and opening up has been amazing.

According to the statistics of the National Cultural Heritage Administration, 5,535 museums had been registered on the Chinese mainland by the end of 2019. The actual total number could be around 7,000 if it includes the museums affiliated to universities and other institutions. 76 percent of China's county-level administrative regions had at least one museum.

According to Administration statistics, over the past five years, minors accounted for 260 million visits annually to Chinese museums on average.

The popularity of museums in China is due to their displays being increasingly more interactive, attractive and immersive.

4.0 Application of Digital Technologies in Museums in China

In recent years, major museums in China have accelerated their digital transformation. Technology plays a massive role in the real-time management of artifacts.

Sensors monitor artifact warehouses for temperature, pressure, humidity, and other conditions that make it possible to optimize the environmental conditions for each artifact or set of artifacts. museums use RFID chips to tag artifacts and collect data, allowing the smart museum management software to automatically create work orders for staff, optimizing their time and efforts.

RFID and sensors in the museum's internet of things (IoT) ecosystem play a significant role in how the museum manages the security of its artifacts as well.

It is important to note that a majority of the technologies currently in use in the museums, and those expected to be implemented in the near future, are enabled by a robust 5G infrastructure.

The application of technologies in museums has brought high-definition, three-dimensional, interactive and virtual experiences for people.

The digitization of museum exhibits and displays in China has been a collective effort by museums, universities and high-tech corporations like Huawei , ZTE etc

5.0 Museums in Developing Countries

Most developing countries were colonies or semi-colonies of the West including Japan for several centuries. In fact, the first industrial revolution of 1784 with the invention of steam engine by James Watt led to the development and deployment of gunboats by the West to colonize and exploit the native populations in all corners of the globe.

In the process of extracting their natural resources, the colonizing powers also robbed most of the most precious relics of native civilizations to enrich their own museums.

Though with independence from colonial rule after the Second World War, every developing country government has been expanding exhibits and displays of her own civilization and culture in her national museum. Due to shortage of fund and lack of appreciation of the contributions of other civilizations and cultures to her own, few exhibits of other civilizations and cultures are included in exhibits in the national museum.

Their displays and exhibits are static and non interactive and are therefore badly in need of the application of digital technologies.

6.0 Virtual Belt & Road Civilization Museum

Media reports in China on the Belt and Road Initiative (BRI) in China seem to be focused on infrastructure projects being built and completed by Chinese construction corporations in Belt and Road countries. The civilization, cultural and people-to-people aspects of BRI receive no widespread publicity.

Chinese books on BRI that deal with the civilization aspects tend to focus on China reaching out like that of Zhang Qian of the Han Dynasty and Xuanzang of the Tang Dynasty. In fact until the Mongol invasion of Eastern Europe in the thirteenth century, no Chinese diplomats or merchants ventured beyond Central Asia. If not for the commerce-savvy Sogdian people of Central Asia with Samarkand as their capital trading between China and Europe, the Land Silk Road would not have been a reality.

As for the Maritime Silk Road, all attention is given to the seven epic voyages of Admiral Zheng He of the Ming Dynasty without giving attention to the peoples of Southeast Asia and Arabia who travelled to Guangdong and Fujian provinces that made two way exchanges in the Maritime Silk Road a reality.

I therefore suggest that the Virtual Belt & Road Civilization Museum should be set up in Chinese Museums to properly give importance to those Belt & Road civilizations that made and continues to make significant contributions to Chinese civilization.

Modern and smart museums in China should have little difficulty in achieving this task with their experiences in the application of digital technologies and with the assistance of technology advanced multimedia corporations and universities.

Using the Chinese civilization and dynasties as chronological reference, developments in Belt & Road civilizations can be documented digitally to complete the history of the Virtual Belt & Road Civilization Museum.

The Virtual Belt & Road Museum can be offered by China to national museums in Belt & Road countries as part of the Global Civilization Initiative.

As demonstrated by the "Meet Dunhuang"Exhibition, all that is required physically is a room or hall inside the national museum of a Belt and Road country with a 360 degree digital screen that surrounds visitors,

7.0 My Further Suggestions

The virtual Belt and Road Civilization Museum must tell human stories, not just cultural relics and song and dance.

For example, the Three Religion/Philosophy Hall of Hengshan Xuankong Temple is dedicated to Sakyamuni from Buddhism, Laozi from Taoism, and Confucius from Confucianism.

The Founders of the three great philosophies or religions were venerated in the same hall of the 1500 year old temple. It is a great story of the tolerant, embracing and absorptive underpinning of Chinese civilization.

Hengshan Hanging Temple Three Phisolophy Hall 恒山悬空寺三教殿

I also suggest that every museum in China twins with a museum in one of the Belt and Road countries to obtain important stories in the country's civilization so as to quickly complete the total story of the Belt and Road civilization.

Thank you all

2023尼山古典文明论坛
博物馆论坛
2023 年 9 月 26 日

“虚拟一带一路文明博物馆”

拿督 李怡章 马来西亚
发展中世界工程技术院 AETDEW 院长

1.0 全球文明倡议

2023 年 3 月 15 日，中国国家主席习近平提出“全球文明倡议”。这是习主席的第三项重大全球倡议。习主席在 2021 年提出的“全球发展倡议”和在 2022 年提出的“全球安全倡议”。

习主席呼吁尊重文明多样性、倡导人类共同价值，重视文明传承和创新，加强国际人文交流与合作。

全球文明倡议、全球发展倡议、全球安全倡议源自中国现代化的成功经验。 中华五千年文明 是这些伟大事业的支柱。

2.0 一带一路

2013 年习主席在哈萨克斯坦与印度尼西亚提出的“一带一路” 倡议, 唤醒了发展中国家的不同文明共同价值意识。古老的陆上和海上丝绸之路体现了 “一带一路” 合作,互学,互利 精神。

“一带一路”倡议取得 了丰硕成果，赢得了广大发展中国家的广泛支持和参与。特别是在发展中国家, 它创造了就业 机会，改善了基础设施，促进了社会经济发展。

中国本身就是“一带一路”成功的杰出典范。 2021 年，中国宣布了 8 亿人口脱贫的伟大成就。 这在人类历史上是绝无仅有的!

更令人惊奇的是，8 亿人已经进入小康社会。 即使在最偏远 的农村地区，中国也能满足人民的衣食住行、教育、医疗、就业等基本需求。

在此过程 中，中国不断改善环境，退沙还林还耕，整治河流湖泊，保护湿地，从而保护了动植物群。

中国消除贫困的成功基于遍布全国各地的实体和虚拟基础设施建设。

中国消除贫困的成功基于遍布全国各地的实体和虚拟基础设施建设。 习主席经常引用一句 中国古话：“要想富，先修路”。

随着中国人民变得更加富裕，他们将资源投入到提高生活质量上，正如中国俗话所说的(琴棋书画)。 全国广泛开展对中华文明的学习和研究. 中华文明是中国现代化成功的一个重要因素。

历代 “一带一路”沿线国家文明对中华文明的贡献也正在为中 国所承认。

3.0 博物馆在中国教育中的作用

当前，中国正致力于学习、理解和研究其丰富的文明，这是世界上唯一不间断的五千多年文明.

博物馆的作用对于儿童和青少年的教育非常重要。 中国教育部和国家文物局于 2020 年 10 月 联合发布了《指导意见》，阐述学校如何更好地利用博物馆资源。 学校应根据当地博物馆的藏品设计与历史、自然科学和技术相关的新活动。 语文、历史、地理、美术、物理、化学、生物等课程将包含博物馆藏品内容。 鼓励开展更多以博物馆为特色的课外活动。

改革开放后中国博物馆的蓬勃发展令人惊叹。据国家文物局统计，截至 2019 年底，中国已登记博物馆 5535 家，如果包括大学等机构所属博物馆，实际总数约为 7000 家。中国 76% 的县级行政区至少拥有一个博物馆。

据国家博物馆统计，近五年来，中国博物馆平均每年有2.6 亿未成年人参观人次。博物馆在中国之所以受欢迎，是因为它们的展示越来越具有互动性、吸引力和沉浸感。

4.0 数字技术在中国博物馆的应用

近年来，中国国内各大博物馆加快数字化转型。 技术在工件的实时管理中发挥着巨大 作用。 传感器监控工件仓库的温度、压力、湿度和其他条件，从而可以优化每个工件 或一组工件的环境条件。博物馆使用 射频识别 芯片来标记文物并收集数据，使智能博物馆管理软件能够自动为员工创建工作指令，从而优化他们的时间和精力。 博物馆物联网 生态系统中的射频识别和传感器在博物馆如何管理其文物的安全方面也发挥着重要作用。

值得注意的是，博物馆目前使用的大多数技术以及预计在不久的将来实施的技术都是由强大的 5G 基础设施支撑的。技术在博物馆中的应用为人们带来了高清、立体、互动、虚拟的体验。

中国博物馆展品的数字化是博物馆、大学以及华为、中兴等高科技企业的共同努力。

与我提出的虚拟一带一路文明博物馆的建议更相关的是中国对外文化集团有限公司的“遇见敦煌”光影艺术展。展览以敦煌文化艺术为核心，200 余幅敦煌壁画作品，通过 3D 光雕数字技术，在高 12 米、总面积超过 1500 平方米的展示空间，使用 48 台高清 投影，打造了一座全沉浸式光影世界，对敦煌壁画进行全新创作和演绎，震撼再现敦煌石窟文化的艺术魅力。

5.0 发展中国家的博物馆

大多数发展中国家几个世纪以来一直是包括日本在内的西方的殖民地或半殖民地。

事实上， 1784 年詹姆斯·瓦特发明蒸汽机引发的第一次工业革命导致西方国家开发和部署炮舰，以殖民 和剥削全球各个角落的土著居民。 殖民列强在攫取本国自然资源的过程中，也掠夺了本土文 明的大部分最珍贵的文物，以丰富自己的博物馆。

尽管在第二次世界大战后摆脱殖 民统治而获得独立，每个发展中国家政府都在其国家博物馆中扩大了本国文明和文化的展览 由于资金短缺以及缺乏对其他文明和文化对自己文明和文化的贡献的重视，国家博物 馆的展品中很少有其他文明和文化的展品。

他们的展示和展品是静态的、非交互的，因此急需数字技术的应用。

6.0 虚拟一带一路文明博物馆

中国媒体对中国“一带一路”倡议的报道似乎主要集中在中国建筑企业在“一带一路”沿线国家建 设和完成的基础设施项目上。“一带一路” 的文明、文化、人文等方面没有得到广泛宣传。

中国有关“一带一路”的书籍涉及文明和文化方面，往往侧重于中国像汉代张骞和唐代玄奘沿着 陆地丝绸之路向西旅程。 事实上，直到十三世纪蒙古人入侵东欧之前，还没有中国外交官或 商人冒险走出中亚。 如果没有精通商业的中亚粟特人，以撒马尔罕为中欧贸易的中心，陆上 丝绸之路就不会成为现实。

就海上丝绸之路而言，所有的注意力都集中在明朝郑和七次下西 洋的史诗般的航程上，而没有关注到东南亚和阿拉伯的人民，他们通过广东和福建两省进行了 双向贸易, 海上丝绸之路交流成为现实。

我建议中国馆群设立虚拟“一带一路”文明博物馆，适当重视那些曾经并仍在为中华文明作出重 大贡献的“一带一路”文明。凭借数字技术的应用经验以及技术先进的多媒体企业和大学的协助，　中国的智慧博物馆群应该不难实现这一任务。 以中华文明和朝代为时间顺序，以数字方式记录“一带一路”文明的发展，从而完成虚拟“一带一路”文明博物馆。

作为 “全球文明倡议”的一部分，中国可以向“一带一路”沿线国家的国家博物馆提供虚拟“一带 一路”博物馆。 正如 “遇见敦煌”展所展示的那样，所需要的只是一带一路国家国家博物馆内 的一个房间或大厅，有一个 360 度数字屏幕围绕着参观者. 这将使一带一路国家的博物馆实现现代化.

这将向所有一带一路国家讲述中华文明的故事, 促进全球文明倡议的早日实现.

6.0 我更多建议

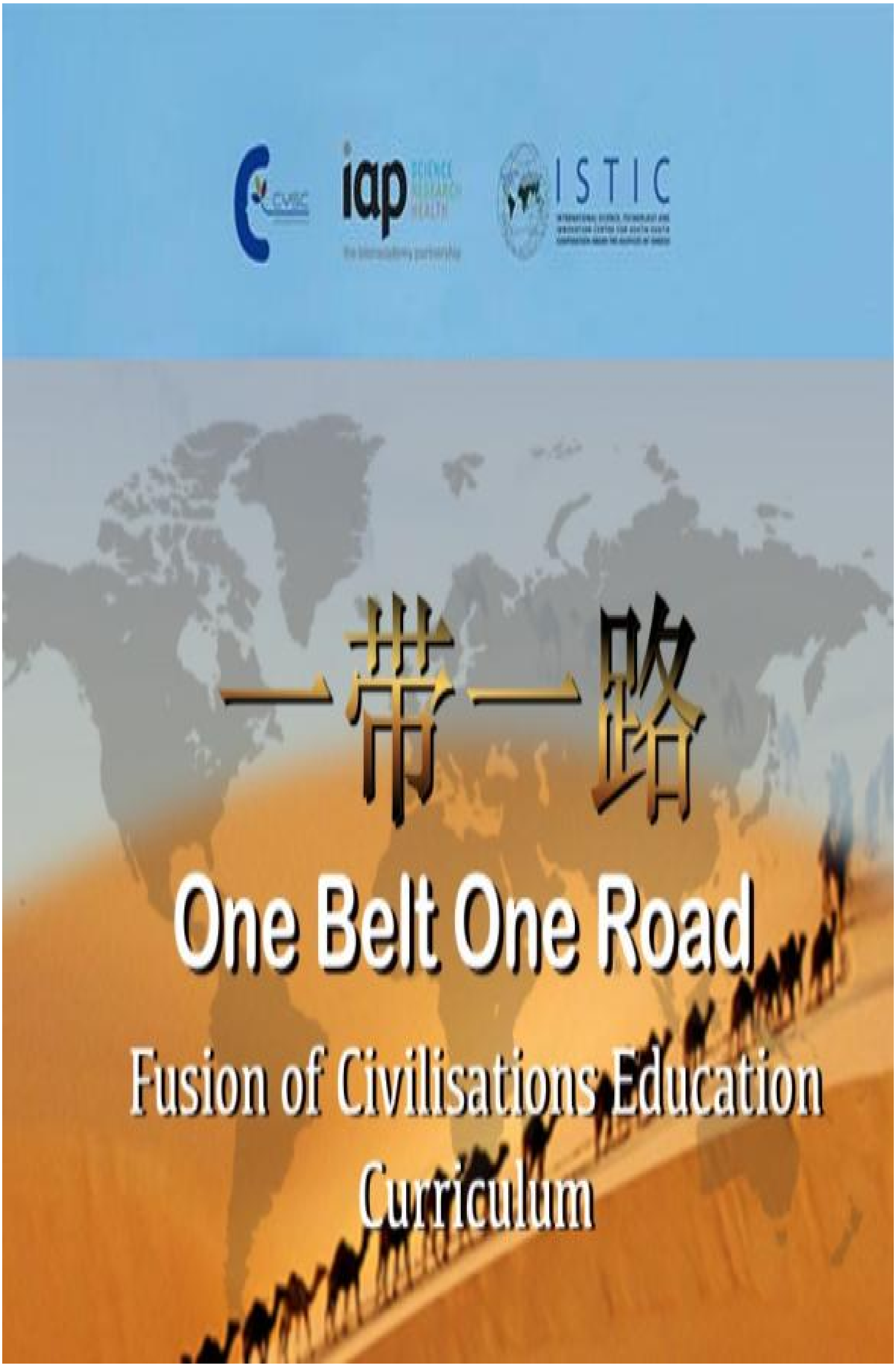
虚拟“一带一路”文明博物馆必须讲述人类的故事，而不仅是文物歌舞。例如恒山悬空寺三教殿，殿内供奉着佛教的释迦牟尼、道教的老子、儒家的孔子。三教始祖同堂供奉,堪称是中国文明史上的一段佳话。

三大哲学或宗教的创始人都在这座拥有 1500 年历史的寺庙的同一个大厅里受到崇敬。 这是中华文明包容、包容、吸收的伟大故事。

我还建议中国的每一个博物馆与一带一路国家的一个博物馆对接，获取其国家文明中的重要故事，迅速地完成一带一路文明的完整故事。

谢谢大家

ANNEX 3　附件 3


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

Preface

Fusion of OBOR Civilizations School Curriculum

Background

The curriculum

Definition of terms

Conceptual framework of FoCEd

Element of Content Areas

Teaching and Learning

Assessment

Curriculum Team

Organisers & Partners

Part 1 Land Silk Road

Overview

◎Unit1 Water Resource

Activity1.1 Windlass

Activity1.2 The Water Wheel

Activity1.3 An Oasis in the Desert

Activity1.4 The Water Pump

◎Unit2 Astronomy

Activity2.1 Astrolabe

Activity2.2 Telescope

Activity2.3 Pinhole Camera

◎Unit3 Architecture

Activity3.1 Pillars

Activity3.2 Roof

Activity3.3 Tower

Activity3.4 Dome

Part 2 Maritime Silk Road

Overview

Admiral Zheng He and Maritime Silk Road

◎**Unit1 Stars and Navigation Tools**

Activity1.1 Looking for Polaris

Activity1.2 Brightness of Stars

Activity1.3 Make Your Own Compass

Activity1.4 Modern Day Navigation Tools

Activity1.5 Let’s Design a Bicycle Route

◎**Unit2 Winds and Navigation**

Activity2.1 The Windsocks

Activity2.2 The Seasonal Winds and its Importance

Activity2.3 The Effects of Monsoon

Activity2.4 Monsoon for Voyages

◎**Unit3 Sailing Ships**

Activity3.1 How to Make a Ship Float

Activity3.2 The Water Line

Activity3.3 Water Clock

Activity3.4 Know Your Junk

Activity3.5 Make Your Junk Go Faster

◎**Unit4 Spices**

Activity4.1 Spices in My Favorite Food

Activity4.2 Food Preservation Experiment

Activity4.3 Testing My Own Laksa Recipe

Part 3 ASSEESSMENT

Assessment for OBOR Fusion of Curriculum

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

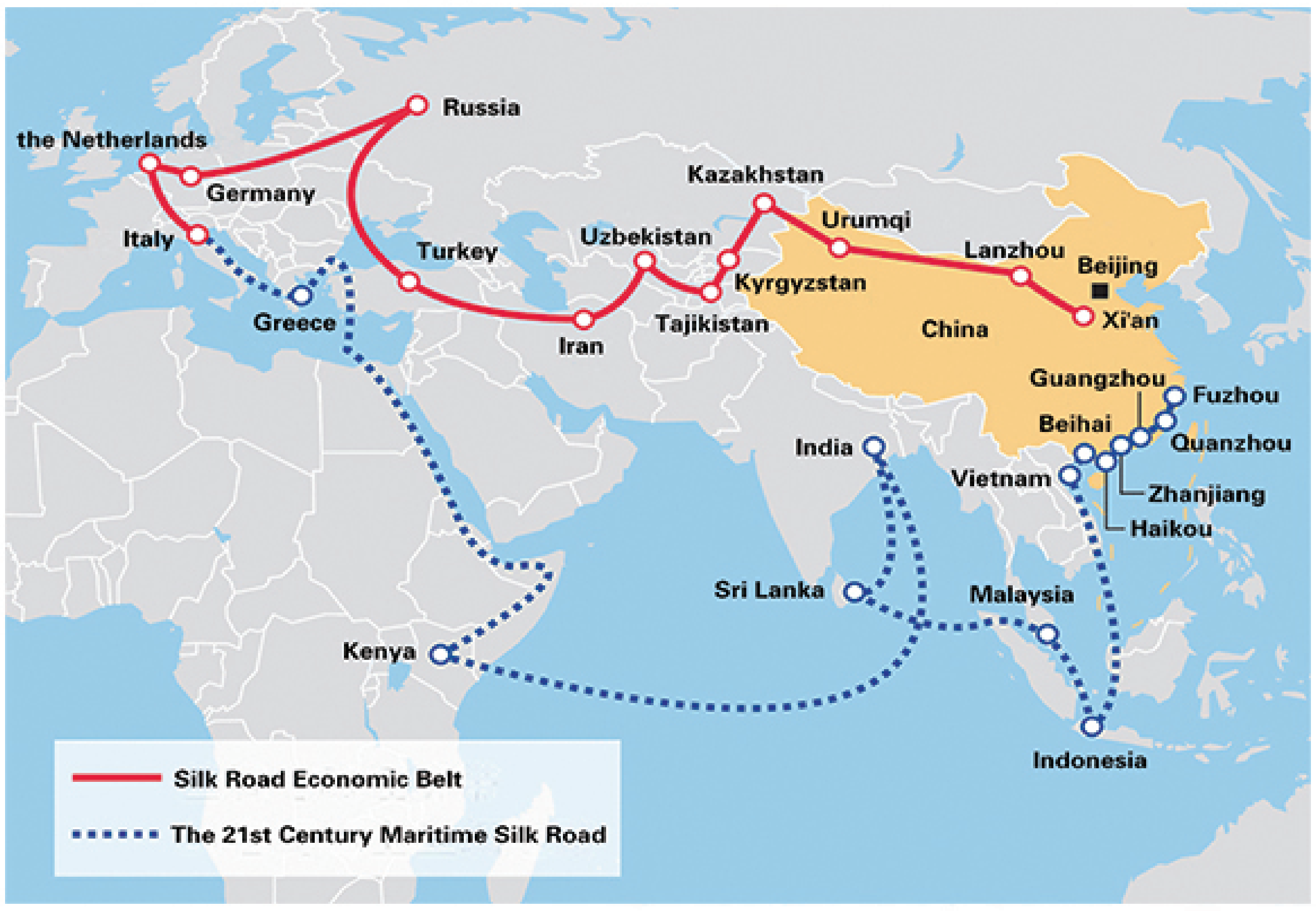
BACKGROUND

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.

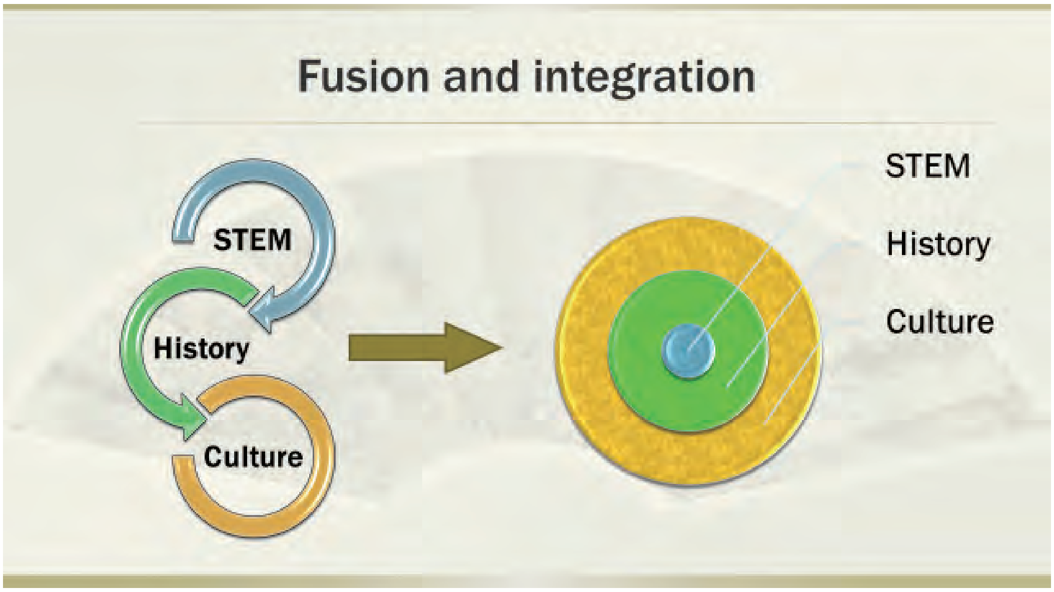
The increased of destruction of the world and humanity demands big shift of priorities in education. Education must prioritize world peace and harmony hand in hand with STEM for sustainable development. Education for peace and harmony may well succeed with the young.

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.

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

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.

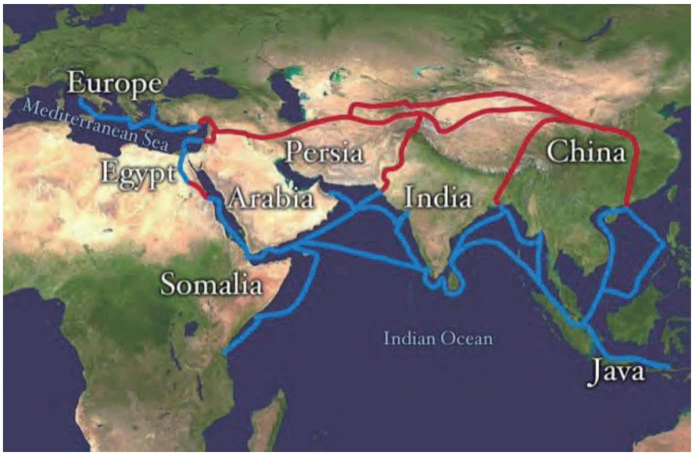
The Silk Road derives its name from the lucrative trade in silk carried out along its length, beginning in China's Han dynasty (207 BCE - 220 CE). The Han dynasty expanded the Central Asian section of the trade routes around 114 BCE through the missions and explorations of Chinese imperial envoy Zhang 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.

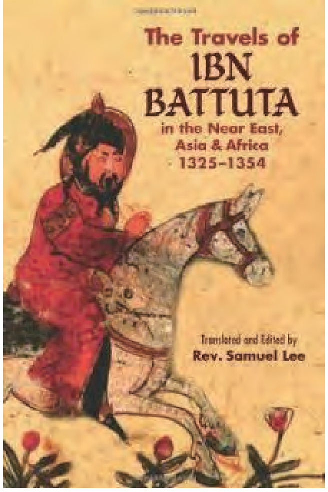
Trades on the Silk Road had played a significant role in the development of the civilizations of China, Korea, Japan, India, Iran, Afghanistan, and other regions in Europe, the Horn of Africa, and Arabia. Though silk was major trade items, many other local goods were traded along the Road as well. Many 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 mari–time 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 build–ings 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 ex–changes. Without this path, the world we live in today would be much differ–ent.

Now, let us revisit the Land Silk Road, and follow the footsteps of our ancestors to explore the development and application of science and tech–nology 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?

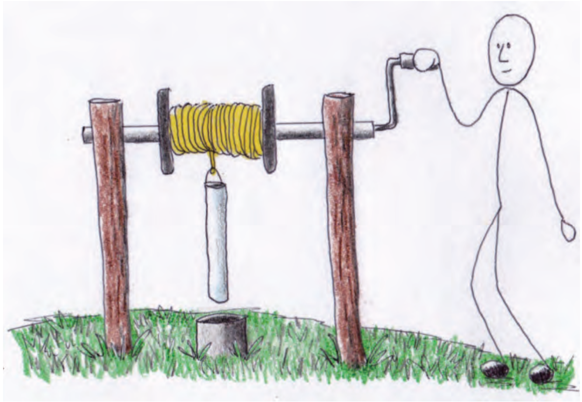
✳Reading materials for teachers

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

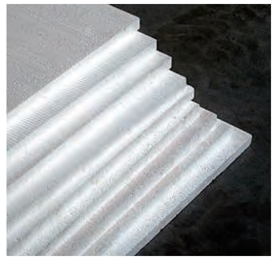
Materials

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?

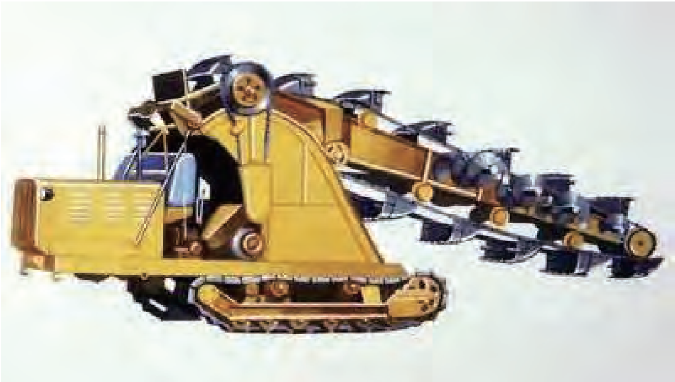
※Reading materials for teachers

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 movement 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

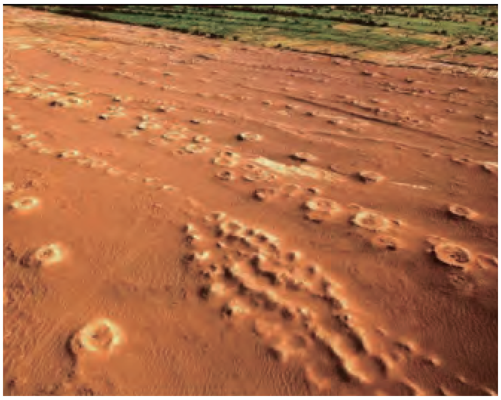
Pupils should be able to:

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

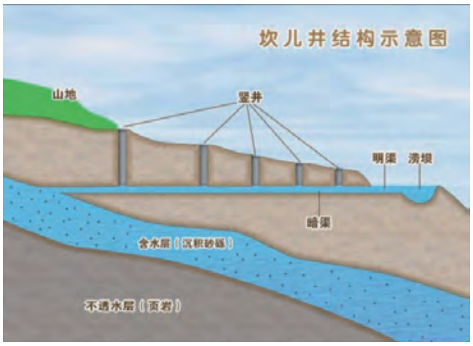
bamboo sticks

 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?

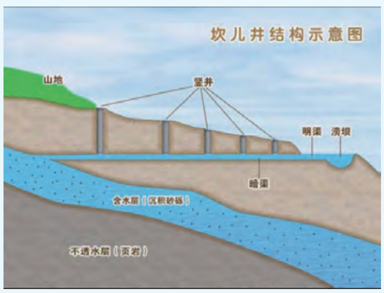
3.Besides teapots and karez, what other communicating vessels do you know in your life?

✳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:

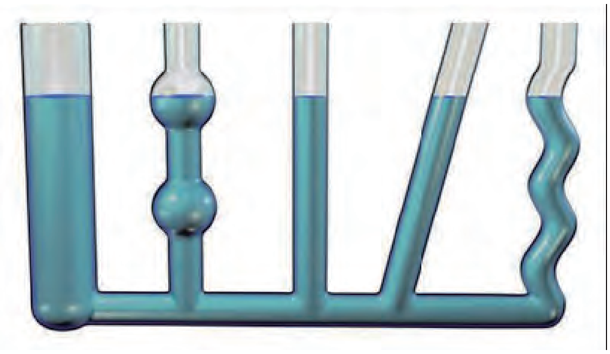
1. Human beings in adversity took actions corresponding to local circumstances, made up for the imperfect natural conditions, and created sophisticated civilizations. This spirit of never giving up and active mind are worth learning.

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 civili-zations 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?

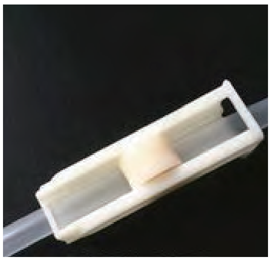
2.What is each part like?

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.

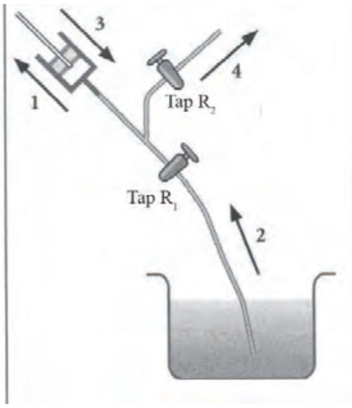
Suggested methods

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.

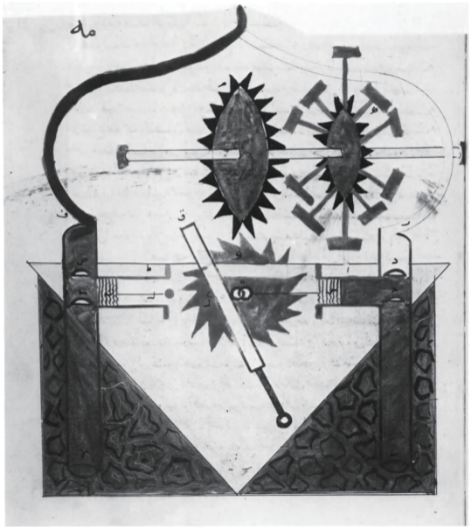
The photo of the model	What do you find?

✳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 vacu–

um, 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:

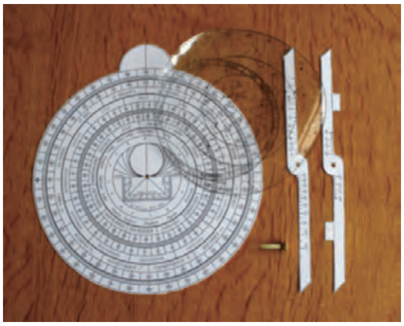
1.What is an astrolabe?

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 pictures of the astrolabe.

ii.Write the information on by whom was it invented and then who perfected 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).

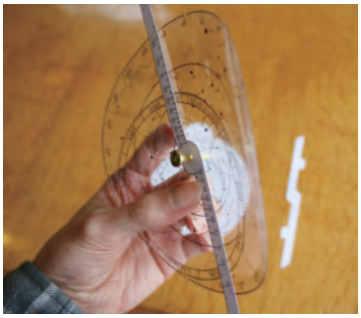
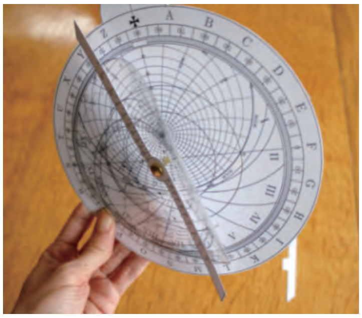
6.Superimpose these in order; the alidade, the mould (tympanum on the upper), the spider and the needle, and secure these with the Parisian clip in the centre.

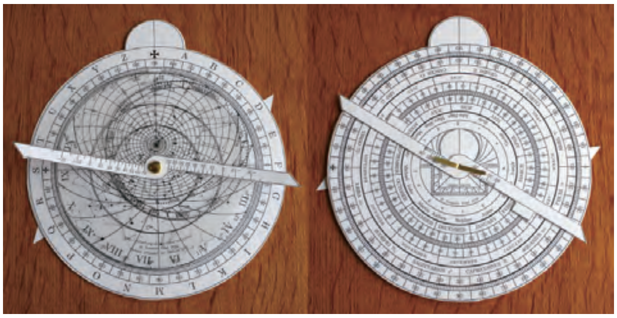
7.Stick a piece of straw on the length of the alidade.

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 instru-ments, 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 sec-ond 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 hemi–spheres: the upper hemisphere, where objects above the horizon are visi–ble, 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

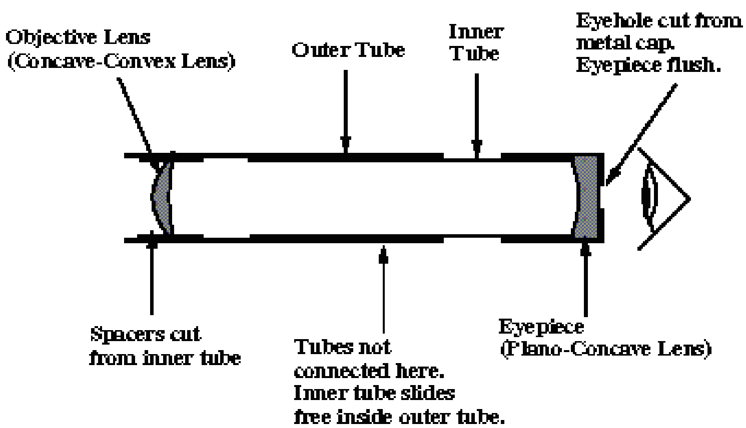
●Plano−concave lens: Diameter 47 mm, focal length 2000 mm

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 telescope

4.Test your telescope

✳Connectivity

Get the pupils to discuss:

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

2.What lenses is this optical instrument composed of?

✳Worksheet

For student

Name: Class: Date:

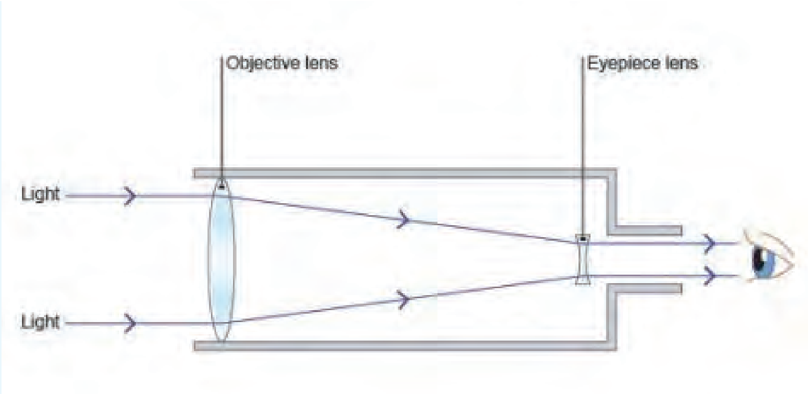
1、Use convex lens and concave lens respectively to observe objects, what do you see?

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.

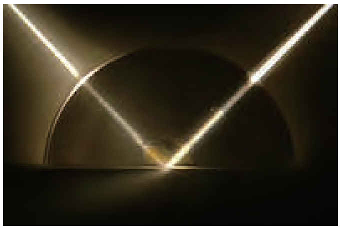
From the birth of the first optical telescope to Hubbe Space Telescope and Chinese FAST (Five–hundred–meter Aperture Spherical radio Telescope), the biggest spherical radio telescopes in the world, telescope has improved performances in full swing, which has pushed the astronomy to develop greatly and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

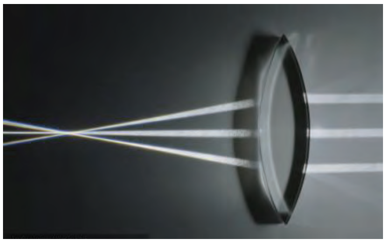


Prism: a solid geometric figure whose two end faces are similar, equal, and parallel rectilinear figures, and whose sides are parallelograms.

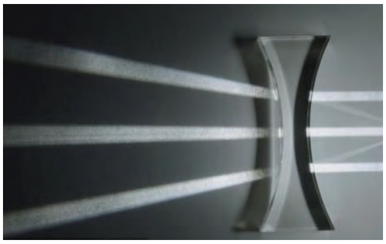
Lenses: A lens is a transmissive optical device that focuses or disperses a light beam by means of refraction. A simple lens consists of a single piece of transparent material, while a compound lens consists of several simple lenses (elements), usually arranged along a common axis. Lenses are made from 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?

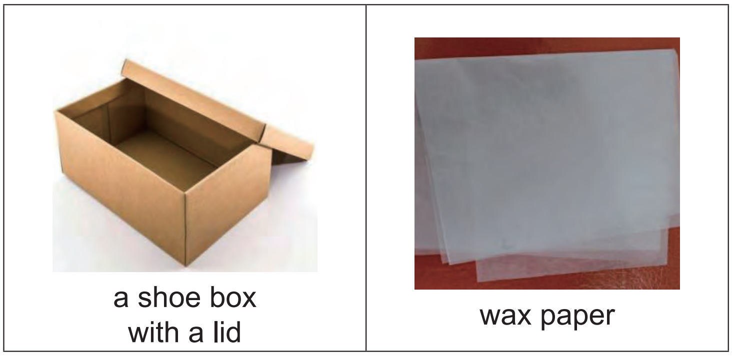
⁎Inquiry

Materials

A sharp pencil

A pencil knife

Scissors



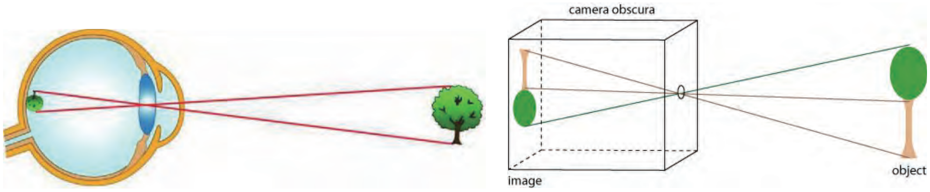
a shoe box with a lid	wax paper

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?

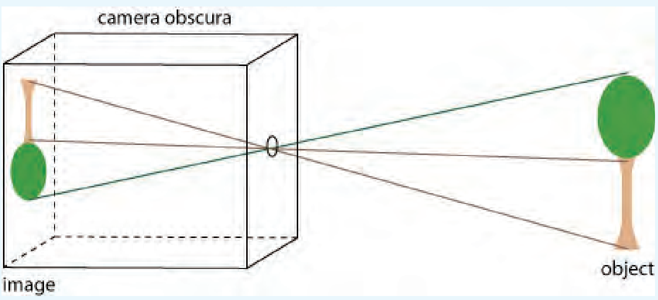
✳Worksheet

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	

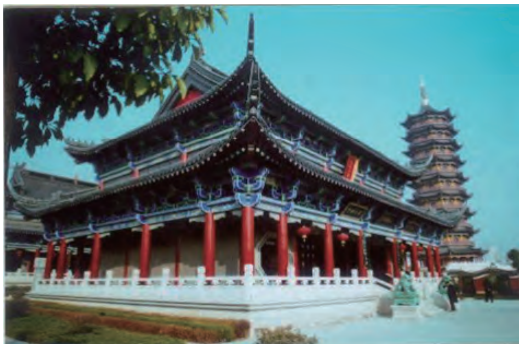
3. What do you find?

✳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 con-structed 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 tow-er 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

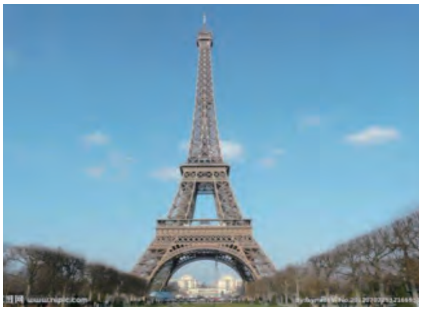
1. Observation

i.The characteristics and structure of the tower

a.Observe the tower in the picture below and think about the basic char–acteristics of the tower.

Oriental Pearl Tower, Shanghai of China

Kuwait Water Tower



Eiffel Tower, Paris

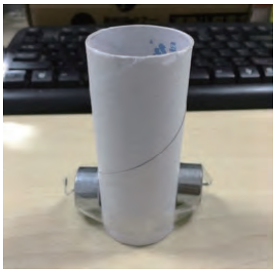
Porcelain Tower, Nanjing of China

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 egg–

shells 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

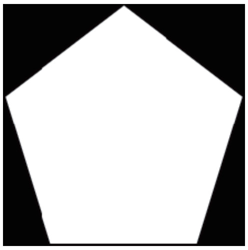
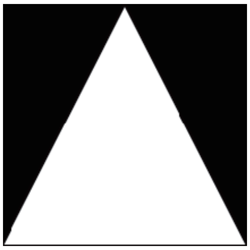
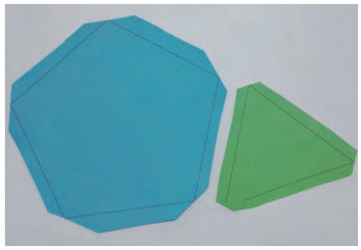
i.Does you model look like a dome?

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

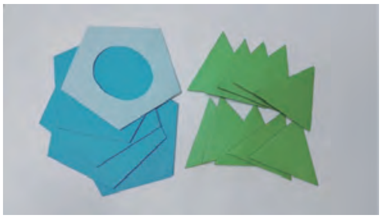
iii.Show your model to your classmates, and talk about what you have found in the process of making the model, and explain how you solved the problems you have met.

Suggested methods

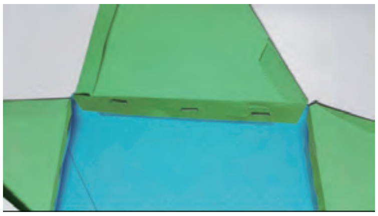
1.With an adult, measure and cut out the shapes below. The sides of each shape should measure 2 feet (about 61cm). You will need ten triangles with flaps on each side, and six pentagons. Put one pentagon aside to be the roof.

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, religious 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, Saiyid 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 advantage, 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.

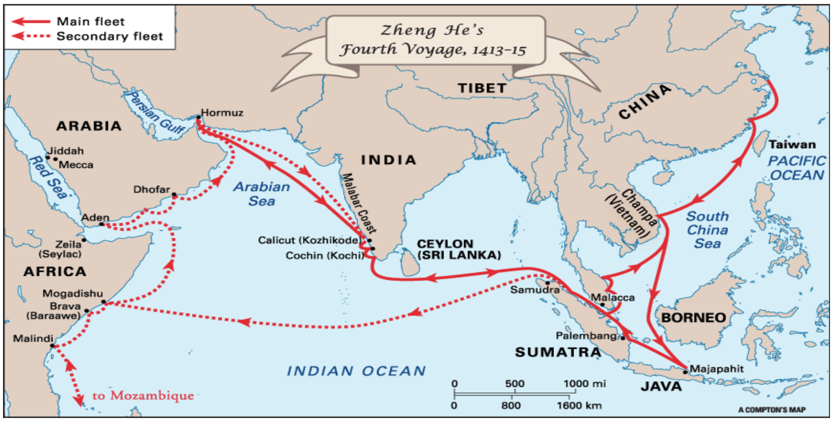
Zheng He loved going on adventures to foreign lands. He dreamed of becoming a navigator for the Chinese Emperor. To realize his dream, he worked hard to develop his knowledge, skills and experience to achieve his dream. With his strong will and dedication, Zheng He became a well–known strategist who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

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 Har–bor. 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 carda–mom, cinnamon, ginger, turmeric, and especially pepper from Calicut, gem–

stone 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.

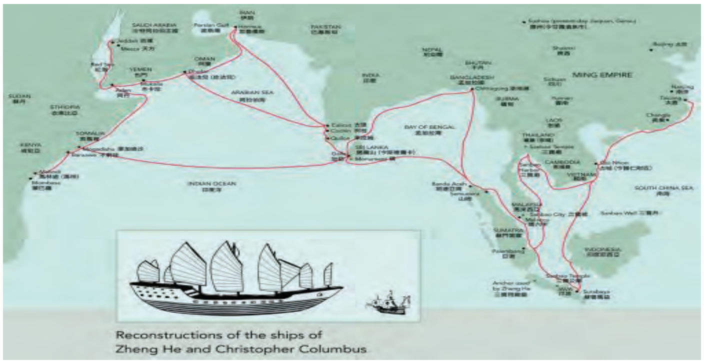
Stellar Diagram with instructions for navigation from Hormuz to Calicut

From Oman, Zheng He visited other countries like Calicut, Aden, Mak–kah, 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 sail–ing 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 inscriptions 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, Dhofar
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 achievement 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.

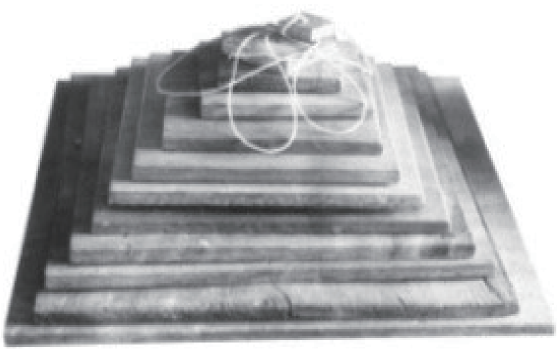
ZhengHe’s fleet was equipped with state-of-the-art navigation equipment and devices available at that time. The fleet employed the following three methods to determine its position: water depth positioning, landscape marker positioning and astronomical positioning.

✪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

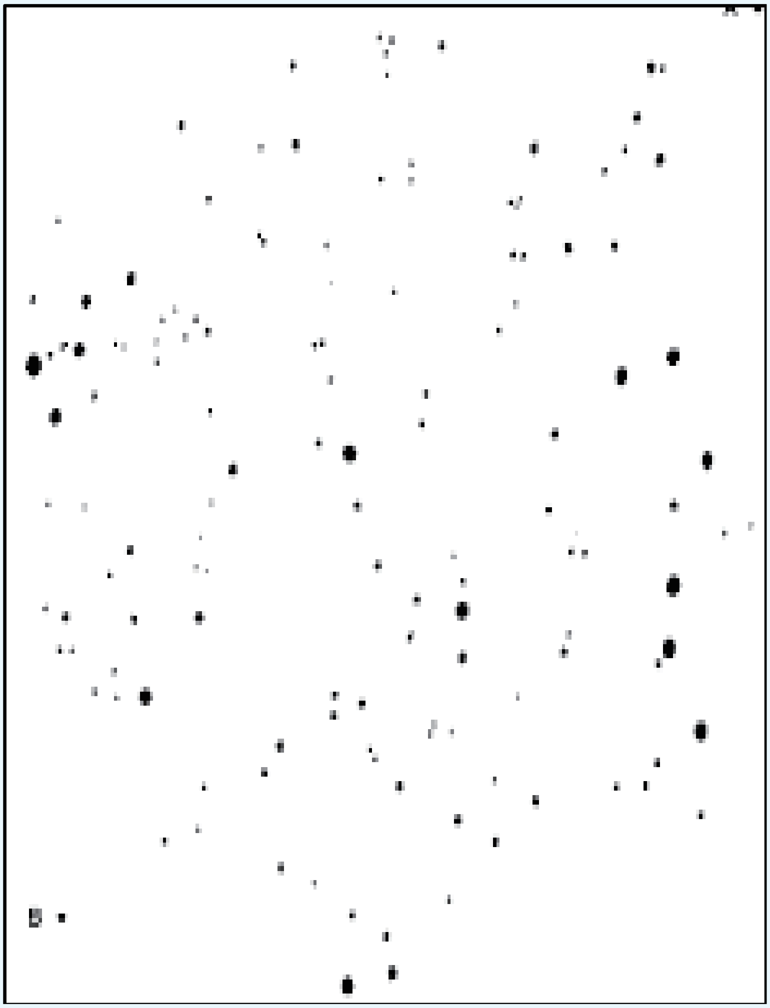
Worksheet 2

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.

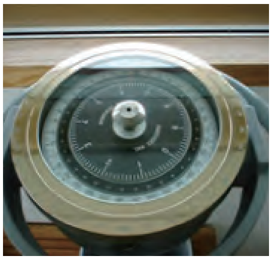
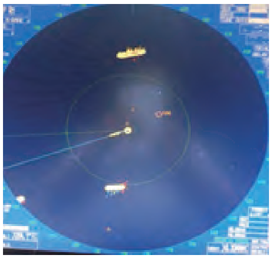
✳Focus Question(s)

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).

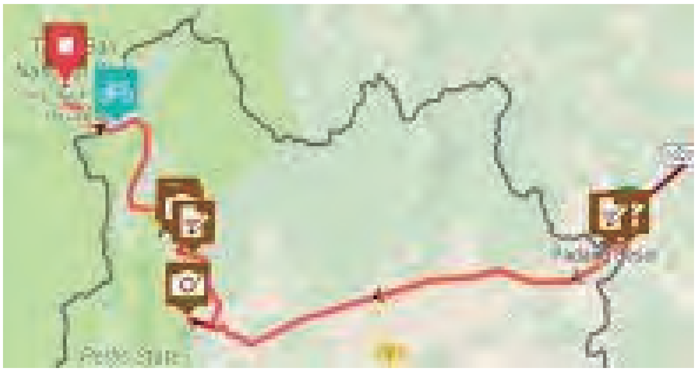
Bicycle

Procedure:

1.Use your GPS with a tracking GPX program to track your route, ex–plore 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

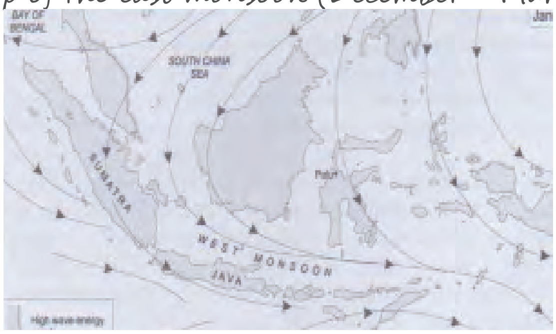
Malaka (now Malacca in Malaysia) is strategically located at the throat of the east-west sea route. From a small fishing village with its strategic location, Malacca developed into one of the busiest port in the 15th century. Hundreds of merchants from Arabia, Persia, India and China as well as Indonesian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

3.Describe how the early voyagers use their knowledge on the monsoon 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

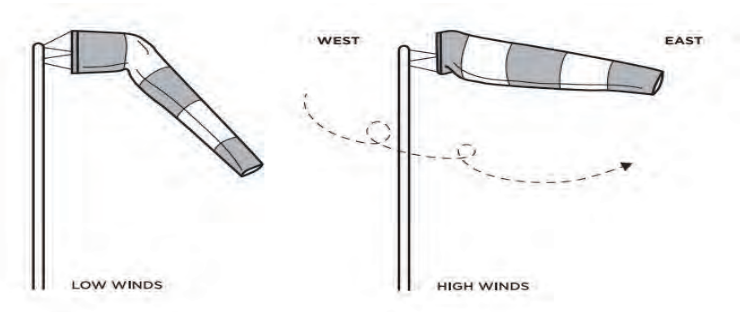
Double–sided adhesive tape

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:

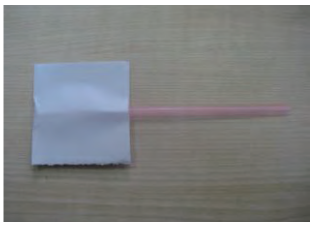
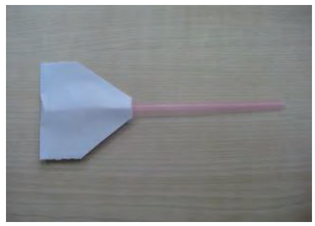
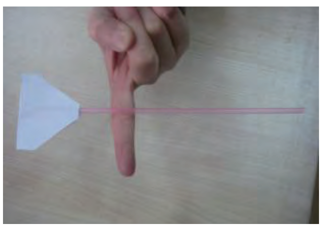
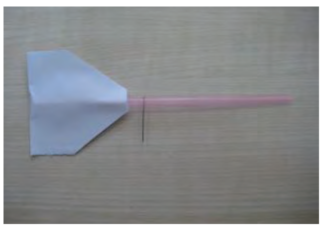
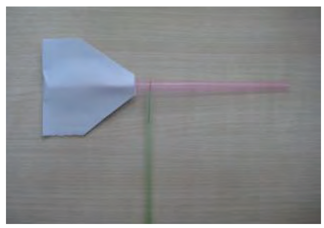
i.Cut the paper square and fold it in half.

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?

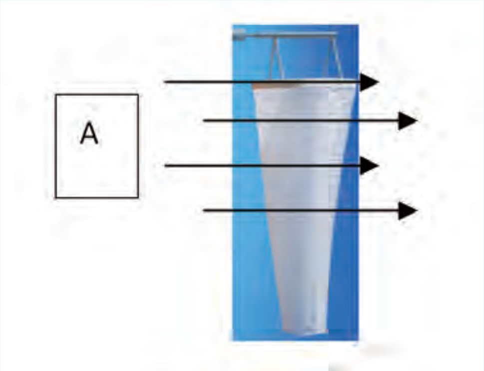
✳Connectivity

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

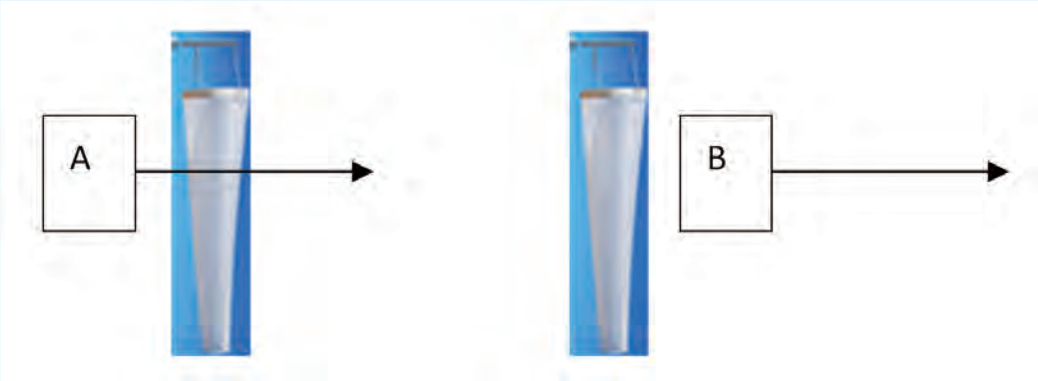
Name : Class: Date:

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

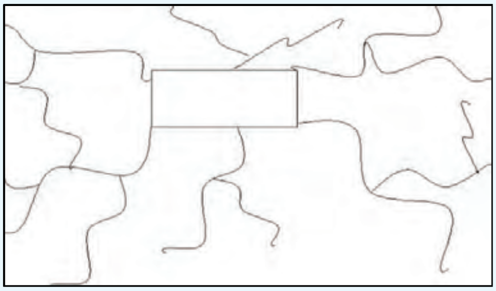
Discuss the importance of the countries in a region in working together and helping each other during the monsoon seasons. How could people from other states or countries help those who are affected by the monsoons?

✻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 influence 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 storing 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 century 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:

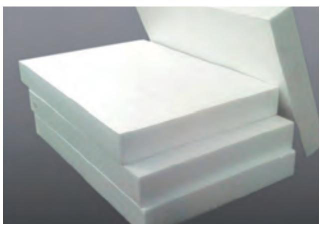
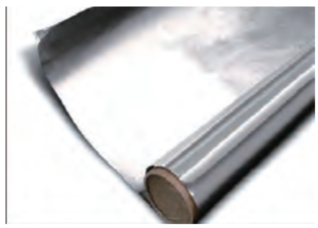
foam board
empty cans
mineral water bottles
ice cream sticks
disposable chopsticks
disposable tray
scissors
knife
super glue
any other material you would like

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?

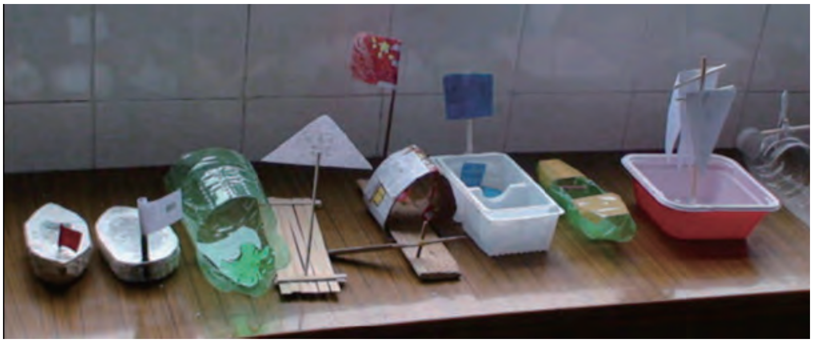
Fan the paper at different angles. Let it go, observe the distance when the paper is blown by the wind. And Consider how to harness the wind to fly the furthest.

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.

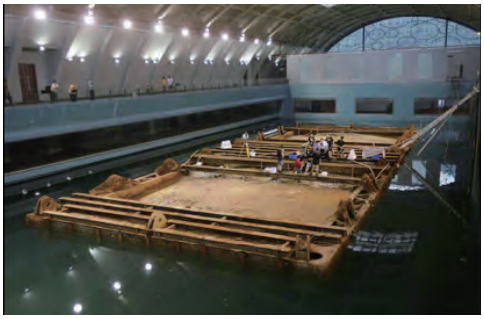
Chinese sailing ships are quite famous in the world. As early as the Qin Dynasty, people could build a large-scale sailing ship that was 30 meters long, 6-8 meters wide, and capable of carrying 60,000 kilograms. By the time of the Han Dynasty, a ship can be made about a hundred feet long. By the time of the Song Dynasty, large ships carrying more than 200,000 kilograms 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

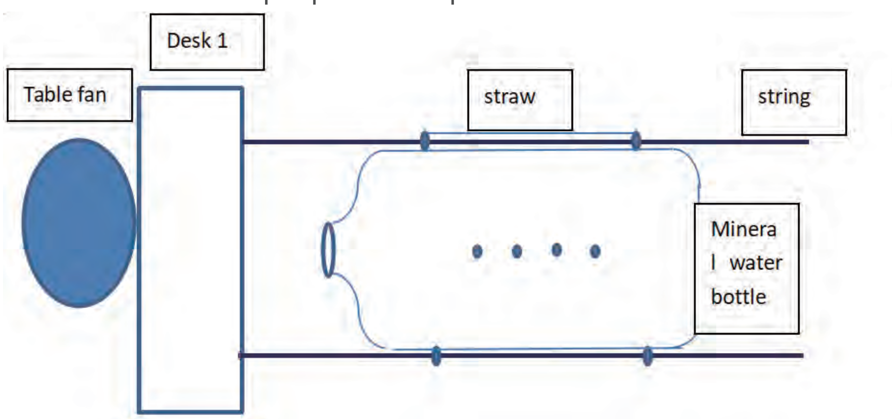
10.When your junk is ready, repeat the test on the same setting. Measure the time taken for your junk to move from one end to another. Record your data.

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 suggestions. 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 mo–tion 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 Pen–ang 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 interest–ing 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 nat–ural 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 preservation.

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 variable.

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, concentrated 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

<table>
<tr><td colspan="2">Purpose – what do you want to know</td></tr>
<tr><td>Create a hypothesis</td><td>Materials - what do you use:</td></tr>
<tr><td colspan="2">Experiment- how are you going to test your hypothesis</td></tr>
<tr><td>Prediction (for each container)</td><td>Observation (for each container)</td></tr>
<tr><td colspan="2">Conclusion- what did you find out?</td></tr>
</table>

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 ser-rated 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
中国科协青少年科技中心

AKADEMI SAINS MALAYSIA

SEAMEO Regional Centre for QITEP IN SCIENCE

อพวช. NSM

汉博

CYSC

iap SCIENCE HEALTH POLICY
the interacademy partnership

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

一带一路
文明融合教育课程

前言

"一带一路"文明融合学校课程

背景

课程设置

术语定义

文明融合教育的概念框架

内容领域要素

教学与学习

评估

课程团队

组织者和合作伙伴

第1部分 陆地丝绸之路

概述

第一单元 水资源

活动1.1 辘轳

活动1.2 水车

活动1.3 沙漠中的绿洲

活动1.4 水泵

第二单元 天文

活动2.1 星盘

活动2.2 望远镜

活动2.3 针孔相机

第三单元 建筑

活动3.1 柱子

活动3.2 屋顶

活动3.3 塔

活动3.4 穹顶

第 2 部分 海上丝绸之路

概述

郑和下西洋与海上丝绸之路

第一单元 北极星和航海工具

活动1.1 寻找北极星

活动1.2 恒星的亮度

活动1.3 制作自己的指南针

活动1.4 现代导航工具

活动1.5 让我们设计一条自行车路线

第二单元 风与导航

活动2.1 风向标

活动2.2 季风及其重要性

活动2.3 季风的影响

活动2.4 季风对航海的影响

第三单元 帆船

活动3.1 如何让船漂浮

活动3.2 水位线

活动3.3 水钟

活动3.4 了解你的帆船

活动3.5 让你的帆船走得更快

第四单元 香料

活动4. 1 我喜欢的食物中的香料

活动4.2 食物保存实验

活动4.3 测试我自己的叻沙配方

第3部分 评估

一带一路融合课程的评估

前言

“一带一路”文明融合课程是由国际合作科学教育计划（SEP）发起的一个项目，旨在促进陆地丝绸之路和海上丝绸之路沿线的教育、科技、文明和文化的融合。该课程旨在帮助学生更好地理解整个丝绸之路文明的创新所带来的共同利益，这种共同的利益一直持续到今天。该课程受到一带一路倡议的启发，这个倡议是中国政府采取的一个发展战略，涉及基础设施、投资、文化和教育发展以及亚洲、欧洲和非洲国家之间的交流。一带一路倡议已蔓延到美洲和太平洋岛屿，成为一个促进成员国和经济体对政治、经济和文化理解的全球倡议。

课程以模块的形式编写。该模块分为两部分，每个部分分别强调商人、旅行者、科学家、哲学家和冒险家所走的陆上丝绸之路和海上丝绸之路，他们不仅携带商业商品，而且引入科学创新，以及语言、文化、宗教和伦理价值观。这些叙述伴随着学生的活动，遵循基于探究的科学教育（IBSE）教学法，在该教学法中，学生有机会通过实践的方法来调查、发现和寻求解决方案，这种方法鼓励了思维技能的发展，符合当前学校科学教学方法的创造性。在叙述和活动中嵌入了一些可取的价值观，如尊重、容忍和合作，从而促进和平和理解。

我谨衷心感谢工作组成员为编写课程所作出的宝贵贡献。事实上，他们在课程开发和课堂实践方面的专业知识和经验已经将这些想法转化为适合小学教育水平的实际活动。如果没有以下组织的支持是不可能完成的：马来西亚教育部，中国南京的东南大学学习科学研究中心，中国北京的中国科学院自然科学史研究所，中国科学技术协会青少年科学中心（CAST），中国儿童科学教师协会的“边做边学”科学教育改革试点项目与智库，中国江苏省的“手脑教育”项目，巴基斯坦的阿迦汗大学教育发展研究所、SEAMEO科学教学和教育人员质量教学中心（QITEP）和泰国国家科学博物馆。我向这些组织表示感谢。

我还要感谢CAST、ECO科学基金会（ECOSF）、马来西亚科学院和联合国教科文组织（ISTIC）赞助下的南南合作国际科技与创新中心、吉隆坡、泰国国家科学博物馆促进各种讲习班的组织。我深切感谢校企伙伴关系为该想法的初步概念化和随后的工作组会议提供的宝贵建议和支持。

我十分感谢中国科学技术协会为模块提供的印刷资金。最重要的是，我十分感谢 IAP SEP 全球理事会及其国际咨询委员会同事们的鼓励和支持。

我衷心希望该模块能惠及尽可能多的教师和教育工作者，并希望该项目能实现其目标。我深信，小学教育阶段的这一课程将向全球其他地区，如美洲和太平洋岛屿的文明传播，并向中学和大学教育阶段的课程拓展。我对我们的儿童和青年充满信心，相信他们通过对文明融合的理解，将成为社会变革的推动者，引导我们的地球村走向和平与可持续发展。

拿督李怡章院士

IAP SEP全球理事会主席

2018年12月31日，吉隆坡

“一带一路 ”文明融合学校课程

背景

教育在培养未来公民方面发挥着关键作用。我们在教育计划中引入了各种科目，以确保实现主要的教育目标，例如，能够解决问题并进行批判性思考、具有创造力、关心并希望回馈社会、坚持不懈、正直且有自尊，有道德勇气，能够很好地利用周围的世界。

近来，在现有教育计划中实施文明融合课程的想法一直备受争议。人们认为，这是促进世界和平与人类和谐生活的新方法。通过了解和很好地感受不同文明对当今知识的贡献，孩子们就会认识到和平与和谐生活的必要性和重要性。基于这一前提制定和开发了文明融合教育（FoCEd）课程，以满足需求。

该项目的原因是，鉴于目前的冲突和社会暴力的增加以及导致暴行和流离失所的恐怖主义，需要通过对儿童进行基于证据的科学教育来灌输和平与和谐理念。

中国的“一带一路 ”倡议

丝绸之路经济带

21世纪的丝绸之路

有必要编制关于文明融合的课程，重点介绍每种文明在文化、贸易、科学和技术方面的发现和贡献，以及它们通过陆上和海上丝绸之路对其他文明产生的有益影响。这将有望向年轻人灌输互相尊重的思想，促进宽容、理解和尊重彼此的文化和传统。

制定“一带一路 ”教育论坛课程的思路是，“一带一路 ”（B&R）倡议沿线各文明发现之间的联系，以及这些发现如何影响“一带一路 ”沿线国家和地区的文化和文明，从而改善人类状况。让儿童了解相邻文化和文明之间的联系，可以向他们灌输和平与和谐共处的重要理念。课程内容还包括B&R沿线大旅行家的作用，他们帮助传播了B&R文明的融合。

中国的“一带一路”（OBOR）倡议赋予“一带一路文明融合课程设计”项目以现代意义，“一带一路 ”倡议通过实体、网络和文化的互联互通，改善发展中世界的人类状况。

科学院间合作伙伴关系（IAP）与科学教育计划（SEP）融合“一带一路文明课程设计”项目的灵感来源于两个“La Main a la pate”（LAMAP）主题项目，即以伊斯兰黄金时代的突破性发现为基础的“穆斯林国家的发现”，以及欧洲文艺复兴时期伊斯兰知识和技术转移所带来的“欧洲国家的发现”。通过古代丝绸之路，伊斯兰的发现向东与印度和中国的文明相互影响。

这个科学院间合作伙伴关系（IAP）与科学教育计划（SEP）项目以伊斯兰黄金时代的原则为基础：在全世界自由地寻求和分享知识；不仅在科学方面，而且在宗教、诗歌、文学、音乐和艺术方面也涉及到相关知识。

2017年2月在苏丹喀土穆和2017年7月在中国的北京举行了两次科学院间合作伙伴关系（IAP）与科学教育计划（SEP）论坛, 让科技历史学家和课程设计者讨论了这一概念。该研讨会组建立了一个由课程设计者和科学传播者组成的工作组，着手编制学校课程。随后在吉隆坡举办了一次工作组研讨会。在吉隆坡举行的工作组研讨会完善了编写的文件，收集了与框架相关的详细信息，解释数据，编写课程初稿。随后, 在巴基斯坦伊斯兰堡举办了另一个讲习班，审查了教材草案。

课程设置

> 科学、技术、工程和数学（STEM）教育已被公认为增强儿童天生好奇心和创造性本能的工具，以应对工业4.0和全球数字经济的快速发展。
>
> 因此，强调和促进STEM教育的重要性，特别是基于证据或探究的科学教育（IBSE）方法论在许多国家的教育计划中得到了非常多的重视。

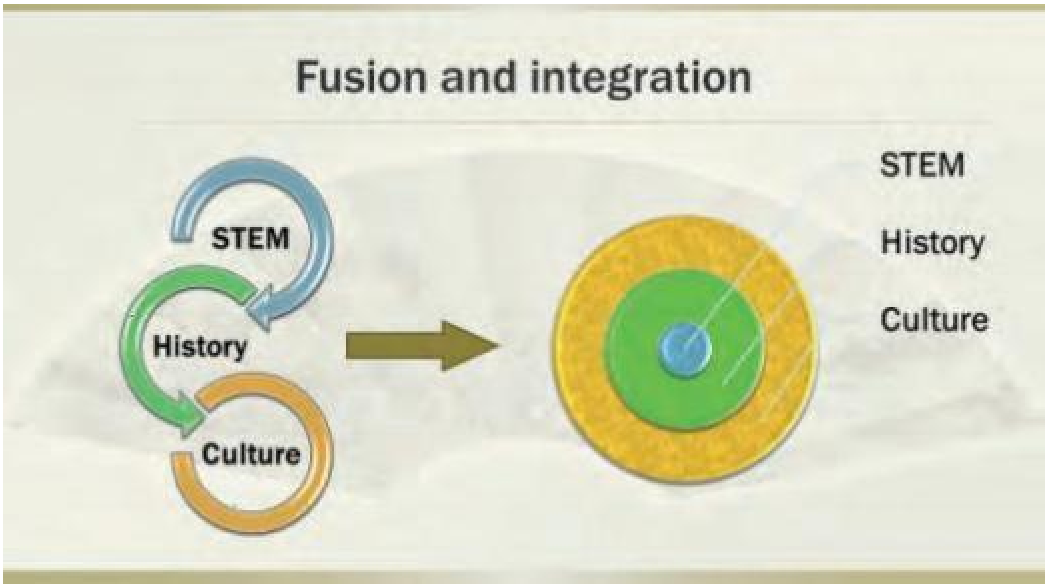
近几十年来，STEM人力资本的提升极大地改善了人类的生活条件；同时也极大地增强了传统武器的杀伤力以及网络战争中令人胆寒的军事硬件。因此，战争和冲突更具破坏性。

教育必须优先考虑世界和平与和谐，并与STEM并驾齐驱，以实现可持续发展。和平与和谐教育很可能在年轻人身上取得成功。孩子们不仅天生好奇，而且天性善良。在这个互联网和数字时代，儿童更善于通过社交媒体获取和分享信息知识。反过来，他们可以向父母和社区传播和平与和谐的信息。事实上，他们可以成为促进和平与和谐的社会变革的真正推动者。

课程重点

课程的重点是STEM教育、历史和文化。历史是我们最好的老师。古代丝绸之路的辉煌表明，地理上的距离是无法克服的。但如果我们勇敢地向彼此迈出第一步，我们就能开始走上通往友谊、共同发展、和平、和谐和更美好未来的道路。

历史也是一面镜子。只有以史为鉴，世界才能进步，人类才能更美好。过去无法改变，但未来可以塑造。



术语定义

文明

人们在社区中和平共处的发展水平。

文明融合（FoC）

文明融合是不同文明之间的联系，它们有助于当今的知识，并带来全球和平与和谐。

FoC教育（FoCE）

文明融合教育是一种与文明融合有关的教育，是促进学习和获取知识、技能、价值观、信仰和习惯的教学过程。

FoCE课程.

文明融合教育课程是一套实现文明融合教育具体目标的计划和安排，包括目的、内容、学习资料，以及如何使用其作为学习活动的指南。

文明融合教育的概念框架

目的：

文明融合教育旨在通过对由古代智慧驱动的当前科学知识和发现的理解，促进对其他文化的宽容和尊重，以灌输全球和平与和谐理念。

目标：

文明融合教育的目标是使学生能够：

将知识和科学过程确定为解决问题的共同方法。

描述早期发明与现代创新之间的发展和联系。

欣赏来自不同文明与发现的贡献。

展示促进和平与和谐的团队合作。

内容领域要素

文明融合教育课程框架包括：大理念、概念、能力和连通性。不过，水平和标准应由各国自行决定，以规划、采用和调整文明融合教育框架和教材。

大理念：描述超越年级水平的主要概念的声明性陈述。大理念对于使学生关注具体的科技内容至关重要。从“一带一路”倡议中可以看出，这两个大理念是：

●水

●陆

概念：描述学生应该获得的东西，即知识、技能、价值观、信仰和习惯，在每一个大理念下，这些与文明融合有关的概念都是特定年级教学的结果。

研讨：描述不同文明之间的联系，这些文明为当今的知识做出了贡献，从而接受差异，实现和平与和谐。这些文明包括“一带一路”沿线国家古代文明的发现者和发明者，他们为当今的创新做出了贡献。

能力：描述学生通过教学应该知道什么，能做什么，以及能够对文明融合感知到何种程度。对能力的描述应具体到年级水平。

框架

大理念	概念	连通性	能力	等级和标准
通过海洋来探索世界	•知识（科学与技术、天文学、文化、语言） •价值观、信仰和习惯：支持（权力、资金和人力）；供养（保护、物品、关系、和谐）、宗教/信仰，克服旅行中的问题。	•发现：阿斯罗拉贝-发明者：希腊文明（罗马和希腊），公元前220年，被伊斯兰阿斯罗那末(穆罕默德法扎里生活在8世纪）改良为祈祷用的奇布拉 •建议的活动：制作指南针	学生欣赏文明的多样性 •批判性思维-比较和对比 •沟通-描述 •协作 •创造力开发和设计	由各自国家负责

通过陆地来探索世界。	•知识（科学技术、天文学、文化、语言）； •价值观、信仰和习惯：支持（权力、资金和人力支持（权力、资金和人力）、供养（保护、物品、关系、和谐）、宗教/信仰，克服旅行中的问题。	•发现:坎儿井/暗渠； •（地下水）发明者：波斯人（伊朗）（起源于3000年前的伊朗--从那里慢慢向西和向东传播--在许多国家流传至今； •建议的活动：制造水泵、风磨机、水磨机（不同管理水的方法）。	学生欣赏文明的多样性 •批判性思维比较和集中； •交流描述； •协作； •创造力开发和设计。	

教学与学习

为了在培训与学习实践中落实文明融合的概念，建议参考摩洛哥的伟大旅行家伊本・白图泰和中国的郑和。他们被认为是描绘不同文明之间互联互通的标志性人物。在课堂上，可以通过讲述伊本・白图泰和郑和下西洋这两位伟大旅行家的故事来传播文明融合教育课程的概念。

故事讲述将引出课堂活动，这些活动强调以学生为中心，基于探究式科学教育（IBSE）包括基于问题/项目的学习（PBL）和情境学习。

探究式科学教育已被公认为是一种有效的科学教学方法。根据科学院间合作伙伴关系（IAP）与科学教育计划（SEP），探究式科学教育是一种科学教学方法，它源于对学生学习方式、科学探究本质的理解，以及对要学习的基本内容的关注。它还基于这样一种信念，即必须确保学生真正理解所学内容，而不是简单地重复学习内容和信息。他们使用科学家所使用的技能，如提出问题、收集数据、推理、根据已知信息审查证据得出结论和讨论结果。（IAP 2011）

良好的教学和学习可以满足21世纪在未来保持繁荣所需要的技能。

这些技能包括：

- 批判性思维
- 表达
- 协作
- 创造力

模块

课程以模块形式呈现，分两部分编写。第一部分包括陆上丝绸之路，涉及摩洛哥伊本・白图泰的旅行。这部分重点介绍了他在中亚洲地区技术进步的观察。第二部分重点介绍了中国著名探险家郑和的旅行。郑和是中国着名的探险家。他的航行带来了商品和文化贸易。他的大船配备了当时最先进的航海工具，并且他的船队配备了各司其职的工作人员。

教师指南

这些模块与大多数国家的小学科学教学大纲相一致。

为这些模块选择的活动基于科学过程技能，而不是科学事实或原理。因此，这些模块可用于任何水平的小学生作为寻找答案的方法，探究过程可以无限制地应用。每项活动都以一个故事开头，然后是水平、目标和主要焦点问题。还说明了开展活动的步骤和使用的必要材料作为指导，此外，还提供了术语解释，术语解释强调了学生在使用这些单元时将学到的单词。

建议本模块与相关科学主题教学结合使用，或在相关科学主题教学后不久使用，或作为课外活动使用。教师可根据学生的需要和能力自由调整。

建议的教学资源

鼓励教育工作者根据伊本·白图泰和郑和下西洋的经历，改编和采用教学材料。鼓励教育工作者通过改编和采用以伊本·白图泰和郑和下西洋为题材的教学材料，在实施幼儿教育方面取得进展。

下表总结了他们在一带一路国家访问的时期和访问的地方。

<table>
<tr><th></th><th>伊本·白图泰(1325-1354)</th><th>郑和(1405-1433)</th></tr>
<tr><td>1</td><td colspan="2">斯里兰卡、马六甲海峡、马来西亚（马六甲）、印度尼西亚、（萨穆德拉/苏门答腊岛/帕赛）、越南</td></tr>
<tr><td>2</td><td colspan="2">中国（广州、福建、杭州、北京）</td></tr>
<tr><td>3</td><td colspan="2">印度（卡利卡特）</td></tr>
<tr><td>4</td><td colspan="2">马尔代夫</td></tr>
<tr><td>5</td><td>中东（Makkah）</td><td>中东（麦加、亚丁、德法）</td></tr>
</table>

6	非洲（廷巴图）	非洲(摩加迪沙，巴拉维，桑给巴尔，Mombasa)
7	摩洛哥（马拉基什、非斯、丹吉尔)	
8	印度（德里）	印度（卡利卡特、科钦）
9	中亚（巴格达、大马士革、波斯，乌兹贝基桑，布哈拉，Afganisan，Samarkhan）	
10	小亚细亚(安纳托利亚，康桑蒂诺)	
11	欧罗巴(西班牙，格拉纳达，瓦伦西亚，科尔多瓦，威尼斯）	

一些推荐资源：

- 伊本 •白图泰：穿越世界的人（纪录片）
- 中国宝藏舰队的冒险家郑和（纪录片）
- 伊本・白图泰在加州大学伯克利分校的旅行（伊本・巴图塔的旅行和学生活动的时间轴）
- 现有相关的文明融合课程
- LAMAP/ISTIC“在伊斯兰国家的发现”英文版
- 1001发明
- 中国的天才

评估

评估是教与学的重要组成部分。在IBSE中，应该有一个良好和有效的措施来提供关于教学方法的有效性的信息，在这种情况下是探究性科学教育。评估包括基于课堂的评估、测试和考试。因此，它涵盖了学生所从事的活动，如日常工作由教师提供的书面或实际任务。

这个数据可以通过教师的观察、测试、学生工作表、实验/实际活动的结果、由教师或外部机构进行的测试结果来收集。这些数据可以根据其他学生的表现、标准和学生以前的表现来判断。判断可以由教师口头传达，可用一个分数或百分比、一个成就的概况、或一个等级或排名进行判断。

本模块中使用的评估项目是基于学生与预期表现相比所能做的事情。

课程团队

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 Learn-ingScience, Southeast University, Nanjin, Jiangsu Province, China.

4. Dr. Chen Wei, Associate Professor, Institute of the History for NaturalSciences, 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 forEducational Development, Pakistan.

6. Dr. Indarjani, Deputy Director for Programme, SEAMEO Regional Divisionistory curriculum expert and former head of History, Curriculum Development Division, Ministry of Education Malaysia. Center for QITEP in Science, Bandung, Indonesia.

7. Dr. Aphiya Hathayatham, Vice-President, National Science Museum,Thailand.

8. Datin SeriNorzamani Abdol, Deputy Director, School Management

9. Mrs. Zainon Abd Majid, Head of Science Unit, Curriculum Develop-mentDivision, 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 scienceofficer Curriculum Development Division.

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

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

组织者和合作伙伴

组织者

科学院间合作伙伴关系 科学教育计划（IAP SEP）

全球IAP科学教育计划（IAP SEP）于2003年启动。IAP SEP 的主要努力一直集中在促进基于探究性的科学教育（IBSE），它强调一种实践科学教学的方法,特别是对小学生。这是一种试图引导教师和学生远离死记硬背式学习和过于依赖教科书、发展思考和分析技能的教学法。这是为了确保创新和创造性的年轻STEM专业人员的发展。科学院间合作伙伴关系(IAP)与科学教育计划(SEP)项目还侧重于提高普通人群的科学素养。

合作伙伴

马来西亚科学院（ASM）

马来西亚科学院（ASM）是一个法定机构，于1995年2月1日生效，

并根据《1994年科学院法》成立。

作为国家在科学、工程、技术和创新方面的思想领袖，ASM向政府提供战略咨询报告。ASM还执行为发展科学、工程和技术方面的人力资本作出贡献的方案，因此，ASM与国家、国际组织和国际网络进行合作，以实现这些目标。

马来西亚科学院的Dato’Ir.(Dr)Lee Yee Cheong（马来西亚）任期内担任IAP与SEP项目的学院领导，并全球理事会主席(2013-2018)。

南南合作国际科学、技术与创新中心（ISTIC）

ISTIC是联合国教文组织主办的国际组织，根据马来西亚政府与联合国教科文组织之间的协议以及2007年联合国教科文组织大会的决议而建立。

ISTIC的活动范围是全球性和区域性的，有助于联合国教科文组织的战略目标。ISTIC的主要目标是提高整个发展中国家管理科学、技术和创新的能力，促进政府、学术界和工业界之间的合作，促进公共和私营部门之间的知识转移，发展参与国规划良好的、基于相关知识的方案和机构，在国际一级发展网络和合作培训方案，支持发展中国家之间科技术人员的交流，促进交流以及传播信息。

ISTIC是在科学、技术和创新方面，利用77国集团+中国的网络和伊斯兰会议组织（OIC）进行南-南合作的国际平台。

经济合作组织科学基金会（ECOSF）

经济合作组织科学基金会（ECOSF）于2011年12月在巴基斯坦伊斯兰堡成立, 是经济合作组织（ECO）的一个政府间专门机构，负责促进成员国之间的科学、技术和创新研究合作以及其他相关活动，从而促进该地区的经济发展。成员国包括：阿富汗伊斯兰共和国、阿塞拜疆共和国、伊朗伊斯兰共和国，哈萨克斯坦共和国、吉尔吉斯斯坦共和国、巴基斯坦伊斯兰共和国和塔吉克斯坦共和国、土库曼斯坦、土耳其共和国和乌兹别克斯坦共和国。

为了加强面向子孙后代的科学基础和该地区的经济，该基金会采用基于探究的科学教育（IBSE） 的方法，促进学校层面的科学教育。为了确保ECO地区更好的工程资格标准，ECOSF与教科文组织也根据FEIAP标准主动进行工程资格标准化。这将使工程师不仅可以在ECO地区旅行，而且可以在世界其他地方旅行。

此外，动员和促进青年参与科学、技术和教育，以促进经济合作组织地区内外的经济发展与和平，仍然是经济合作与发展组织论坛的优先事项。将性别观点纳入旨在改善青年生活和促进青年发展的政策、计划和行动是基金会的优先事项。

泰国国家科学博物馆

泰国国家科学馆(NSM)是一组以科学为基础的博物馆群，为纪念诗丽吉王后的60岁生日而建立。该国家科学博物馆作为科技部的代理机构，于2000年开放，后来又增加了自然历史博物馆、信息技术博物馆和国家科学博物馆科学广场。NSM还支持和咨询泰国和一些邻国的其他博物馆和学习中心。它引领着东南亚科学传播的前沿，让每个人都能接触到科学。

除了所有参观博物馆的游客，国家职业学校每年通过在博物馆的科学夏令营、一系列的科学展览和实验室，以及大开眼界的天文学体验等外联和内部方案向数百万学生进行科普展示。科学大篷车将NSM带到泰国许多地区的学校。国家博物馆管理局还为教师、教育工作者、科学家、研究人员和其他博物馆专业人员举办国家和国际活动、培训和研讨会。NSM与合作伙伴进行合作，组织了许多年度活动，如“科学大道”、“科学就在那里”和科学电影节。国家科技博览会是一个突出泰国及其他地区科学的科学盛会。作为一个国家科学和技术博物馆机构，NSM研究包括许多领域，并与许多研究所和研究人员合作。两个优势细分研究领域是科学传播和泰国的自然历史和生物多样性。

中国科学技术协会青少年科学中心（CYSCC）

儿童青少年科学中心（CYSC）成立于1978年，是中国科协下属的非营利性组织。

儿童青少年科学中心致力于通过科学教育项目和公共活动，让公众参与科学和技术，激励年轻一代的创新。中国科学与技术中心与各省级分支机构、科学博物馆和科技中心共同组成了全国范围的非正式科学教育和科普活动网络。

中国儿童科学教师协会（CACSI）

中国儿童科学教师协会成立于1981年，总部位于北京，由中国著名桥梁学家、教育家茅以升院士，著名物理学家、教育家周培源院士等科学家发起成立。CACSI 是中国科学技术协会(CAST)的机构，主要负责为教师提供科学教育课程。CACSI由五个常设委员会组成：组织委员会、培训委员会、儿童和青年科学中心委员会、宣传委员会和理论研究委员会。CACSI目前的会员包括个人会员和机构会员，在全国30个省市设有分支机构。地方CACSI分会隶属于地方科学技术协会。

CACSI主办的学术期刊是《中国科技教育》。

第一部分：陆上丝绸之路

概述

丝绸之路是古代连接东西方的贸易路线网络。它是指连接东亚和东南亚与中亚、西亚、东非和南欧的陆路和海路。

“丝绸之路”的名字源于沿着这条路进行的利润丰厚的丝绸贸易，丝绸之路始于中国汉朝(公元前207年-公元220年)。大约在公元前114 年，汉朝通过使节张骞的传教和探索，扩大了贸易路线的中亚段。中国人非常重视贸易产品的安全，为了保护贸易路线，他们修建了万里长城。

陆上丝绸之路由北部草原路线（从蒙古、西伯利亚到中亚）和南部绿洲路线（从中国新疆到中亚）组成，东西向延伸到旧世界的古老商业中心。

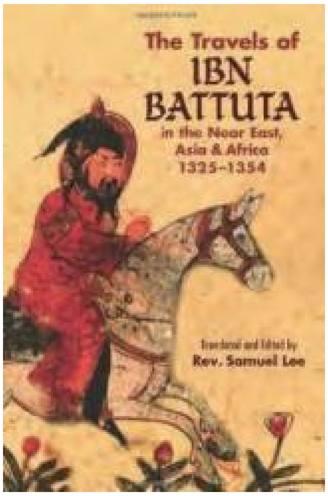
从公元前2世纪到公元前13世纪和公元前14世纪左右，陆上丝绸之路是连接中国、印度、美索不达米亚、埃及、古希腊和罗马等古代文明发源地的重要纽带。

丝绸之路的贸易在中国、韩国、日本、印度、伊朗、阿富汗以及欧洲、非洲之角和阿拉伯的其他地区的文明发展中发挥了重要作用。虽然丝绸是主要的贸易项目，许多其他当地的货物也在路上交易。现在我们生活中的许多东西，如小麦、辣椒、黄瓜、葡萄、棉花等，都是通过这条漫长的路线传入中国的。

丝绸之路也是不同文明之间文化交流的通道。商人、使节、朝圣者、冒险家、工人和工匠长途跋涉东西方，促进了东西方艺术、语言、宗教、科学和技术的融合。最显著的是瘟疫，也沿着丝绸之路传播。

丝绸之路

这些旅行者中的许多人选择陆路和海路进行旅行。如果货物装载量不是很大，而且时间也允许，他们更喜欢陆路旅行，以获得更可预测和更安全的旅行。



伊本・白图泰（1304-1377）是当时探索整个已知世界的先驱之一。在30年的时间里，这个来自旧世界最西端的摩洛哥人进行了三次主要的长途旅行，总路程约为七万五千英里。在他的书《伊本・白图泰游记》中，他记录了现代埃及、伊朗、乌兹别克斯坦、巴基斯坦、印度、马尔代夫、孟加拉、马来西亚、印度尼西亚和中国的许多国家和人民的信息。

白图泰尝试了陆路和海上路线。他的海上旅行，经常遇到不可预测的挑战，如海难，因此他不得不在马尔代夫呆了近一年。但他的陆路旅行要顺利得多，除了他的好运，他应该感谢当时许多成熟的技术确保了安全舒适的生活和陆路旅行。

在白图泰的时代，水资源的先进利用使得人们即使在干旱地区也能生活得很舒适；传统天文学能够引导人们在旅途中找到自己的路；具有当地特色的建筑为游客提供了急需的庇护所。如果没有这些设施的科学技术知识的发展，即使是对像白图泰这样勇敢的人来说，到另一个地方旅行将会困难得多。

总而言之，历史上的陆上丝绸之路在对跨大陆交流的贡献方面取得了类似于今天全球化的成就。如果没有这条道路，我们今天生活的世界就会大不相同。

现在，让我们重温陆上丝绸之路，沿着这条东西贯通的通道，沿着先人的足迹，去探索科学技术的发展和应用吧。

第一单元 水资源

有一个中国家庭传说。

很久很久以前，巨大的洪水淹没了中国的许多地区。当时的中国统治者派了一位名叫伯鲧的专家去抗洪。神秘的是，伯鲧有魔力可以随心所欲地召唤土壤。抗洪时，洪水所到之处，伯鲧淤积泥土,但他的堤坝最终决堤了。暴烈的洪流一发不可收拾，卷走了城镇。伯鲧让儿子禹接替他的职位继续战斗。这一次，禹没有修建巨大的水坝，而是修建了许多运河将洪水分流到低洼地区。在他多年的耐心和不懈的努力下，禹终于驯服了洪水。

这个传说虽然像一个神话，但它揭示了水资源的利用对人类的生存和发展有着非常重要的影响。陆上丝绸之路沿线大部分地区是半干旱或干旱地区，水资源短缺。很难有效地利用有限的水资源，并将水输送到住宅、农田和牧场附近。有些地方从低洼地带取水到高处，而有些地方则从远处取水。在雨季，雨水以某种方式被储存起来，以备将来干旱的日子使用。

在地表水很少的地区，人们不得不从地下取水。为了生存，这些地区的人们发展了一系列水利设施。他们用辘轳、水车和水泵提水，修建运河和坎儿井运输水，并发展了由水流驱动的水车。

这些水利设施不仅为养活人口的绿洲和农田提供了农业灌溉，也展示了丝绸之路沿线的科技融合。正如《伊本・白图泰游记》一书所描述的那样，多亏了水车的广泛使用，即使是最干旱的城市也有了花园，荒野变成了牧场和农田。

活动1.1 辘轳

✳介绍

陆地丝绸之路的起点是西安（原名长安），是中国古代汉朝和唐朝的首都。在这次探索陆地丝绸之路的旅程中，我们从西安出发。在老西安城里，有几口大井，为市中心的居民提供饮用水。有趣的是，西安的甜水井街是以其水的甜味而命名的。

甜水井（指甜水的井），西安城碑刻（左）：井养无穷

看看上图，想想为什么井口上方有一个奇怪的装置。如果井延伸到地下深处，直接取水将非常费力。辘轳的发明是为了使从深井中提水更加方便和容易。类似的设备也可以在丝绸之路的另一端找到。在《旅行》一书中，白图泰记录了地中海周围城市和村庄的许多水井，那里的人们可能会使用类似的设备取水。

✳年龄

10-12岁

✳目标

学生应能够：

1. 了解辘轳的工作原理

2. 应用辘轳来解决问题

✳焦点问题

工程问题：放置两张相距15厘米的桌子，看起来像一口井。设计一 个辘轳，把装满水的小桶从桌子之间的地面吊到桌面。小桶直径约 10 厘米长，桌面离地面约80厘米。

学生们需要考虑的一些工程问题如下：

1. 辘轳由哪些部件组成？

2. 每个部分都是什么样的？

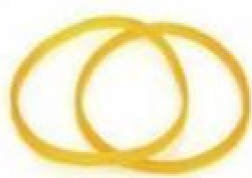
3. 每个部分都是由什么组成的？

4. 什么样的结构可以支撑辘轳？

5. 为什么在轴上安装一块厚气缸？可以使用什么材料？

✳探究

材料

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

步骤：

1. 观察

i. 观察卷笔刀和水龙头。讨论这些工具的功能。

ii. 不使用刀柄，卷笔刀能正常工作吗？你能不用手柄打开水龙头吗？

iii. 想一想卷笔刀的曲柄和水龙头的手柄的功能。

iv. 他们有什么共同之处？

2. 设计

请画出你的辘轳设计并计算尺寸。

3. 制造

为你的设计和制作选择材料。当你制作模型时，请注意你的图表上对原始设计的任何更改。如果你有任何困难，向别人寻求帮助。

4. 试验

i. 放置两张80厘米高的桌子，间隔15厘米。

ii. 把水放在一个大桶里，放在两张桌子之间的地上。

iii. 将辘轳模型安装在桌子上，使其稳定。

iv. 把小桶放进大桶里，将小桶内装满水。

v. 转动手柄提起小桶。数一下手柄需要转多少圈才能把小桶从井（即大桶）

vi. 升到井口（即桌面）。测量施加在手柄上的力。

vii. 直接将这个小桶从井里（即大桶）提到井口（即桌面）。用测力计测量提起小桶的力，比较两个力的值。

5. 改进和沟通

i. 如果你的辘轳模型在提起小桶的力方面没有太大的区别，你如何改进模型？

ii. 如果你的辘轳手柄转了太多圈，减慢了提升速度，你如何改进它？

iii. 如果你的辘轳在工作时坏了，你该如何改进？

iv. 向同学展示你改进后的模型，并谈谈你在制作模型的过程中发现了什么，解释你是如何解决遇到的问题的。

方法

1. 用一次性筷子搭建一个支架。

2. 通过线轴插入钢轴，用胶带或胶枪将结构固定牢固。

3. 将筒-轴结构固定在支架上，两端用橡皮筋盖住，防止移动。

4. 将适当长度的连杆放置到钢轴一端作为手柄，用胶枪将连杆牢牢固定在位置上。

5. 用一根棉线缠绕在筒子上，一端固定在筒子上，另一端贴在小桶上。

6. 转动手柄，棉线逐渐缠绕在线筒上，以提起木桶。

✳讨论

让学生们讨论以下问题：

1. 在你们国家，用什么样的工具从深井取水？工具的工作原理是什么？

2. 你能在你的生活中找到轴吗？

＊工作表

姓名:　　　　　　　　　　班级:　　　　　　　　　　日期:

工程问题：将两张相距15厘米的桌子拼成一口井。设计一个辘轳，将装满一些重物（书、纸、沙、水和弹珠）的小桶从地面吊到桌面上。小桶直 径为10厘米长；高度为离地面约80厘米。

画出你的设计图。

制作你的模型并测试它。记录你的测试结果，并在必要时进行修改。

从这个模型中你找到了什么？

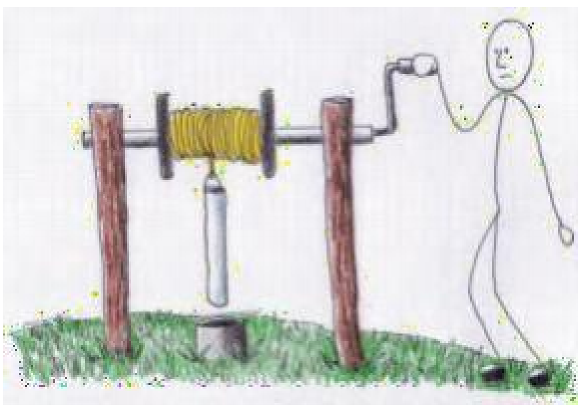
✳教师阅读材料

早在公元前1000年，人们就发明了辘轳。辘轳包括支架、线筒、把手、绳子、水桶等。支架立在一口井的口上。支架上装有筒子的轴由一个手柄转动。绳子缠绕在线桶上，另一端连接在桶上。当把手转动时，绳子被缠绕或从筒上解开时，桶在井里上下移动。

辘轳广泛应用于农业灌溉，大大促进了古代农业的发展。此外，辘轳也被用于地下施工和采矿。在大约2500年前的中国春秋时期，有关于使用辘轳从竖井中提起铜的历史记录。如今，辘轳已逐渐被电动水泵所取代。

✳术语解释

轴：轴是一种简单的机器，由旋转轮或齿轮的中心轴组成，如螺丝刀、方向盘等。轴使工作变得轻松。



✳参考文献

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

活动1.2 水车

✳水车

沿着丝绸之路向西走，我们到达了第二站：兰州，丝绸之路的战略城市。人们从5000年前就开始住在那里了。兰州属温带大陆性气候，降水量小，水资源丰富，属于黄河流域。

在公元1556年，第一个兰州水车被安装在黄河的北岸。此后，黄河两岸越来越多的农民学会了用水车来灌溉农田。兰州水车是一个由黄河水流驱动的水利设施，它的辐条直径为16.5米长，能够将水提升到20米高。

当水被移到轮子顶部后，它被倒入木槽中以灌溉农田。它是一种古老的自动供水系统。

中国著名的兰州水车

✳年龄

10- 12岁

✳目标

学生们将能够：

1. 了解如何使用轴来建造一个水车
2. 了解一个水车系统中的能量转换过程

✳焦点问题

工程问题：制作一个水车模型。在水流的驱动下，水车能够将水提升到15厘米高的位置，然后将水移动到距离水车50厘米远的凹槽中。

学生们需要考虑的一些工程问题如下：

1. 模型由哪些部分组成？
2. 轴如何用来旋转车轮？
3. 移动的水是如何工作的？
4. 水是如何进入模型并使车轮移动的？
5. 提升的水是如何收集的？

✳探究

材料

塑料水瓶

塑料水瓶瓶盖

大水槽

小水槽

 一次性筷子	 木条	 1厘米厚泡沫板

步骤

1. 观察

i. 观察下面的风车和风扇，并讨论它们的叶片如何转动。

ii. 观看关于兰州水车的视频。从视频来看，水车有什么主要的结构？讨论一下水车的工作原理。

iii. 讨论风机、风车和水车的共同特点。它们有什么共同的结构？

2. 设计

请绘制你的水车设计，并计算尺寸。

3. 制作

为你的设计和制造选择材料。在制作模型时，请注意图表上对原始设计的任何更改。如果你有任何困难，寻求别人的帮助。

4. 试验

使用水车模型将水拉入水槽，保持水车状态。测试该模型是否符合工程要求。

5. 改进和讨论

i. 水车能运行平稳吗？

ii. 水流是否能够驱动水车旋转？

iii. 水车能把水升到15厘米高吗？

iv. 向你的同学展示你的模型，谈谈你在制作模型的过程中发现的东西，并解释你是如何解决你遇到的问题的。

方法

1. 用木棒来搭建一个支架。

2. 将模板切成圆形，成为车轮。

3. 沿着车轮的圆线，在车轮上固定几个水瓶盖，彼此之间的距离保持一致，这些盖子被用作提水的水桶。

4. 将一次性小棍插入车轮的中心，并将其固定为中心轴。将车轮安装到支架上。

5. 将一个塑料水瓶纵向切成两半，形成一个开放的半圆形沟槽作为引水通道。用木棒搭建引水渠支架。将引水通道放置在车轮上的水桶附近， 以方便地从车轮上接收水。

✳讨论

让学生们讨论以下问题：

1. 在你们所在的国家或地区是否有类似的设施？

2. 除了水车，你们国家或地区还有什么其他水利设施用来灌溉？

✳学习表

学生用

姓名: 班级: 日期:

1、观察下面的风车和风扇，看看它们的叶片是如何转动的。

2、水车的主要结构是什么？

3、风扇、风车、水车的共同特点是什么？它们的共同结构是什么？

学生小组

姓名: 班级: 日期:

工程问题：制作水车模型，以满足工程要求，将水从河流转移到附近农田的位置。画出你的设计

制作你的模型并测试它。记录你的测试结果，并在必要时进行修改。

从这个模型中中你找到了什么？

✳教师阅读材料

在古代，人们通常生活在河边或其他水源旁，以方便取水。随着农业技术的发展，人们开始大面积种植作物。因此，水车等灌溉设施被发明出来，将水从河流输送到附近的农田。在中国的历史记录中提到的最早的水车是在公元1世纪。

除了灌溉，人们还使用水车来做其他艰苦的工作，比如转动石磨。有许多不同的水车，比如用人的脚或手操作的，还有用牛或驴驱动的。

脚踏式式水车

直到现代，由于农业水泵的广泛使用，水车才逐渐从人们的生活中消失了。如今，水车作为一种灌溉设施已经完全被电动水泵所取代。然而，它的工作原理仍然被应用于我们的生活中。看看岸边和港口疏浚航道的斗式挖掘机，它的挖泥桶正是来自于水车的吊桶。

斗式挖掘机

✳术语解释

力效应：当一个力作用于一个物体时，它会改变物体的移动过程。当不同的推力或拉力影响一个物体时，可能会改变该物体的运动速度，或使其起动或停止。

✳参考资料

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

活动1.3 沙漠中的绿洲

✳引言

让我们前往下一站——新疆。新疆大部分被沙漠覆盖，这里的气候非常干燥。由于地表水资源非常匮乏，这里遍布黄沙和稀疏的绿色植物。天山和昆仑山融化的雪水是新疆的主要水源之一。然而，收集雪水并不容易，因为山脚下的积水会在短时间内蒸发或渗入地下。尤其是吐鲁番盆地，它是中国地势最低、最炎热的地区，被誉为中国的“旱极”。然而，令人惊叹的是，这个干旱地区却有着丰富的物产（在当地维吾尔语中，吐鲁番是繁荣富庶之地的意思)，以葡萄、哈密瓜和棉花闻名。那么吐鲁番盆地的灌溉用水从何而来？

不仅是中国新疆，从中亚到北非的沙漠地区都面临着同样的灌溉挑战。这些地区广泛使用一种名为“坎儿井”的水利设施，将地下水引入农田。正是坎儿井滋养了沙漠中的绿洲。

伊本-白图泰等旅行家也受益于坎儿井。他在书中描述了麦地那城附近的坎儿井的建造过程。

✳年龄

10- 11岁

✳目标

学生们应能够：

1. 通过坎儿井的历史背景知识了解重力
2. 了解连通器的工作原理

✳焦点问题

吐鲁番盆地的地理优势如何有利于将周围山区融化的积雪和地下水补给农田？什么样的供水系统可以将地下水输送到盆地内的农田？下面几张由遥感器拍摄的照片是新疆吐鲁番的某地方。你见过这样的供水系统吗？你知道它的名字吗？

工程问题：设计并制作一个坎儿井供水系统模型。以下是一些供学生思考的工程问题：

1. 坎儿井是由什么组成的？
2. 从地面上看它是什么样的？
3. 从地下看是什么样的？
4. 坎儿井的哪些部分是相连的？

✳探究

材料

超轻粘土

刀

竹棒

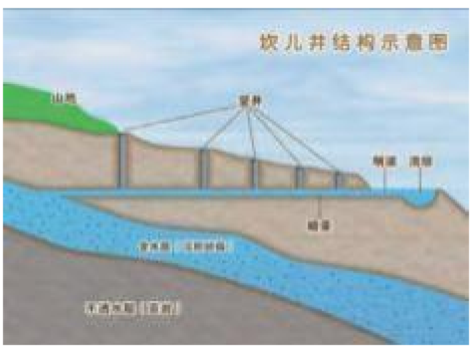
硬纸板

 超轻粘土或等塑胶泥	 木条	 硬纸板

步骤

1.观察

i. 观察下图。坎儿井由哪些部分组成？



ii. 谈谈坎儿井如何将水引入绿洲。

iii. 观察茶壶的结构，注意壶身和壶嘴的水位，你有什么发现？

iv. 坎儿井和茶壶有什么共同之处?

2. 设计

请绘制你的设计并计算尺寸。

3. 制作

为你的设计和制造选择材料。在制作模型时，请注意图表上对原始设计的任何更改。如果你有任何困难，寻求别人的帮助。

4. 讨论

展示你的模型，并解释该模型如何展示坎儿井引水灌溉的工作原理。

方法

1. 用超轻粘土制作出一面高一面低的山区模型。较高的一面代表山脉，而较低的一面代表盆地。

2. 横切模型以得到一个横截面。

3. 用蓝色粘土制作地下水层（含水层），并粘贴在横截面上。山区的含水层水位应高于流域内的含水层。

4. 将几根竹棍插在粘土上，做成几个竖井。

5. 用一根竹棍连接所有竖井的底部，形成一个涵洞。涵洞的末端延伸到地表,并变成明渠和地面上的洪水坝（一个小水库）。请注意，在流域区域，涵洞和渠道均应位于含水层的上方。

6. 坎儿井的模型已经完成了。

＊讨论

让学生们讨论以下问题：

1.在你们的国家或地区有像坎儿井这样的供水系统吗？

2.你们的系统是如何将水输送到绿洲的？这个系统的工作原理是什么？

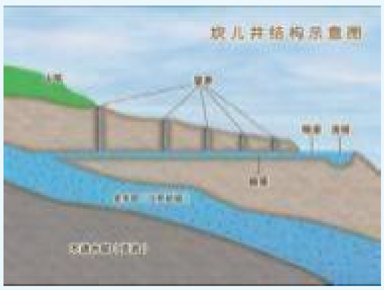
3. 除了茶壶和坎儿井，你还知道哪些生活中的连通器呢？

＊工作表

学生用

姓名:　　　　　　　　班级:　　　　　　　　　　日期:

1、观察下面的图片。坎儿井是由什么部分组成的？



2、谈谈坎儿井是如何把水输送到绿洲的。

3、观察茶壶的结构，注意壶体和壶口的水位。你发现什么？

4、坎儿井和茶壶有什么共同之处？

✳教师阅读材料

丝绸之路上的珍珠项链------ 坎儿井

想象一下，当我们在中亚和西亚旅行时，头顶是灼热的太阳，脚下是干燥的沙子，喉咙像火烧一样灼痛。这时候，我们可能会迫不及待地想回宾馆享受空调和甜似蜜的西瓜，或者眼前突然出现一个湖泊，让我们跳进去凉快凉快。然而，这些都是可遇不可求的。但有一样东西，可以让我们离清凉惬意的梦想更近一些。

在远处深橙色连绵起伏的群山中，有无数个相距二三十米的土丘，这并不罕见。在每个土丘的中间，都有一个像井口一样的洞，但洞的下面却不是普通井里的静水，而是像地下河一样的溪流。

当然，这时候我们可以从河里提甜水。不过，沿着地下水渠流淌的方向走，也是一种巧妙的方法，地下水渠最终会流向地面，到那时，我们就可以尽情享受泉水了。

沿着溪流前行，我们来到了一个村庄，珍珠项链般的泉水就是为这里准备的。热情的村民拿出泡在泉水里的凉果，招待远道而来的我们。更重要的是，空调不再是奢望。泉水的出水口宽敞舒适，胜过人工空调，有时甚至像地下的凉亭。坐在八角形的栏杆上，我们可以一边品尝水果，一边听村里的老人讲述坎儿井的历史。

这个地下通道被称为坎儿井(有些地方又称其为暗渠)，这个名字来自伊朗。据说，早在4000年前，坎儿井就建在伊朗东北部的呼罗珊地区。古希腊历史学家希罗多德、波利比乌斯等人曾记录过波斯的坎儿井。

坎儿井技术随后从波斯向西和向东其他缺乏地表水(如河流、湖泊等）但其附近山区却富含地下水的地方。如今，我们从中国的新疆东部到北非的摩洛哥西部，甚至在西欧和北美的一些地区，都可以找到坎儿井。

从休息的井口出发向下走，我们看到一个水池，里面储存着从坎儿井流出的泉水，用于灌溉和人与牲畜的日常饮用。

沿着地下河渠行走，每隔一段距离你就能看到通向地面的竖井，也就是我们在地上看到的土堆。起初，工匠们下到竖井底部，分别挖掘地下河渠。这些竖井可用于挖掘后的维护。井口的泥土被从竖井中挖出，可以利用这些泥土防止地面上的碎片被冲入地下河渠。

最后，我们到达了最后一个竖井，坎儿井的母井，这是整个供水系统的第一部分。通过地表植被的特点，经验丰富的工匠猜测这个地方最有可能含有地下水，于是他们开始从这里开始挖掘。

通常，母井是整个竖井群中最深的，有些甚至达到400米深。一旦挖掘到地下水位,地下水就开始渗入母井，因此有必要向村庄的方向挖掘地下河渠。河渠利用向下斜坡的重力所提供的流速将水输送到地表。

为了将水从源头引到村庄，一些坎儿井的河渠很长，而最长的地下河渠的世界纪录是70公里。当然，起初并不需要如此之长。随着时间的推移，人们需要越来越多的水。因此，必须将该坎儿井向母井上游延伸，或者再打一个坎儿井作为分支。

虽然许多地方采用现代机械技术打井，但坎儿井的供水系统仍有许多优点，如全年水量稳定，水质好。最重要的是，坎儿井的流量与地下水的储存量是一致的，而且它不会很快抽出地下水。它是生态友好的，许多坎儿井已经供养人类数百年。

挖掘和维护坎儿井需要很多钱，而且在地下挖掘是很危险的。然而，为了在干旱地区发展人类文明，修建坎儿井是值得的。坎儿井使这些地方的社会联系更加紧密。它是古代各文明和平交流与互动的产物。

几千年来，坎儿井为人类的繁殖做出了贡献。人类珍视和感激坎儿井系统。现在，伊朗、阿曼和其他国家的坎儿井已被联合国教科文组织列为非物质文化遗产。

好了，享受完坎儿井给我们提供的水果和水，我们应该再次踏上丝绸之路。

来自坎儿井的启发：

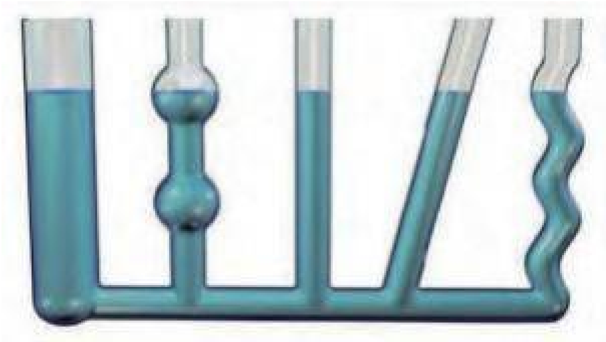
1. 处于逆境中的人类采取了与当地环境相对应的行动，弥补了不完善的自然条件，并创造了复杂的文明。这种永不放弃和积极主动的精神值得学习。

2. 水对生活非常重要，没有水，我们就不能生活，世界上也不会有大量的人口。然而地球上的淡水资源却非常有限。饮用水在很多地方都很有价值，所以有必要养成节水的习惯。珍惜水资源就是珍惜生命和地球。

3. 挖一口普通的井并不是什么大挑战，但把水从井口运到遥远的村庄却需要努力。沿下斜坡修建涵洞是一种有效的解决方案。

✳术语解释

连通器：连通器是一组含有均匀液体的容器的名称。当液体静止时，无论容器的形状和体积如何，它在所有容器中平衡到一个相同的水位。如果在一个容器中加入额外的液体，该液体将在所有连通的容器中再次找到一个新的相同水位。例如，茶壶是一个典型的连通器。倒茶后，壶口和壶体中的水再次达到相同的水位。



✳参考文献

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

活动1.4 水泵

✳引言

人类过了很长时间才想出用水来灌溉农田的办法。水泵的发明让人们全年都能从河流中抽水。水通过河渠运输，有时远离灌溉的水源。抽水机在古典时代形成，在中世纪得到了改进。丝绸之路沿线的各种文明化都为抽水技术的发展及其应用做出了贡献。水泵是由工程师al-Jazari等人开发的，但正如伊本-白图泰所记载的那样，葡萄牙人使用得更多。

✳年龄

10- 12岁

✳目标

学生们应能够：

1. 理解大气压力的概念
2. 利用大气压来解决实际问题

✳聚焦问题

干旱地区的水资源非常稀缺，地下水多分布在较深层的地区。人们主要通过深钻来获得宝贵的水。如何从水源取水到农田或高地？什么样的工具能更容易地获得水呢？

✳工程问题

根据抽吸和排出的工作原理，设计一个水泵，将水从地板上的水池输 送到地板上的另一个水池。

一些供学生思考的工程问题如下：

1. 泵如何通过抽吸和排出进行抽水？

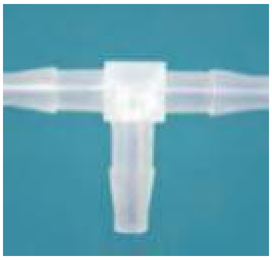
2. 每个部分都是什么样的？

3. 注射器和三通管的功能是什么？

✳探究

原料

水盆

 阀门	 注射器
 三通管	 塑料管

步骤

1. 观察

i. 观察一个吸盘钩，试着把它固定在墙上，或者用一个塑料吸盘打开抽屉或橱柜，想想它是如何工作的。

ii. 将连接注射器与一根塑料管连接。拉出注射器，把彩色的水吸进塑料管里。观察水流的方向和速度。

iii. 观察水龙头的结构。它具有什么功能？

2. 设计

请绘制你的设计并计算尺寸。

3. 制作

为你的设计和制造选择材料。在制作模型时，请注意图表上对原始设计的任何更改。如果你有任何困难，寻求别人的帮助。

4.测试

i. 在地上放一个装满水的盆，在桌子上放一个空盆。

ii. 用模型把水从地上的水盆送到桌上的水盆里。

iii. 观察过程

5. 改进和讨论

i. 如果水流无法到达桌子，你应该如何改进模型？

ii. 如果泵在漏水，你应如何改进模型？

iii. 如果泵工作不顺利，你应如何改进模型？

iv. 向你的同学展示你的模型，谈谈你在制作模型的过程中发现的东西，并解释你是如何解决你遇到的问题的。

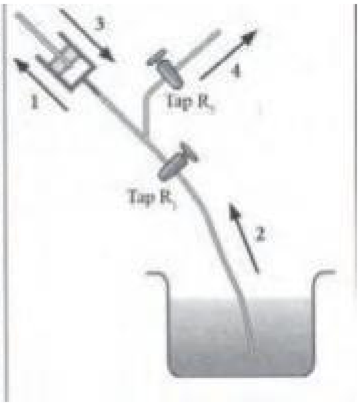
方法

1. 将三根塑料管连接到一个三通管上，形成一个T形管。

2. 在T形管的左右出口各加一次水龙头，并将注射器连接到T形管的中间出口。

3. 打开水龙头1，将连接的塑料管放在地板上的水盆中。拉动注射器将水吸入T形管，然后关闭水龙头1。

4. 打开水龙头2，推动注射器，迫使水离开注射器，并流向水龙头2到桌子上的脸盆



✳讨论

让学生们讨论以下问题：

1. 在生活中使用的水泵是什么样子的？

2. 电动水泵的工作原理是什么？它与这个活动中探索的水泵哪些地方相似？哪些地方不同？

*学习表

学生用

姓名: 班级: 日期:

1、观察一个吸盘钩，试着把它固定在墙上，或者用一个塑料吸盘打开抽屉或橱 柜 ，想想它是如何工作的。

2、将注射器与塑料管连接起来。拉出注射器，然后把彩色的水拉进管子里。观 察水流的方向和速度。

3、观察水龙头的结构。它具有什么功能？

学生小组

姓名: 班级: 日期:

工程问题：制作一种装置，可以把水从地板上的盆中拉到桌子上的盆中

绘制设计图

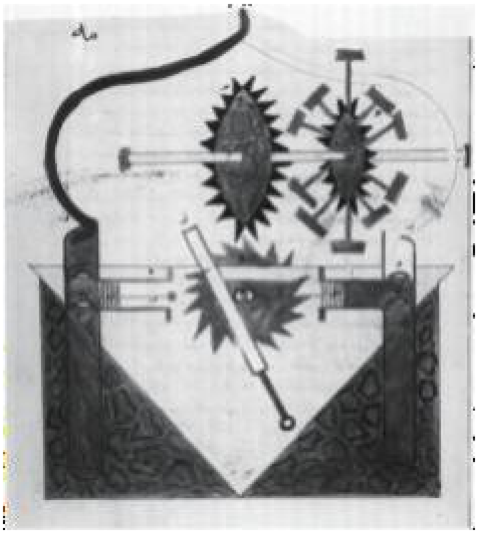
制作模型并进行测试。记录测试结果，必要时进行修改。

通过模型的照片	你发现了什么？

✳教师阅读材料

阿尔-贾扎里被认为是阿拉伯最著名、最具创新精神的工程师。他出生于12世纪中叶，曾供职于如今土耳其南部的一个小宫廷。国王为他提供了良好的研究和发展条件，让他进行机械创新。他在书中记录了50种巧妙的机械。其中活塞泵是最重要的机器之一。

阿尔-贾扎里的活塞泵由水车驱动。通过一个齿轮系统，将两个活塞分别连接到一根杆上，这根杆可以在一根管道中来回移动。通过活塞，水泵可以产生部分真空，并借助气压将水吸到高达13.6米的出水口。这个首台已知的吸水活塞泵比20世纪初出现的吸水泵还要先进。比15世纪欧洲出现的吸水泵更加先进。



※术语解释

压力是指在单位面积内，物体表面所受直角力的大小。国际理论化学和应用化学联合会推荐的压力符号是小写p。P与p的用法取决于工作领域、附近是否存在其他物理量的符号（如功率和动量）以及书写风格。

※参考文献

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

第二单元 天文

在历史上，人们曾有过两种时间划分系统。一种是我们现在熟悉的作息时间表：

早上8:00起床，中午12:10吃午饭，下午4:30看动画片。

你的每一个动作都对应着一个精确的小时。而时钟上的数字或指针所代表的时间每天都是不变的。如果我们不知道时间，常常会感到不知所措。然而，这种时间划分系统直到现代工业社会才开始普及。

另一种情况是，人们用阳光而不是闹钟来唤醒自己。他们把白天分成12个小时，把夜晚分成另外12个小时。许多动物和植物，如蝙蝠、猫和向日葵，都应该欢迎这种系统。生活在传统农业社会的人们也是如此。他们在日出之后工作和学习，在日落之后休息和娱乐。

从很早开始，人们就发现每天日出日落的时间是不同的。夏天白天长，冬天白天短。春天和秋天的日出日落时间适中。事实上，太阳在古人的精神生活中非常重要。许多宗教都要求信徒在日出日落时祈祷。

如何方便地计算时间呢？在世界许多地方，人们使用一种仪器来确定太阳、月亮和星星的升落时间。这就是星盘。

一个普通的星盘有几个主要部分。在下面的章节中，你将了解到这种有趣的古代计算器。星盘还可以用来观察星星的位置，从而确定使用者的位置。因此，除了告诉旅行者何时祈祷或吃晚饭外，星盘对旅行者也非常有用。

活动2.1 星盘

✳引言

伊斯兰教的穆斯林每天在清真寺祈祷五次。每天的祈祷时间都不一样，因为要跟随太阳的移动。如何通过跟踪太阳来测量时间呢？人们发明了星盘。星盘不仅能知道星星升起的时间，还能告诉人们地理位置、高度、日期和编制日历。

虽然伊本-白图泰不是天文学专家，但他可能见过很多天文学家，因为每座清真寺都有一位天文学家在观测星盘。由于星盘通常是一种高雅的艺术品，伊本-白图泰可能是少数几位能看到这种昂贵仪器的人之一。但简化版的星盘在导航方面仍然很有用。

✳年龄

11- 12岁

✳目标

学生应能够：

1. 了解星盘的结构和功能

2.学习衡量时间的不同方法

✳聚焦问题

工程问题：探索星盘。

以下是一些供学生思考的工程问题：

1.什么是星盘？

2. 星盘是如何工作的？

✳探究

材料

星盘影印件：模具、鼓室、针和照准仪、影印星形轮（透明胶片）

索引卡

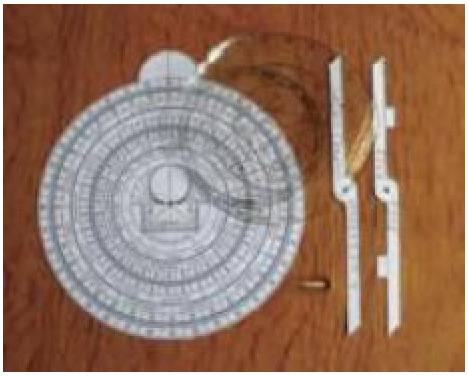
胶水

剪刀

两个孔眼

回形针

巴黎夹



步骤

1.观察

i. 研究有关星盘的可用信息；获取星盘的图片。

ii. 写下它是由谁发明的，然后它是由谁完善的？它是谁使用的？它有哪些不同的组成部分？

iii. 分享你的发现，引用伊斯兰教的希腊时期时间顺序来表明这个工具已经被使用了非常长的时间。

iv. 获取关于星盘功能的信息。

2. 设计制作

i. 给每一组提供制作星盘模型的材料。

ii.讨论如何组装星盘的各个部分。

3. 测试

测试你的模型，以找到你需要和修改的内容。

方法

1. 将模具的背面贴在索引卡上，然后剪下圆盘。

2. 剪下模具的表面，贴在索引卡的另一面。

3. 剪下鼓室，粘在模具前面的表面上，同时向南对准模具的12个切口（刻度）。

4. 缝合针和索引卡上的照准仪，然后切断。

5. 按照虚线剪出透明胶片上的星形轮轮廓。

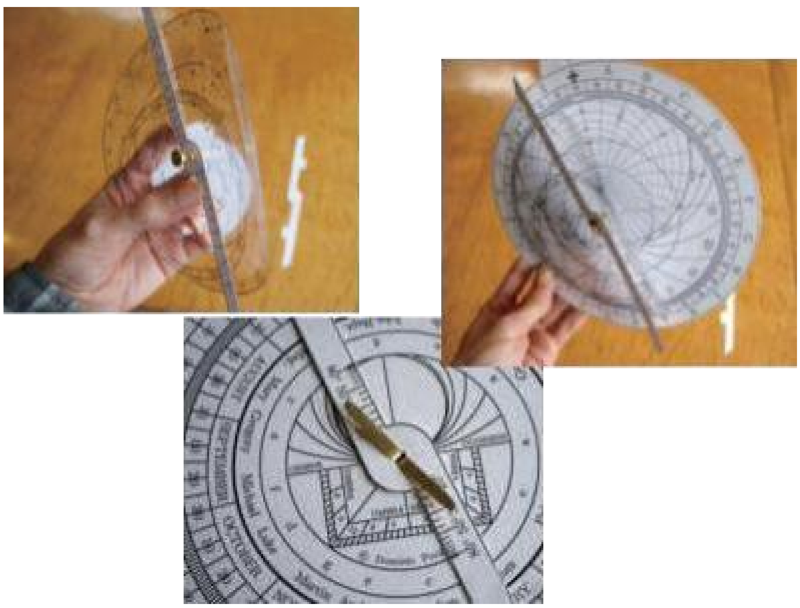
6. 按顺序叠加；照准器，上面有鼓室的模具，星形轮和针，用巴黎夹子固定在中间。

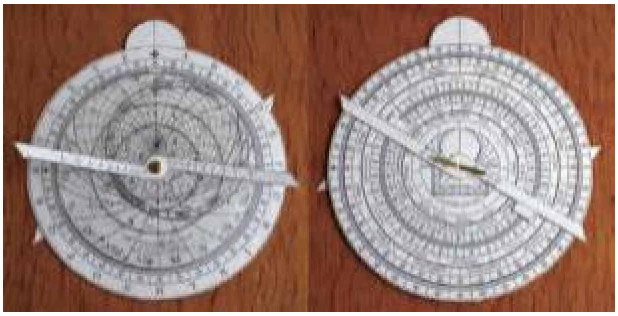
7. 顺着照准器长度插一根禾杆。

8. 打悬挂孔，并用孔眼加强它。

9. 在孔里放一个回形针。

10. 模型做好后，马上做一下星盘的整体测试，各组成部分的问题。





✳讨论

让学生们讨论以下问题：

1. 你所在的国家或地区使用的是哪种日历？每种日历是如何测定日期的？

2. 你们的国家或地区使用了什么工具或方法来测定时间

✳学习表

学生用

项目: 班级: 日期:

1. 画出你在研究中发现的星盘 。

1）发明人：… … … … … … … … … … … … … …。

2）发明时间：… … … … … … … … … … … … … …… …。

3）谁改进的：… … … … … … … … … … … … … … … …。

4）它是为谁发明的：… … … … … … … … … … … … 。

5）星盘的部件/要素：

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

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

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

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

学生

名字： 班级： 类别： 日期：

1.关于星盘发明的时间顺序表。

年月日	发明家	地方

2.根据上述时间顺序表中的信息，你能对星盘的发明做出什么结论？

3.列出星盘的功能。

学生

名字：　　班级：　　类别：　　日期：

1.写下你制作星盘模型的步骤。

2.你认为你的星盘模型可以工作吗？给出理由。

3.你如何改善你的星盘？

✳教师阅读材料

什么是星盘？

可以说，星盘是数学工具之王，具有多种功能，从测量时间到测量面积，方便地图绘制、地形测量以及对天文坐标或三角函数等问题的计算。星盘不仅是一种测量工具，更是一种计算工具。

星盘是 8 世纪下半叶出于政治和宗教原因而发展起来的。Astrolabe 起源于希腊语，意思是星星的记录者。星盘测量的是星星的高度角或高度，它与观察者看到的地平线有关。要测量恒星的高度，我们必须在星盘上的分度量角器上读出高度角。

星盘通过投射星星和太阳的运动来激发灵感 。正午会显示最高高度。它用于测量时间并解决某些占星问题。对于穆斯林来说，它用于确定祈祷时间、朝向麦加的方位以及固定日历。

星盘的部件包括模具的背面、模具的正面、星形轮、阴影方格和正弦象限。这些部件的功能是什么？

模具的背面

在这里你可以看到一年中的12个月用圆圈表示（逆时针）；每个月（有小间隙）都对应一个星座的名字，孩子们可以很容易地识别十二宫的“星座”。你还可以看到上面写着“阴影”字样的半个正方形：它是什么意思呢？照准器转向了，似乎瞄准了稻草：它是干什么用的？

模具的正面

鼓室上画了许多圆；其中一个是0到90度（即使学生不知道角度的测量，你可以告诉他们直角有90度）。你读到：“巴黎纬度”；因此，这个星盘可以在法国大陆使用，但正如动画中所述，它在北极或赤道是不准确的。外圈刻度为24小时。

星形轮

这件作品上有代表天空中最亮的星星的标记（见动画）；这些星星可以通过它们名字的第一个字母找到它们，我们将尝试在观察天空地图的时候识别它们。

✳术语解释

高度：天体坐标系将天空分为两个半球，上半球可以看到地平线以上的天体，下半球则看不到地平线以下的天体，因为地球会遮挡这些天体的视线。高度有时也称为仰角，是物体与观察者当地地平线之间的夹角。对于可见物体来说，它是一个介于0°和90°之间的角度。在实际测量中，海拔高度可能是负数，这意味着物体位于地平线之下，北极星的高度等于其纬度。

地平线：地平线或天际线是将地球与天空分开的视线，是将所有可见方向分为两类的线：与地球表面相交的方向和不相交的方向。在水平坐标系中，观察者所在的地平线为基本平面。轨道的高度为零。

✳参考文献

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

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

活动2.2望远镜

✳引言

你看不见什么东西并不意味着它不存在。有时候，你只需要走进一点看。这就是望远镜派上用场的地方。望远镜是一种通过收集光线来观察远处物体的仪器。人们通常使用望远镜来观察外太空的物体，比如行星、恒星和彗星。有时，望远镜被用来从远处观察地球上的东西，比如船只、野生动物等。

在伊本·白图泰时期，蒙古统治者在现代伊朗西北部建立了巨大的天文台。然而，事实上直到17世纪初望远镜发明，天文学家只能用肉眼观察夜空。因此，当时成为天文学家的要求之一是你不能近视。

✳年龄

10-12岁

✳目标

学生应能够：

1. 展示合作学习

2. 了解望远镜是如何工作的

✳聚焦问题

工程问题：设计和制作一个望远镜，通过它可以清楚地看到远处的物体。

一些供学生思考的工程问题如下：

1． 望远镜的工作原理是什么？

2.制作望远镜所需的材料有哪些？每种材料的用途是什么？

3.每个部分外观都是什么样的？

✳探究

材料

聚氯乙烯管：

●外管（直径：5厘米或2英寸；长度：2米或7英尺）

●内管（直径：4厘米或1.5英寸；长度：15.25厘米或6英寸）

纸巾或卫生纸筒

额外的硬纸

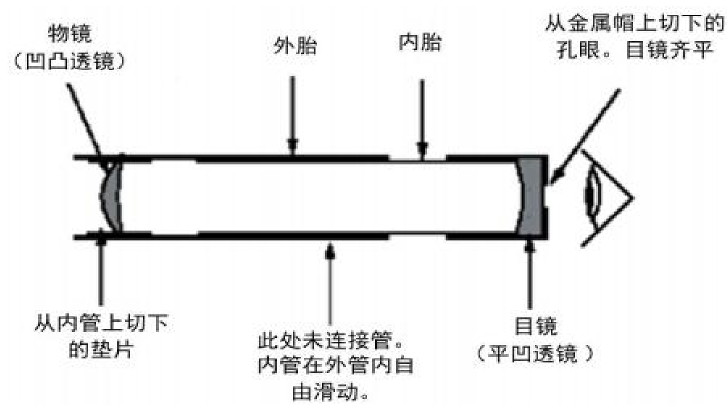
胶水

剪刀

透镜

●凹凸透镜：直径49 mm，焦距100 mm

●平面凹面镜头：直径47 mm，焦距2000 mm



步骤

1.观察

i.观察一个望远镜，然后用这个望远镜来观察物体。

a)望远镜有什么好处？

b)哪些人需要望远镜？为什么？

c)是什么使望远镜比其他选择更强大？

ii.分别使用凸透镜和凹透镜来观察物体，你看到了什么？

iii.将凹凸透镜结合在一起来观察远处的物体，你会发现什么？如何将这些镜头组合起来，以最好地放大远处的物体？

iv.观察一个简单的望远镜，并探索它是如何工作的。

2.设计

请绘制你的设计并计算尺寸。

3.制作

为你的设计和制作选择材料。在制作模型时，请注意图表上对原始设计的任何更改。如果你有任何困难，寻求别人的帮助。

4.试验

测试你的模型，以找到你需要修改的内容。

5.改进和讨论

i.如果你看不清楚，你如何改进它？

ii.如果模型不能很好地放大，你如何改进它？

iii.如果你的望远镜在工作时坏了，你如何改进它？

iv.向你的同学展示你的模型，谈谈你在制作模型的过程中发现的东西，并解释你是如何解决你遇到的问题的。

建议的方法

1.用胶水固定外管前部的凸面透镜作为物镜。

2.用胶水固定内管后部的凹镜作为目镜。

3.将内管嵌入到在外管内部，并调整望远镜的长度范围。

4.测试你的望远镜。

✳讨论

让学生们讨论以下问题：

1.还有像望远镜这样的其他光学仪器吗？该仪器是用来做什么的？

2.这个光学仪器是由什么镜片组成的？

✳工作表

学生

名字：　　　类别：　　　　日期：

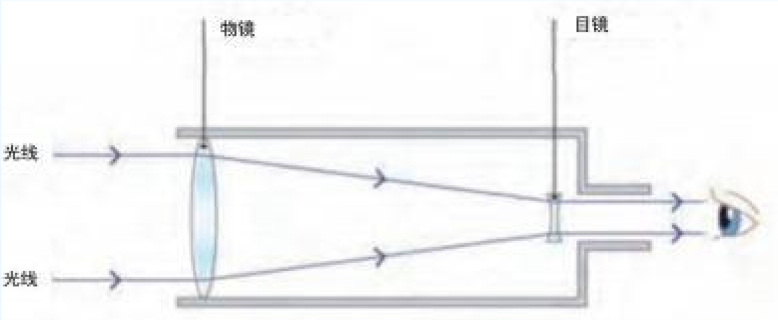
1、分别使用凸透镜和凹透镜来观察物体，你看到了什么？

2、将凹凸透镜组合在一起来观察远处的物体，你会发现什么？如何将这些镜头 组合起来，以最好地放大远处的物体？请画出与眼睛和物体相关的透镜位置。

学生小组

名字：　　　　　　　　类别：　　　　　　　　日期：

1.绘制并标记你看到的望远镜。



2. 让小组一致同意你的望远镜设计并贴上标签。

3. 望远镜展示了光的什么特性?

✳教师阅读材料

1608年，一位荷兰眼镜商人利珀希偶然发现，两个镜头的组合可以更清晰地看到较远的物体。他制造了世界上第一台望远镜。

1609年，伽利略制作了一台直径4.2厘米、长1.2米的大望远镜，用凸透镜作物镜，用凹透镜作目镜，这种光学设备后来被称为伽利略式望远镜，从那时起，天文学进入了望远镜时代。

伽利略式望远镜

天文望远镜是观测天体的重要工具。说不夸张，没有望远镜的诞生和发展，就不会有现代天文学。

从那时起，望远镜不断发展，以获得更远、更清晰的视野，并应用于专业用途。1611年，德国天文学家开普勒将两个双凸透镜分别用作物镜和目镜，大大提高了放大性能。此后，这种光学系统被称为开普勒式望远镜。现在常用的折射式望远镜仍然是这两种系统中的一种。天文望远镜就是开普勒式系统。

从第一台光学望远镜的诞生到哈勃太空望远镜以及世界上最大的球面射电望远镜——中国的FAST（五百米口径球面射电望远镜），望远镜的性能得到了极大的改进，将天文学推向了一个新的高度。望远镜性能的全面提升，推动了天文学的长足发展，也推动了人们进一步探索宇宙。

FAST（五百米口径球面射电望远镜）中国.贵州

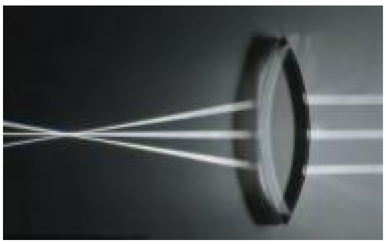
＊术语解释

反射：它是两种不同介质的界面上波阵面的改变，这一改变使波阵面返回到产生它的介质中。常见的例子包括光波、声波和水波的反射。。

棱镜：实体几何图形，其两个端面为相似、相等、平行的直线边图形，其边为平行四边形。

透镜：透镜是一种透射光学装置，通过折射来聚焦或分散光束。一个简单的镜头由一块透明材料组成，而一个复合镜头由几个简单的镜头（要素）组成，通常沿着一个共同的轴排列。镜头由玻璃或塑料等材料制成，并被研磨、抛光或模压成所需的形状。

凸透镜和凹透镜：大多数透镜都是球面透镜，它们的两个表面都是球面的一部分。每个表面可以是凸面的（从透镜向外 凸出）、凹面的（凹入透镜）或平面的（平）。如果两个表面都是凸面，则透镜为双凸透镜（或双凸透镜，或单凸透镜）。如果两个表面的曲率半径相同，则透镜为等凸透镜、透镜就是等凸透镜。有两个 凹面的透镜是双凹透镜（或单凹透镜）。如果其中一个表面是平面，则透镜为平凸透镜或平凹透镜，具体取决于另一个表面的曲率。一个凸面和一个凹面的透镜为凸凹透镜或半月板透镜。这种透镜最常用于矫正视力。



双凸透镜

双凹透镜

✳引用

https://www.education.com/activity/article/keyhole-spy-glass/
https://en.wikipedia.org/wiki/Lens_(optics)#Types_of_simple_lenses

活动2.3针孔摄像头

✳引言

中国学者墨子（公元前 479 年至公元前 390 年）或其追随者记录了光通过针孔传播时图像会倒转的现象。后来，希腊、罗马和阿拉伯科学家进行了许多实验，探索光传播的特性。他们逐渐认识到，眼睛的功能就像一台照相机。瞳孔就像一个针孔，眼球背面内侧的视网膜就是照相机的胶片。当光线通过瞳孔传播时，外面的景物就会在视网膜上形成倒像。公元 965 年左右，伊拉克巴士拉的伊本-海萨姆第一个建造了暗房，用于将照相机拍摄的胶片冲洗成照片。他的照相机模型是现代照相机的早期祖先。

✳年龄

10-11岁

✳目标

学生应能够：

1. 比较一下针孔照相机和我们的眼睛
2. 了解针孔照相机是如何工作的

✳聚焦问题

工程问题：设计和制作一个针孔照相机

一些供学生思考的工程问题如下：

1. 照相机的工作原理是什么？
2. 制作照相机需要什么材料？每种材料有什么用途？
3. 每个组成部分是什么样的？

✳探究

材料

削尖的铅笔

铅笔刀

剪刀

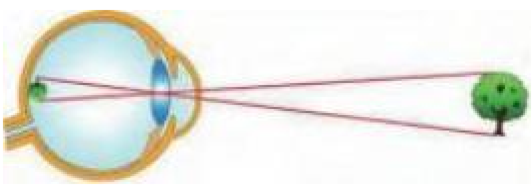
 带盖子的鞋盒	 蜡纸

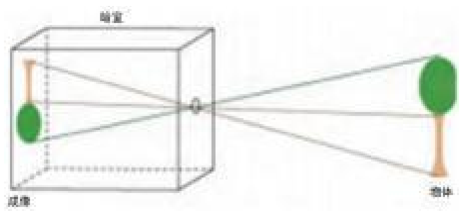
步骤

1.观察

i.从网上找到有关针孔照相机的信息。

ii. 观察眼球的结构图，并与针孔相机的原理图进行比较，发现两者具有相同的特征。





2.设计

请绘制你的设计并计算尺寸。

3.制造

为你的设计和制作选择材料。在制作模型时，请注意图表上对原始设计的任何更改。如果你有任何困难，寻求别人的帮助。

4.试验

测试你的模型，以找到需要修改的内容。

5.改进和讨论

i. 如果你看不清楚，你如何改进它？

ii. 如果模型不是很好，你如何改进它？

iii. 向其他同学展示你的设计模型，讨论你在制作模型的过程中发现了什么，以及你是如何解决遇到的问题的。

方法

1. 在鞋盒盖上做一个圆洞（直径10cm），用蜡纸覆盖圆洞，并固定。
2. 在鞋盒底部挖一个小洞（直径为1mm—3mm）。
3. 把盒子底部的小洞放在明亮的房间、街道或其他物体上。
4. 用一条毯子盖住你的头和鞋盒，让鞋盒底部的洞暴露在外。
5. 你会在鞋盒盖上的蜡纸上看到一个彩色的倒置图像。

✳讨论

让学生们讨论以下问题：

1. 现代照相机的成像原理是什么？
2. 现代相机和针孔相机有哪些共同之处？

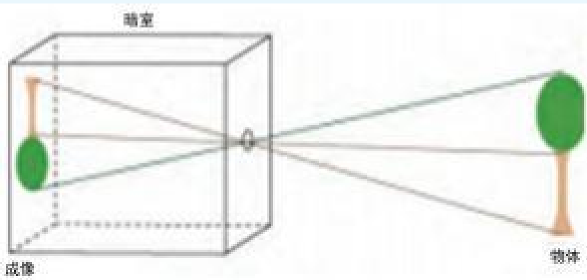
✳工作表

名字：　　　　　类别：　　　　　日期：

1. 观察眼球的结构图，并与针孔相机的原理图进行比较，发现两者具有相同的特征。

针孔照相机	我们的眼睛	功能
屏幕	视网膜	图像形成的位置
针孔	眼角膜	聚焦光线

2.绘制你的针孔照相机，并贴上标签



3.解释一下光线上发生了什么？

✳教师阅读材料

我们怎么看？

我们的眼睛是如何我们看到小至头发丝的物体，或远至仙女座星系的物体的？

人们知道，眼睛的功能就像一台照相机，外部世界会在眼球内后部的视网膜上图像。但这个概念却很难理解。古代文明中最受人尊敬的思想家：柏拉图、亚里士多德、欧几里得和盖伦都曾以各自不同的方式解释过不正确的视觉理论，直到公元965年左右，来自伊拉克巴士拉的伊本-海赛姆提出了经实验证明的新视觉模型。伊本-海赛姆是第一个解释视觉是由光线在物体上发生反射，然后进入眼睛而产生的。几个世纪后，文艺复兴时期的学者约翰内斯-开普勒明确认同了伊本-海赛姆的光概念。

伊本·海瑟姆是第一个研究针孔照相机现象的人。针孔相机的概念很简单：一个一边有一个小洞的盒子能够把外面的图像投射到盒子里面的一边。那些熟悉现代相机工作方式的人会注意到，这是相机的一般工作方式，但今天又增加了镜头。伊本·海瑟姆在我们所知的现代摄影发展的几百年前就建造了这些针孔相机。

✳术语解释

光的直线传播：光在均匀介质中以直线传播。这一规律是几何光学的重要基础，它明确地解释了图像的形成。人的眼睛通过光的直线传播来识别物体或图像的位置。

✳参考文献

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

第三单元 建筑

伊本·巴图泰在旅行中，总是对各地宏伟的建筑感到惊讶。事实上，埃及的金字塔、亚历山大的灯塔、君士坦丁堡的大教堂和元朝的宫殿，不仅在七百年前震惊了旅行者，到现在仍然是伟大的奇迹。

建筑一直是个老话题。建筑起初是从需求（庇护、安全、崇拜等）和手段（现有的建筑材料和辅助技能）之间的动态演变而来。随着人类文化的发展和知识不断通过口头传统和实践被书面化，建筑成为一种工艺，而“建筑”就该工艺最正式和最受尊敬的名字。人们普遍认为，建筑的成功是反复试验过程的产物，随着试验结果越来越令人满意，试验渐少而复制渐多。所谓的乡土建筑继续在世界上许多地方建造起来。事实上，在人们每天所经历的建筑世界中，乡土建筑占据了大部分。早期的人类定居点大多是农村地区。由于生产过剩，经济开始扩张并导致城市化，从而出现了某些情况下发展迅速的城市地区。

“一带一路”沿线的国家具有鲜明的文化特征，在建筑方面尤其如此。东亚和东南亚国家因其丰富而悠久的历史而以木结构建筑为主。中亚的穆斯林建筑具有强烈的民族和宗教特色。而丝绸之路另一端的西方国家则表现出不同的建筑风格。

该课程向学生讲授“一带一路”沿线国家独特的建筑元素和建筑技术，建筑科学，建筑材料，使他们可以自己设计和建造。

活动3.1柱子

✳引言

人们必须有庇护所才能生存下去，在无法避开太阳、雨、风和寒冷的情况下会死亡。建筑的上部是屋顶，而下部是柱子。建于公元前580年的雅典卫城，现在仍有几座古代建筑的残迹，但大理石柱仍然矗立着。

雅典卫城的遗迹

✳年龄

10-11岁

✳目标

学生应能够：

1.观察柱子的形状

2.探索柱子所能承受的承载能力

3.了解建筑物的支撑结构

✳聚焦问题

科学实验：探讨不同截面柱子的承载能力。建筑物的重量主要由柱子支撑着。什么样的柱子能更好地支撑它呢？

一些供学生思考的工程问题如下：

1．如何进行实验以保证科学性？

2．在实验中，哪些变量应该是一致的？

✳探究

材料

A4尺寸纸

双面胶带

书

步骤

1.观察

观察下图中的柱子。这些柱子的形状是一样吗？Ⅱ.画出这些柱子的横截面，预测哪些柱子有最强的承载能力。

方形梁

六角柱

圆柱

2.实验步骤

用相同的A4大小的纸制作三角形棱柱、四边形棱柱、圆柱或其他形状的柱子。注意：不要裁纸或添加任何东西。

3.测试和记录

数一下每种柱子所能承受的书的数量。写下你的结果。

✳讨论

让学生们讨论以下问题：

1.你们所在的国家或地区有柱子吗？

2.用什么材料来建造柱子？柱子是什么样子的？

✳工作表

名字： 类别： 日期：

1.绘制要测试的柱子。

2.记录测试结果。

柱的形式	这个支柱可以承受的书籍的数量
三角柱	
四角柱	
圆柱	

3.你发现了什么

✳教师阅读材料

建筑和结构工程中的圆柱或支柱是一种构件，通过压缩将上方结构的重量传递给下方的其他构件。换句话说，柱子是一种压缩构件。柱子一词尤其适用于大型圆形支撑物（柱轴）。柱的轴心），带有柱头和底座或基座，由石材制成或看似由石材制成。

源于古希腊的西方圆柱是古希腊建筑最重要的遗产。西方圆柱主要由棱柱装饰，反映光影变化。在颜色上，它反映了石材本身的纹理。最具装饰性的是柱头，它可以吸引人们的注意力

东方建筑历来以木结构为典型特征。自古以来，雕梁画栋在中国十分盛行，红色是柱子上最常见的颜色。西方人西方人喜欢装饰柱头，而中国人则喜欢装饰柱础。柱础有多种，如莲花柱础、圆形柱础、方形柱础等、圆形柱础和方形柱础等。


东方建筑中的柱子和柱子的底座

∗术语解释

柱子：柱子通常是支撑建筑物的结构，如梁、桁架、楼板等。根据截面的形状、可分为方柱、六角棱柱、圆柱、矩形柱等、矩形柱等。一般来说，横截面的棱越多，柱子的承载能力就越强。因此，圆柱是最佳选择

活动3.2 屋顶

✳引言

伊本·巴图塔在他的旅行中经常睡在屋顶上或睡在屋顶下，因为在大篷车房里没有足够的空间。所以他有很多机会看不同风格的屋顶。当然，建筑的屋顶在很多情况下都是非常吸引人的。

屋顶是建筑外壳的一部分。它是在建筑物或庇护所的最上面部分的覆盖物，保护人们免受动物、雨雪、炎热、大风和暴晒的侵扰。屋顶的形状因地区而异，差别很大。屋顶的基本形状有平的、单坡性、山墙形、斜脊形、蝴蝶形、拱形和圆顶形。这些形状有实际用途吗？

✳年龄

10-12岁

✳目标

学生应能够：

1.观察中国古代的建筑

2.理解上翘的屋檐

3. 探索最速降曲线

✳聚焦问题

当雨水撞击屋顶时，屋顶的斜坡是否会影响水滑出屋顶的速度？

✳探究

材料

波纹纸板

玻璃球

秒表

米尺

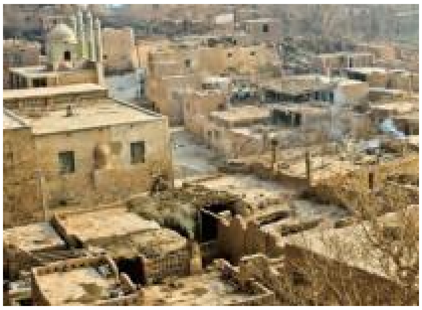
量角器

步骤

1.观察

i.观察以下四个不同地区的建筑并进行讨论

这些屋顶的主要差异。



新疆吐鲁番建筑

在中国北部的村庄

蒙古包

马来西亚建筑

ii. 你能找到屋顶坡和局部降水之间的联系吗？

2.实验步骤

用瓦楞纸板做屋顶，用玻璃球像雨水一样往下滑。用公制刻度尺测量瓦楞纸板的坡度，测量不同玻度璃球向下滑动的速度。

3.测试和记录

记录坡度和玻璃球滑出的时间。玻璃球在哪个斜坡上滑动的最快？写下你的结果。

✳讨论

让学生们讨论以下问题：

1.你所在国家或地区的屋顶有什么特点？

2.这种屋顶有什么功能？这种设计与当地气候之间有任何联系吗？

✳工作表

名字：　　　　　　　　类别：　　　　　　　　日期：

1. 观察来自四个不同地区的建筑，并讨论它们的屋顶的差异。你能找到屋顶坡和局部降水之间的联系吗？

2. 用波纹板做屋顶，使玻璃球像雨水一样从屋顶滑下来。找出滑动速度是否因屋顶的坡度而变化。进行一个小组讨论，并计划好你的实验。

3.记录实验结果

斜坡	滑动时间

4.你发现了什么？

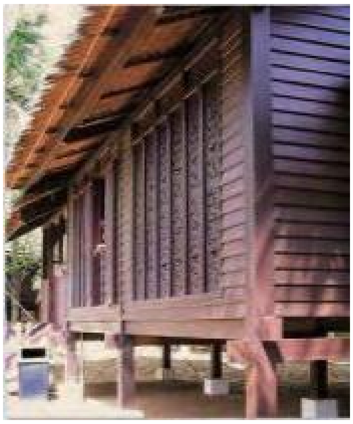
∗教师阅读材料

住宅建筑的外观和建筑材料因地区而异。由于自然环境的不同，不同地区的住宅建筑具有显著的地方特色。

在降水较小的地区，建筑特别注意保温，多采用平屋顶或缓坡。在降水集中显著的地区，住宅建筑具有较强的通风、散热和排放雨水的能力。

因此，中国南部和东南亚的住宅建筑广泛采用高架底座和深坡及双层的屋顶结构。例如，马来西亚的传统住宅被称为浮脚建筑。它的骨架是木柱，而墙壁、天花板和地板都是由竹制的木板和竹制的夹板建造的。它通常有一个被树叶（现在或采用树叶或木板）覆盖的斜屋顶。倾斜深而长，确保雨水快速排出屋顶，防止强烈的阳光。地板高于地面几英尺，既防潮又仿蛇鼠。

在坡屋顶和建筑的主要部分之间有一些空隙允许空气流动。



马来西亚传统住宅

※术语解释

坡度：一个用来描述斜坡的方向和陡度的数字。它经常被用来代表小山、屋顶和坡道的陡峭程度。屋顶坡对排水和热辐射都有影响。

活动3.3塔

✳介绍

在伊本-白图泰的时代，自古以来就是世界七大奇迹之一的亚历山大的大灯塔已经破损多年。那时谁也无法想象，几百年后许多摩天大楼拔地而起。

科威特是丝绸之路沿线国家，地势总体较低，最高点海拔306米（1004英尺）。平坦多沙的阿拉伯沙漠覆盖了科威特的大部分地区，因此人们的日常饮用水主要是淡化海水。海水被泵从淡化设施送到科威特水塔。科威特塔于1979年3月正式落成，被视为现代科威特的地标和象征。

✳年龄

10-11岁

✳目标

学生应能够：

1.了解科威特水塔的结构

2.建立一个塔式模型，探索其稳定性

✳聚焦问题

工程问题：用3张A4纸和1个纸杯建一个水塔。纸和1个纸杯。塔的高度超过40厘米。水塔顶部需要有一个可以放置乒乓球的平台。塔塔应具有一定的抗风性和抗震性。。

一些供学生思考的工程问题如下：

1．你想建造的水塔的结构是什么？

2．塔的底部是什么？

3．塔体的形状是什么？

4．各部件应如何连接？

5．你的塔会有多高？

✳探究

材料

3张A4大小的纸

1个纸筒

双面胶带

砝码

剪刀

步骤

1.观察

i.该塔的特点和结构

a. 观察下图中的塔，思考塔的基本特征。

东方明珠，上海.中国

科威特水塔

埃菲尔铁塔，巴黎.法国

瓷塔，南京.中国

b. 塔有哪些结构？ 最基本的结构是什么？

ii.塔的重心

a. 用手轻轻推一个纸。把它推下去容易吗？

b.在纸筒底部安装两个重量，然后重试。

C.将纸筒倒过来，使砝码在纸筒上方，然后再试一次。

根据实验结果，什么位置最稳定？

2.设计

你想制作什么样的水塔？画出你的设计图。

3.制作

按照你的设计，与伙伴们一起建造水塔。

4.测试

i. 测量塔的高度，确保其结构完整，算算成本是否在20元以内。

ii. 将水塔放在桌子上，测试它是否能在没有任何外部辅助的情况下稳定地站立。

iii. 在塔顶放置砝码，测试它是否能承受1千克重物而不晃动或倒塌。

iv. 卸下重物，给塔扇风。测试其抗风性。

v. 用喷壶向塔喷水，测试其防雨性能。

vi. 轻轻摇晃桌子，测试其抗震性。

vii. 如果你的塔通过了上述测试，你可以继续在塔上增加砝码，挑战它能承受的最大重量。

5.改进与交流

i. 如果你的塔的高度不符合要求，或者塔的结构不完整，请重新设计尺寸和结构。

ii. 如果你的塔架没有足够的承重能力，请检查塔架是否不够坚固或平台面积太小。如果是，请重新设计并选择相应的材料。

iii. 如果你的塔架被风吹动或倒塌，请检查塔架的形状是否稳定。请调整塔的主体结构。

iv. 如果你的塔在晃动时容易倒塌，请检查塔基是否太小或重心不合适，并重新设计。

v. 如果你的塔符合基本要求，请改进外观，使其更加美观。

vi. 向同学展示你的模型，谈谈你在制作模型的过程中发现了什么，并解释你是如何解决遇到的问题的。

✳讨论

让学生们讨论以下问题：

1. 贵国或地区有哪些特色塔？

2.这些塔是用什么材料建造的？它们与其他塔有什么不同？

工作表

学生姓名：　　　　班级：　　　　日期：

1.塔有哪些结构？

2.根据实验结果，最稳定的位置是什么？

3.实验结果对我们建造稳定的高塔有什么帮助？

学生组

姓名: 班级: 日期:

工程问题：用3张A4纸和1个纸杯建一座水塔。水塔的高度超过40厘米。

画出你的设计

制作模型并进行测试。记录测试结果，必要时进行修改。

模型的照片	你发现了什么？

✳教师阅读材料

塔式结构建筑可追溯到古印度，当时称为Stupa，指的是佛教建筑中的塔式建筑。随着佛教在东方地区的传播，佛塔式建筑大行其道，塔成为东方地区的特色传统建筑。随着技术的发展，塔楼在许多方面发挥了如下作用：

军事防御

塔楼可以更好地观察周围地区，可用于实时勘察情况。塔楼一般建在防御城墙上或目标附近（如攻城塔）。如今，这种塔仍被用于监狱、军营和防御围墙。

势能

通过利用重力将物体或物质向下移动，塔可以用来储存物品或液体，如储藏筒仓或水塔，或者保持物体对准地面的钻塔。跳台滑雪坡道使用的也是同样的理念，在没有天然山坡或小山的情况下，可以由人工建造。

信息增强

历史上，灯塔、钟楼、信号塔和尖塔等简单的塔被用来远距离传递信息。近年来，无线电桅杆和手机信号塔通过扩大发射器的范围来促进通信。位于加拿大安大略省多伦多市的CN塔是一座通信塔，既可以作为发射塔，也可以作为中继塔。它的设计还融入了旅游景点的特色，包括147层的世界最高观景台。

交通支持

塔楼还可用于支撑桥梁，其高度可与一些最高的水上建筑相媲美。塔楼的使用在悬索桥和斜拉桥中最为普遍。简单的塔楼结构也有助于建造铁路桥梁、大众交通系统和港口。控制塔用于提供能见度，帮助指挥航空交通。

✳术语解释

塔：塔是一种高大的结构，高度大于宽度，通常相差很大。塔与桅杆的区别在于没有缆绳，因此与高层建筑一样，是自支撑结构。

影响建筑物稳定性的因素：影响建筑物稳定性的因素有很多，如重心、我们之前探讨过的柱子形状、稳定的基座、对称的结构等。现在建筑物有了坚实的地基，所以可以建得更高。大多数建筑都是对称的。要建造的塔柱和塔顶形状必须对称，这样重量才能均匀地落在每根支柱上。

✳参考资料

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

活动3.4穹顶

简介

中国史籍《魏书》、《隋书西域传》曾描述丝绸之路上的塔什干、布哈拉和撒马尔罕三座古城的魅力。乌兹别克斯坦的中世纪伊斯兰建筑，尤其是蓝色圆顶建筑，堪称一绝。

伊本·白图泰在旅途中遇到了许多穹顶。这些穹顶代表着清真寺或宫殿的存在，也是旅行者的精神家园。

伊斯兰教的蓝色穹顶

✳年龄

11-12岁

✳目标

学生应该能够：

1. 探索材料、载荷和形状如何影响稳定性。
2. 独立设计并制作穹顶模型。

✳聚焦问题

工程问题：用硬纸板搭建一个大圆顶模型，可容纳1-2人。

以下是一些供学生思考的工程学问题：

1.如果两个形状的组合可以构成一个圆顶，它们是什么？

2.猜猜在制作圆顶模型时，订书机是用来做什么的？

✳探究

材料：

一把锋利的刀

米尺

棉线笔

粘合剂

剪刀

一位能帮助你的成人

厚纸板

订书机

步骤

1.观察

i.你认为蛋壳坚固还是易碎？什么时候容易碎？什么时候不容易碎？

ii.洗净4个鸡蛋，将鸡蛋轻轻地分成两半。从中选出4个半壳。用剪刀轻轻修剪每半个蛋壳，使其平整光滑。

iii. 将四个蛋壳倒置，将平面留在桌面上。在蛋壳的顶端放上书本。观察蛋壳上有多少本书。

2.设计

请绘制你的设计图并计算尺寸。

3.制作

为你的设计和制作选择材料。制作模型时，请在图上注明对原设计的任何改动。如有任何困难，请向他人寻求帮助。

4.测试

测试你的模型，找出需要修改的地方。

5. 改进与交流

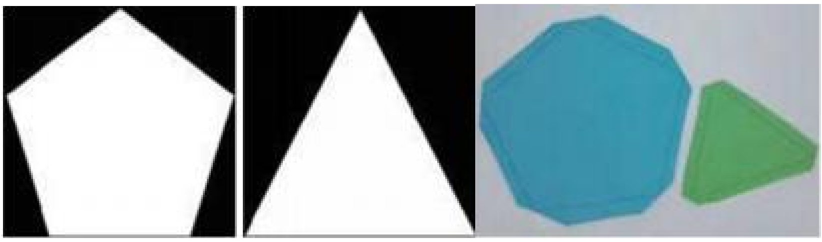
i.你的模型看起来像穹顶吗？

ii.你的模型大到足以容纳一个人吗？

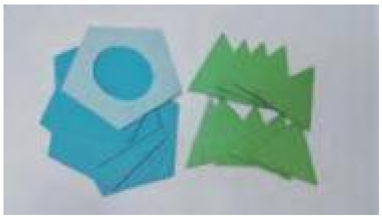
iii.向同学展示你的模型，谈你在制作模型过程中的发现，说明你是如何解决遇到的问题的。

方法

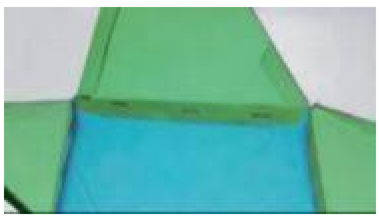
1. 在成人的帮助下，测量并剪出下面的图形。每个形状的边长应为2英尺（约61厘米）。你将需要10个两边都有挡板的三角形和6个五边形。将一个五边形放在一边作为屋顶。



2. 在剩下的一个五边形上开一个大洞，做成一扇门。



3. 在剩下的五个五边形的一边各拼接一个三角形。用螺钉和翼形螺母将五边形固定在一起。用锥子为螺丝打孔。



4. 一个接一个地将图形竖起来，将每个三角形的自由边与其中一个五边形连接起来。直到五个五边形连接成一个圆。

5. 将剩余的三角形拼接在五边形的上侧边之间。

6. 最后，将最后一个五边形固定到位，完成你的模型。

讨论

让学生们讨论以下问题：

1.你所在的国家或地区有穹顶建筑吗？

2.穹顶是什么样子的？用什么材料建造的？

工作表

姓名：　　　　　班级：　　　　　日期：

1.记录你在蛋壳实验中的发现。

2.与你的穹顶模型一起拍照。

3.你对穹顶有什么发现？

✳教师阅读材料

穹顶就像一个倒立的碗。穹顶与拱顶不同，拱顶的每个构件都需要支撑，直到基石就位，而穹顶在建造过程中是稳定的，因为每一层都是一个完整的自上而下的环。砖石穹顶的上部始终处于压缩状态，并得到横向支撑，因此除了作为一个整体外不会坍塌，而且这个浅上盖与理想情况有一定偏差也同样是稳定的。由于穹顶有侧向支撑，因此可以做得比相同跨度的拱顶薄得多。例如，半球形穹顶可以比半圆拱顶薄2.5倍，而具有尖拱外形的穹顶可以更薄。

穹顶内的空间看起来巍峨、圆润、宽敞，犹如宫殿一般。它让人感到庄严、祥和，与宗教氛围相契合。因此，穹顶不仅具有实际用途，还具有艺术价值和宗教代表性。著名的伊斯兰清真寺——圆顶清真寺是伊斯兰教的圣地，也是耶路撒冷最著名的地标之一。圆顶清真寺是世界上现存最古老的清真寺之一，高54米，直径24米，始建于公元7纪，在过去的一千年中曾数次翻修。圆顶清真寺的穹顶从最初的木质结构变成了如今金碧辉煌的模样，代表着穆斯林的虔诚和活力。

耶路撒冷岩石圆顶清真寺

✳术语解释

穹顶（源于拉丁语：domus）是一种建筑构件，类似于中空球体的上半部。关于穹顶的确切定义一直存在争议。描述穹顶的形式和专用术语也多种多样。穹顶可以位于圆形或鼓形大厅之上，也可以由通过斜面或垂面过渡到穹顶的柱子或墩子来支撑。穹顶顶部的窗洞可以被一盏灯覆盖，而灯本身也可以有另一个穹顶。

✳参考资料

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

第二部分海上丝绸之路

概述

海上丝绸之路是指历史上丝绸之路的海上部分，连接中国与东南亚、印度尼西亚群岛、印度次大陆、阿拉伯半岛、索马里、埃及，最后到达欧洲。

中世纪早期，随着来自阿拉伯半岛的水手们开辟了横跨阿拉伯海并进入印度洋的新贸易路线，这一网络得到了扩展。事实上，早在公元8世纪，阿拉伯与中国之间就建立了海上贸易联系。航海技术、天文学以及造船技术的进步使远距离海上旅行变得越来越实用。这些城市成为商品、思想、语言和信仰交流的富庶中心，拥有庞大的市场和不断变化的商人和水手。

这条贸易路线涉及多个海域，包括中国南海、马六甲海峡、印度洋、孟加拉湾、阿拉伯海、波斯湾和红海。这条海上贸易路线与历史上的东南亚海上贸易、香料贸易、印度洋贸易以及8世纪后的阿拉伯海上贸易网络重叠。

丝绸之路沿线的旅行者不仅被贸易所吸引，也被丝绸之路沿线城市的知识和文化交流所吸引，其中许多城市已经发展成为文化和学习的中心。因此，科学、艺术和文学以及手工工艺和技术都沿着这些路线传播到社会中，语言、宗教和文化就这样发展起来并相互影响。

尽管丝绸贸易是中亚贸易路线最早的催化剂之一，但它只是东西方之间贸易的众多产品之一，这些产品包括纺织品、香料、谷物、蔬菜和水果、兽皮、工具、木制品、金属制品、宗教用品、艺术品、宝石等等。

郑和下西洋与海上丝绸之路

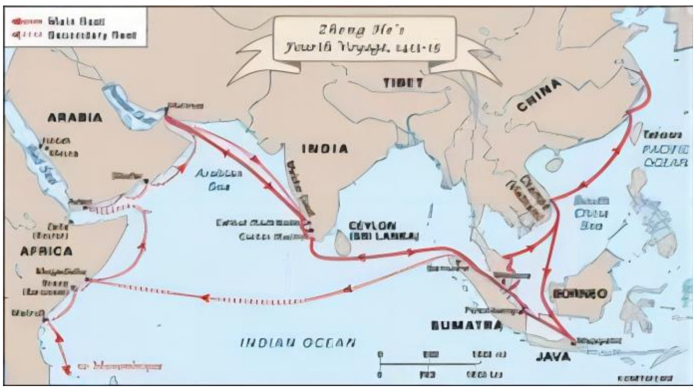
很久以前，中国云南省昆明市诞生了一位世界上最伟大的古代将领。1371年出生的郑和注定是明朝最优秀的高级指挥官。郑和是中国穆斯林，他的祖籍在布哈拉（今乌兹别克斯坦）。他的曾祖父赛典赤·赡思丁·乌马尔是一位政治家，也是成吉思汗的贴身侍卫。在父亲和祖父的激励下，他最大的愿望就是去圣城麦加朝圣。郑和还有一个额外的愿望，由于他的祖先是穆斯林，他的家人都会说阿拉伯语。这在他的航行中变得非常有价值，因为他所探索的许多地区都有穆斯林统治者。由于能够与他们交流，他总是受到他们的欢迎。

郑和喜欢到异国他乡冒险。他梦想成为中国的航海家。为了实现梦想，他努力学习知识、技能和经验。凭着坚强的意志和献身精神，郑和成为了一位著名的战略家，精通外国礼仪和习俗。他还因精通航海知识和最新的航海技术而备受尊敬。

当明朝想要扩大中国的经济和政治关系时，他的梦想终于实现了。当时的统治者明成祖选中郑和为大将。

郑和于1405年首次下西洋。他从刘家港开始航行。他访问了越南，后来又访问了菲律宾的苏禄。他航行到柬埔寨，参观了吴哥寺。他又在暹罗（今泰国）停留了一段时间。后来，他继续前往文莱和爪哇，然后航行到巴伦邦。他的一次重要航行是前往马六甲。他与马六甲的统治者帕拉梅斯瓦拉（Parameswara）建立了良好的关系，帮助他建立了自己的王国。

横跨印度洋的信风将卡利卡特的豆蔻、肉桂、生姜、姜黄，尤其是胡椒、锡兰的宝石以及羊毛地毯等运往中国。更多来自霍尔木兹（波斯湾）和亚丁（红海）的宝石以及来自北非和东非的农产品也来到了中国。



郑和随后乘船前往苏门答腊岛北部的那库尔。这里的人们出产珍贵的龙涎香。龙涎香具有提神醒脑、活血化瘀的功效，深受人们喜爱。由于政局不稳，郑和并未在当地久留。

郑和的下一个目的地是孟加拉，即现在的孟加拉国。早在汉朝，孟加拉就与中国有联系。国王非常尊重中国，在他访问期间，他和他的部队受到了热烈欢迎。国王还多次出访，并送给皇帝一只“麒麟”。

这只“麒麟”其实是一种长颈鹿，也是非洲常见的动物。但在中国，它却被神秘化，被视为吉祥动物。永乐皇帝委托沈度绘制了这幅由孟加拉进贡的长颈鹿图。

航行到孟加拉后，他在锡兰（今斯里兰卡）停留。锡兰是佛陀传教和涅槃的地方。锡兰也是佛教文化兴盛的地方之一。

他向当地的佛教寺庙赠送了许多礼物，并用中文、泰米尔语和波斯语竖立了一块三语石碑以纪念这一事件，并表达他对各种宗教的尊重。

他从孟加拉出发，驶向马尔代夫共和国，又称马尔代夫群岛。马尔代夫与中国关系友好。郑和的主船队和分船队在访问东非各国的途中会经过马尔代夫。

其次是科钦，它在郑和航海史上非常受欢迎。自唐朝末年以来，科钦与中国的文化和贸易往来十分频繁。时至今日，当地渔民仍在使用中国式渔网捕鱼。

郑和的船队航行到霍尔木兹停了下来。霍尔木兹在伊朗境内，是西洋的一个大国。人们信仰伊斯兰教，其文化、科学和技术都比邻国先进。它还是东西航线上的主要水道，也是与霍尔木兹进行对外贸易的重要停靠港。数年后，郑和下西洋来到佐法儿。如今，这里是阿曼的杜法尔。杜法尔国王命令他的所有人外卖他们的货物，与中国舰队进行贸易。

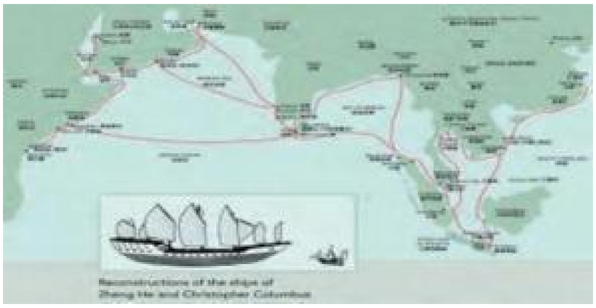
从霍尔木兹到卡利卡特的恒星图附导航说明

郑和从阿曼出发，先后到过卡利卡特、亚丁、麦加、摩加迪沙等国，还到过东非的布拉瓦岛和吉姆博（今索马里的布拉瓦和奇西马尤）以及肯尼亚的蒙巴萨。据说，当时郑和就开始使用《星图》作为参考和航海指南。郑和还派遣翻译洪宝、马欢等人单独前往麦加。他们画的一幅《卡巴图》被带了回来，让远在千里之外的中国穆斯林看到了围绕卡巴和麦加大清真寺朝圣的场景。

他和他的部下在东非期间，向索马里和肯尼亚人民赠送了棉花种子，并教他们种植棉花。中国人还教他们如何缝纫，如何用木杆制造纺织机的原型，以便他们能够生产棉布。

郑和在肯尼亚期间，还访问了位于非洲东部的马林王国，即现在的马林迪。那里出口的中国瓷器和丝绸非常受欢迎。国王曾派遣使节乘坐郑和的船只访问中国。国王还向明朝皇帝赠送了一只“麒麟”作为礼物。

宣德五年（1430年），由于外国使节很少来中国，皇帝命令郑和像永乐年间一样远征西洋。这是郑和的最后一次航行。他在太仓和昌乐分别立了碑文，记载了他七次远征的历程。他还探索了新的路线。



郑和七下西洋之旅

表 郑和七下西洋

顺序	时间	沿途地区
第一次航程	1405-1407	占城，阿瓦，巴邻旁，马六甲，阿鲁，兰布里，锡兰，奥拉姆，科钦，卡利卡特
第二次航程	1407-1409	占城，爪哇，暹罗，科钦，锡兰，卡利卡特
第三次航程	1409-1411	占城，爪哇,马六甲，马六甲，奎隆，卡利卡特，暹罗，卡亚勒
第四次航程	1413-1415	占城，吉兰丹，彭亨，爪哇，巴邻旁，马六甲，兰布里，锡兰，卡利卡特，卡亚勒，霍尔木兹海峡，马尔代夫，摩加迪沙，马林迪，亚丁，马斯喀特
第五次航程	1417-1419	琉球群岛，占城，彭亨,爪哇，马六甲，兰布里，孟加拉，锡兰，卡利卡特，霍尔木兹海峡，马尔代夫，亚丁，摩加迪沙，拉穆群岛和马林迪.
第六次航程	1421-1422	占城，孟加拉，锡兰，卡利卡特，马尔代夫，霍尔木兹海峡，亚丁湾，摩加迪沙
第七次航程	1430-1433	占城，爪哇，巴邻旁，马六甲，安达曼和尼科巴岛，孟加拉，锡兰，卡利卡特，霍 尔木兹海峡，亚丁(可能 是哥 印拜陀),孟加拉，拉卡迪夫和马尔代夫群岛，拉萨，亚丁，麦加，拉萨，亚丁，麦加，摩加迪沙，巴拉圭

明朝初年，海军技术达到了辉煌的顶峰，举世无双。这一成就归功于前朝的大型造船厂、熟练的造船工人和精湛的海军技术。永乐皇帝下令建造远航所需的更大的船只。这是为了实现他的梦想，向世界展示明朝的强大，炫耀中国的资源和重要性。

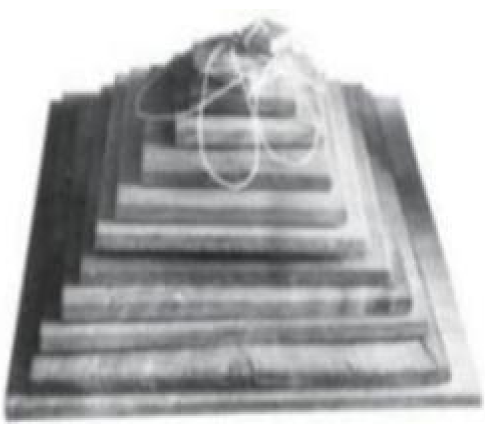
郑和船队配备了当时最先进的导航设备和装置。船队采用了以下三种方法确定位置：水深定位、景观标志定位和天文定位。这些旅行者中的许多人选择陆路和海路进行旅行。如果货物装载量不是很大，而且时间也允许，他们更喜欢陆路旅行，以获得更可预测和更安全的旅行。

单元1 恒星和导航工具

指南针是一种中国人的发明，用于告诉船只相对于磁北极的位置。中国航海家使用带有方位点和磁针的指南针比西方早几百年。

从公元九世纪开始，中国航海家在航海过程中使用船上的磁罗盘导航。当天空晴朗时，他们还能利用星象进行导航，使用的是分别从十一世纪和十三世纪就已出现的印有星图和罗盘方位的手册。使用星象导航是水手培训的重要组成部分

伟大的郑和以航海图的形式留下了许多重要宝藏。他的星象航海图（卯坤图）被水手用来计算船只的地理坐标和位置。这种技术可以引导船只到达目的地，确保船队在航行中的安全。根据郑和航海图绘制的《航海之星》被英国科学家约瑟夫-尼德姆（JosephNeedham）誉为最古老的科学航海图。该地图包含540多个中国和外国地点，并详细记录了每个方向的位置（经度和纬度）、航行速度、路线、深度和高度。



活动1.1 寻找北极星

简介

很久以前，人们用星星作为旅行的向导。旅行的人们依靠北极星指引方向。北极星是"小熊"星座中位于星柄末端的最后一颗恒星。星座是天空中的一组星星。从地球上看，它们就像一个个图案。每个星座都有特殊的名称。为什么旅行者要依靠北极星来指引方向？地球自转时，星星会在天空中移动。北极星位于地球北极上方，因此整夜都在同一位置。我们将学习如何识别夜空中的北极星。

✳年龄

10-12岁

✳目标

学生应该能够

1.识别并命名星座。

2.确认北极星。

3.说明北极星在过去是如何帮助旅行者指明方向的。

4.了解天文学家在命名恒星和星座方面的贡献。

✳聚焦问题

1. 人们为什么用星星来指引方向？

2. 人们用哪些星星来指引方向？

✳探究

材料

星座工作表，上面写满了大熊座和小熊座的星点。

天空地图

步骤

1.开始小组讨论，引导学生说出他们在夜晚的天空中看到了什么。让他们想象没有星星的天空。

2.指导性问题

a.你在夜晚的天空中看到了什么？

b.你认为地球另一端的人看到的星星和星座和我们看到的一样吗？

3.发给学生观察工作表。让学生研究并在作业纸上的这些点中找出小熊星座。

4.连接各点。

5.连接星座的各点后，找到北极星，并给北极星贴上标签。

6.请他们描述星座的形状。

7.让学生寻找其他星座。他们可以参考天空地图

✳讨论

让学生讨论：在如今的旅行中，北极星还能作为指示方向的指南吗？为什么？

工作表1

姓名：　　　　　　　　班级：　　　　　　　　日期：

找出你以前观测过的星座。

天空星座图

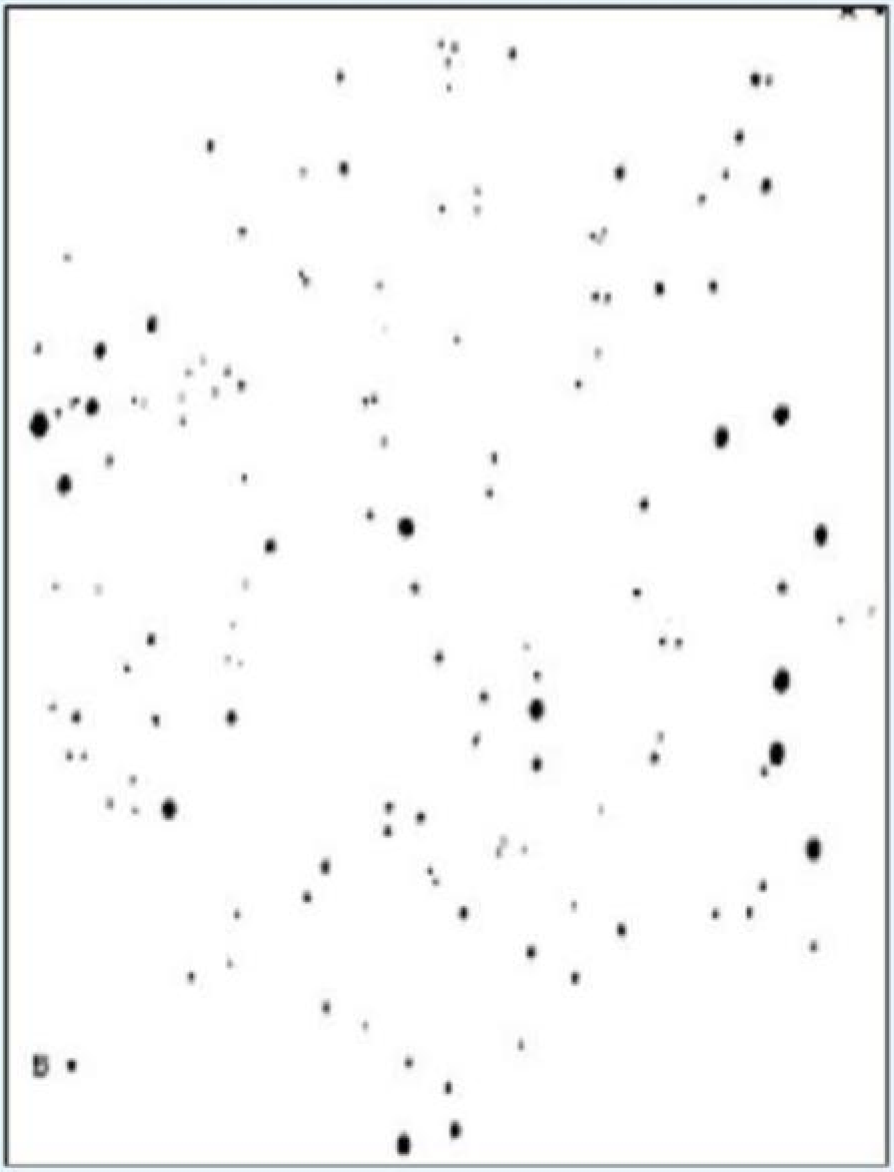
工作表2

姓名：　　　　　　　　班级：　　　　　　　　日期：

1. 识别小熊星座。

2. 连线并识别北极星。

3. 寻找其他星座并将点连接起来。



工作表3

姓名：　　　　　　　　　班级：　　　　　　　　　日期：

1.在方框中画出小熊星座。

2.描述小熊的形状。

3.为什么人们在旅行中使用北极星作为向导?

工作表4

姓名: 班级: 日期:

南极星

1.在星空图中寻找南极星。在方框中画出南极星。

2.描述南极星的形状。

3.旅行者何时使用南极星作为向导?

活动1.2 恒星的亮度

简介

恒星是由炽热气体组成的巨大闪亮球体，存在于宇宙中的所有星系中。所有恒星都是由气体和其他元素组成的。我们在夜空中用肉眼看到的恒星都属于银河系。银河系是一个巨大的恒星系统，包含了我们的太阳系。它包含数千亿颗恒星、星团以及气体和尘埃云。离我们最近恒星是太阳。

当我们仰望夜空时，会看到许多星星。乍一看，所有星星的亮度似乎都一样。天空中的星星亮度一样吗？在这个活动中，我们将观察星星，确定它们的亮度是否相同。

✳年龄

11-12岁

✳目标

学生应该能够：

1.观测恒星的亮度。

2.得出恒星亮度的结论。

3.在观察星星时一起合作。

✳聚焦问题

1. 所有恒星的亮度都一样吗？

2. 决定恒星亮度的因素有哪些？

✳探究材料

望远镜或双筒望远镜

工作表

步骤

1.让学生预测是否所有星星的亮度都一样。

2.让学生晚上在家时观察星星。他们可以使用望远镜、双筒望远镜或肉眼观察星星。请他们记录自己的观察结果。

2. 让他们讨论对星星的观察，并从互联网上查找

有关影响星星亮度的因素的信息。

4.让他们谈谈自己的发现并做出结论。

✳讨论

在过去，甚至在郑和探险之前，探险家们通过参考天空中星星的位置等自然标志来导航。他们靠人工看地图。即便如此，它也不一定能确定当前的位置。在数字时代，全球定位系统(GPS)的出现使导航过程更容易、更快、更准确。

全球定位系统等现代导航技术是否会使星星对人们的作用减弱？了解有关GPS的更多信息，并讨论它对文明融合的贡献。

工作表1

姓名： 班级： 日期：

我想知道什么？	
我以前的经验：	我的观察
我的分析 1.这两个星星的大小一样吗？ 2.为什么有些星星看起来比其他的要小？ 3.为什么有些星星看起来比其他的要亮？ 4.距离和亮度之间的关系是什么。 5.你认为影响星亮度的因素是什么？ 6.人们在旅行中会选择哪一种方式来引导他们？明亮的星星还是不那么明亮的星星？	
我的结论	

活动1.3 制作自己的指南针

简介

指南针是中国人发明的一种用来指示船舶相对于磁北位置的仪器。中国航海家应用带有方向点和磁针的指南针比西方早了几百年。我们将学习指南针的工作原理。

年龄

10- 12岁

✳目标

学生应该能够

1.读指南针。

2.寻找方向。

3.查找有关对象/地点位置的信息。

✳聚焦问题

指南针如何工作？

✳探究

材料磁铁

针/针头

水盆

纸板

现代指南针

步骤

1.教师和学生一起用磁铁和针制作一个简单的指南针。

2.教师让学生说出学校周围重要地点的方位。

3.教师布置学生阅读小标题“导航工具：选自短篇小说《伟大的航海家》”。

4.教师和学生讨论郑和如何在航行中使用航海工具。

5.教师和学生一起探索现代指南针的使用方法。

6.教师将学生分成4组，分配他们去寻宝。

讨论

让学生讨论指南针是过去帮助航海者的伟大发明。现在的船只还使用指南针来帮助指路吗？为什么？

工作表1

姓名：　　　　　　　　班级：　　　　　　　　日期：

寻宝

使用指南针，找到目标/地点：

	目标/地点	指南针上的位置
1		
2		
3		
4		
5		
6		

活动1.4 现代导航工具

简介

技术的进步使海洋航行变得更加容易。如今，船员拥有各种海洋导航设备，使其工作更加轻松简单。此外，他们接受过培训，了解所有现代导航设备的功能和操作，从而使海洋航行更快、更顺畅、更安全。

随着现代科技的发展，现代的船舶拥有多个先进的导航设备系统，可为航行提供准确的数据。

年龄

11-12岁

✳目标

学生应该能够

1.列举一些现代航海工具和设备。

2.说明工具和设备的功能

3.交流和分享他们的发现。

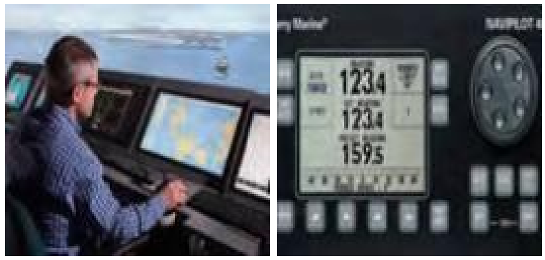
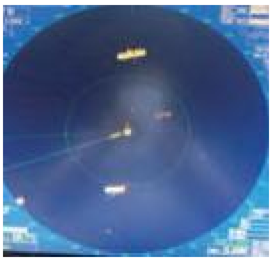
✳聚焦问题

1.当今有哪些新的海上导航工具和设备？

2.它们的功能是什么？

✳探究

材料

 罗盘	 自动驾驶仪
 雷达	 速度与距离记录仪

注意事项：教师也可建议使用其他工具或设备

步骤

1.教师列举并介绍当今使用的几种现代航海工具和设备的照片。

2.将全班分成若干小组。每个小组负责从互联网上搜索一种导航工具的更多照片和信息。

3.如果学校或家里有电脑和应用程序，让学生讨论他们的发现，并准备一个演示文稿来分享他们的报告发现。教师可帮助学生使用应用程序。

4.如果没有电脑，学生也可以通过制作简单的海报来报告和展示他们的发现。

5.教师要指导学生做报告。报告可包括：

i.项目名称

ii.项目目标

iii.调查结果、相关照片、工具的功能

iv.结论

教师可为学生的项目报告增加其他方面的内容。

讨论

“技术是好是坏？”

让学生就发言进行讨论和辩论。

帮助学生说明技术的好的一面和如何克服技术的坏的一面，以及这与社会和谐的关系。

活动1.5 让我们设计一条自行车路线

简介

骑自行车是一项很好的运动。但是，你知道大多数与自行车有关的事故都与汽车交通有关吗？为了减少事故和伤害，了解骑行者的安全方法非常重要。与传统技术相比，GPS系统使工程师能够更有效地收集地面信息。在这次活动中，我们将利用GPS技术在学校周围进行调查，学习如何追踪我们的路线——去设计安全的自行车路线。

年龄

11-12 岁

✳目标

学生应该能够

1.确定自行车的安全路线

2.使用GPS应用程序设计学校周边的自行车路线

3.重视在日常生活中的安全和为他人着想。

✳聚焦问题

1.贵校的自行车道对学生来说是否安全？

3.如何使用GPS应用程序进行调查以跟踪安全的自行车路线？

✳探究

材料

GPS设备（配备GPS的手机）。

BikeGPX用于将GPX线路文件放到手机上并在自行车上进行跟踪的程序(教师可指导学生下载苹果版和安卓版）。

自行车

步骤

1. 使用带有GPX追踪程序的GPS追踪路线，探索学校区域。

2. 评估地形和其他障碍物。在行进路线上，记录沿途对身心有影响的障碍物。是否有较难通过的区域？是否有比其他地方更安全的区域？

3. 使用GPX文件获取数据并绘制地图。

地形图上的GPX文件示例

4. 根据第2步的观察结果，设计一条自行车路线。

✳讨论

与学生讨论在其社区内设置安全自行车道的重要性。

✳术语解释

星座：形成某种图案的一组恒星

方向：路径、路线

亮度：反射光的质量

闪亮：反射光线时非常明亮

集群：一组事物

进步：正在改进

导航：规划和指引船只航行的方向

航海：长途跋涉

准确：各方面都正确

调查：检查和记录

轨迹：沿着小径/路径

第二单元风与导航

马六甲（现为马来西亚的马六甲）位于东西海路的咽喉处。凭借优越的地理位置，马六甲从一个小渔村发展成为15世纪最繁忙的港口之一。每年，来自阿拉伯、波斯、印度、中国以及印度洋地区的成百上千的商人云集马六甲。

由于其重要的战略位置，马六甲经常受到邻国的入侵。马六甲的统治者帕拉梅斯瓦拉向中国求助。中国的皇帝指示郑和出访，帮助帕拉梅斯瓦拉管理他的王国。郑和的舰队驶向马六甲，帮助帕拉米斯瓦拉。帕拉梅斯瓦拉非常感激并支持郑和，允许他建立一个囤积站（贸易站）来储存货物。这一历史遗迹至今仍在，被称为郑和文化博物馆。

1405年郑和海军上将在马六甲的登船点

当时的贸易活动主要依靠帆船和季节风。西季风（5月至9月）把商人带到香料岛，东季风（12月至3月）把他们带到苏门答腊岛和海峡港口。

东部季风（12月至3月）

西部季风（5月至9月）

5月，印度商人驶往马六甲，直到1月才带着来自中国的货物返回印度。5月至9月，来自爪哇和群岛的商人来到马六甲。马六甲作为这些商人的贸易交汇点而蓬勃发展。

帕拉梅斯瓦拉建立了一个港口和仓库，为贸易提供服务，并为仓库货物提供安全保障，还为不同的城市建立了设施。为确保安全，帕拉梅斯瓦拉与明朝建立了保护关系。郑和下西洋有助于实现当地的和平与和谐。郑和的船队在航行到印度洋时途经马六甲。

活动2.1 风向标

简介

风向标用于指示风速和风向。风向标通常用于机场，向飞行员指示风向和风力，也用于有气体泄漏风险的化工厂。风向标有时也设在高速公路边风大的地方。在许多机场，风向标在夜间都有灯光照明，有的在风向标周围的顶部装有泛光灯，有的则安装在风向标的杆子上，用灯光照射风向标内部。在这项活动中，我们将制作一个风向标来观察风向。风向标是一个圆锥形的布筒，像一只巨大的袜子。风向标可以作为了解风向和风速的基本依据，也可以作为装饰品。它在航行中如何使用呢？

年龄

10-12岁

✳目标

学生应该能够

1.说明风向决定了船只航行的方向。

2.说明风对东南亚港口贸易商的风帆和航线的影响。

3.描述早期的航海者如何利用他们对海洋的了解来规划他们的航行。

4.认识到自然现象对人类的巨大益处。

✳聚焦问题

帆船的桅杆上挂着帆，风可以吹动帆推动船前进。水手如何知道风的方向和力量？他又是如何利用风的方向和力量

让船保持正确的位置和方向？

工程问题：制作一个测量风向和风力的装置。工程师需解决的问题：

1.如何测量风的功率？

2.如何测量风向？

3.如何识别不同的风力？

4.风向标可以用什么材料制作？

＊探究

材料

吸管

针

纸板

剪刀

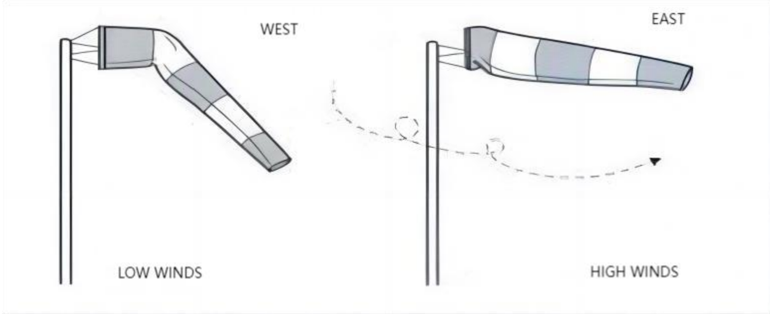
双面胶带

布条

步骤

1.观察

在大风季节或大风天，观察学校的风向标。如果学校没有风向标，可向学生提供风向标的图片，或参考互联网上的信息尝试制作风向标。



2.设计

讨论风向标的结构。设计你的风向标。

3.制作

步骤

i.剪开正方形纸，对折。

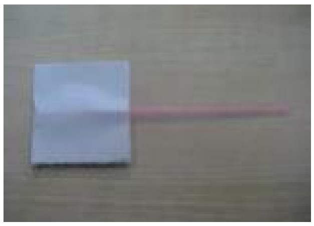
ii.用双面胶将纸片固定在吸管上。

iii.用剪刀将纸片剪成箭头形状。

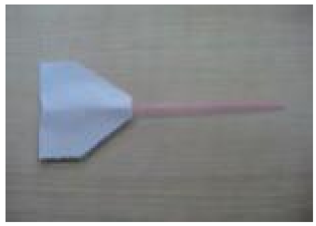
iv.将成品放在手指上，找到平衡点，并将针插入平衡点。

v.使用时，将插针插入垂直的稻草中，以确定风向。

①



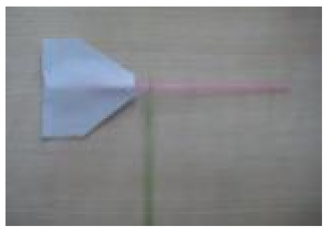
②



③

④

⑤



⑥

vi.沿着吸管粘贴一个倒置的量角器，并在量角器中间挂一个布条。

vii.固定布条顶部。

4.测试

i.将风向标放在室外，如操场上或教学楼顶上，观察纸箭头旋转和布条飘动的情况。

ii.用电风扇吹风向标进行测试。

iii.观察并记录使用不同级别电风扇时风向标的应用结果。

5.改进

i.你的风向标指向正确吗？如果不准确，请修改。

ii.防风罩能否保持稳固？如果不能，请加固。

iii.如果布条没有移动，为什么？

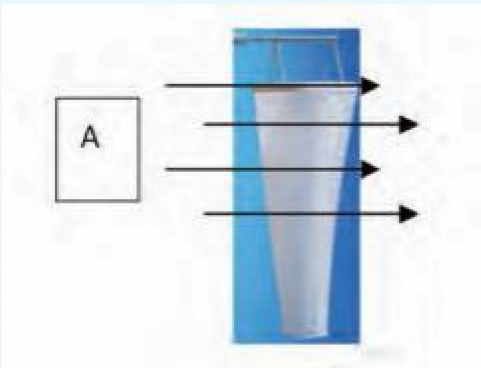
讨论

让学生们讨论季节风的概念，以及这些知识是如何帮助早期航海家环游世界。

工作表

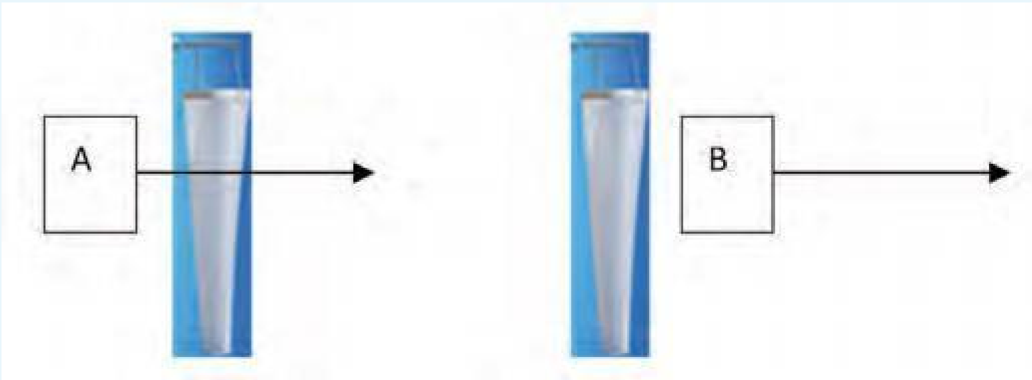
姓名： 班级: 日期:

1. 画出风从A处吹过时风向标的位置。



2. 如果风从东边吹来，风向标的尖端/末端将指向?

3. 强风从A吹向风向标，弱风从B吹向风向标。画出两种风同时过时的风向标，描述你画的图。



4. 如果郑和要向西航行，他会在季风从哪个方向吹来时航行？

活动2.2 季节风及其重要性

简介

郑和的船队依靠的是需要风力推动的帆船。风的方向随着季风季节的变化而变化。西季风（5月至9月）把商人带到香料群岛，东季风（12月至3月）把他们带到苏门答腊岛和海峡港口。5月，印度商人航行到马六甲，直到1月才带着从中国运来的货物返回印度。我们将了解季风知识如何帮助郑和规划行程。

✳年龄

10-12 岁

✳目标

学生应该能够

1.说出季节性季风的名称。

2.找出季风的相反方向。

3.说明季风对商人的重要性。

4.了解自然现象对人类的益处。

✳聚焦问题

根据马六甲的地理位置和季节风，为贸易商提供来马六甲的最佳时间信息。

✳探究

材料

工作表

显示季风的东南亚地图

步骤

1. 让学生研究显示海上丝绸之路沿线所有国家和季节风的地图。
2. 请他们找出所有国家，并预测这些国家是否受到季节风的影响。
3. 确定海上航线可到达的国家的港口

讨论

让学生讨论：现在大船会停在马六甲港口进行贸易吗？为什么？

工作表

姓名： 班级 日期

任务：

使用地图，找出各国可通过以下方式到达的港口

	海上航线	港口国家
1	例如：马六甲	马来西亚
2		
3		
4		
5		
6		
7		

活动2.3 季风的影响

简介

季风气候地区有雨季和旱季之分，这些地区很可能遭受洪水和干旱，这两种灾害都对人类健康有害。季风地区的农民依靠潮湿的夏季来种植庄稼。然而，夏季季风带来的降雨量并不总是相同。在雨季，农民无法种植庄稼，农场的牲畜没有食物，有些甚至会死亡。

夏季季风期间，暴雨会导致洪水泛滥。洪水会淹没灾民，损坏建筑物，使人们失去家园。洪水会损坏净水系统，霍乱等疾病会通过不干净的饮用水传播。携带疾病的蚊子可以在装满雨水的开放式容器中繁殖，大到水桶和池塘，小到椰子壳。这将导致在季风季节有更多的蚊子滋生。这会带来更多的蚊虫叮咬，从而传播疾病。传播疟疾、登革热和基孔肯雅热等疾病的蚊子在热带地区很常见。

✳年龄

11-12 岁

✳目标

学生应该能够

1.说明季风对其国家和人民的影响。

2.说明在季风期间应采取的安全措施。

3.讨论在季风期间互相帮助的重要性。

✳聚焦问题

1.季风对人们有哪些影响?

2.在季风季节，人们应该采取哪些安全预防措施?

✳探究

材料

工作表（思维导图）

展示季风期间情况图片


步骤

1.教师通过展示有关暴雨或雨季及其影响的图片或视频，向学生介绍季风的情况。

2.让学生分享他们在季风中的经历。

3.让他们讨论：

i.季风对人类健康和农业的影响。

ii.家人在季风期间采取的一些安全预防措施。

iii.家人以何种方式帮助邻居。

4.请学生绘制他们讨论过的有关季风的思维导图。

✳讨论

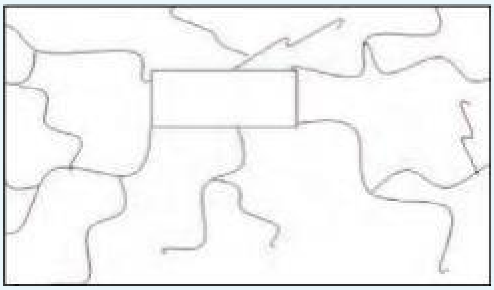
讨论一个地区的国家在季风季节相互合作和帮助的重要性。其他州或国家的人们如何很快帮助受季风影响的人们?

工作表 1

姓名：　　　　　　　　　　　　班级　　　　　　　　　　　　日期

任务：

使用思维导图展示你对季风及其影响的了解。



季风地图（样本）

活动2.4 季风对航海的影响

简介

600多年前，明朝航海家郑和历时28年，七下西洋，足迹遍及30多个亚非国家和地区。这在他之前从未有过。在那个古老的年代，郑和是如何选择航海路线的？哪些地区的海洋条件会影响船只的航行？

✳年龄

11-12岁

✳目标

学生应该能够

1.阅读地图。

2.解释这样一艘大船在没有蒸汽机或电力发动机的情况下是如何航行的。

3.共同查找和整理收集到的信息。

✳聚焦问题

郑和下西洋用的帆船是一艘非常大的航船。根据研究，郑和下西洋最大的船只长148米，宽60米。这是当时世界上最大的船。在没有蒸汽机或电力发动机的情况下，这样一艘大船是如何扬帆远航的呢？

✳探究

材料

茅坤图

世界季风地图

阅读材料

步骤

1.观察毛昆地图，你能发现什么？

2.观察夏季和冬季的世界季风图，你能发现什么？

3.阅读世界地图，说出地图上的国家和郑和下西洋的地点。

4.阅读有关季风的课文，了解什么是季风，什么样的季风会影响航行？

5.寻找更多的故事来说明季风对航海的作用。

6.制作演示文稿或海报，说明所讨论和学习的内容。

✳讨论

让学生查找除中国航海家之外的其他航海家的资料，了解其他航海家在航行中使用和参考的季风时间表。

✳教师阅读材料

季风和伊本·马吉德

我们利用季风的最佳信息是来自一位名叫伊本·马吉德（Ibn Majid）的航海大师。他来自现在的阿拉伯联合酋长国阿曼，于15世纪航海并著书立说。伊本·马吉德不仅描述了阿拉伯人利用星象导航的方法，还报告了以下环绕印度洋的路线，并列出了一年中船只离开某些港口以安全抵达目的地的时间。近几千年来季风的恒定性意味着，他的时间表或出发时间也可以用来了解更早的时代，例如罗马时代。

从伊本·马吉德的著作中，我们可以构建出一个季节性时间表，在这个时间表中，船只在秋季从西拉夫和印度西南部等海湾港口出发，乘东北季风驶往桑给巴尔等东非港口，在春季乘西南季风的第一场风返回。来自红海港口（如艾拉）的船只会在夏末向南航行，利用西南季风的尾声驶往印度西南部港口，在12月和1月再次返回，此时他们将迎来东北季风的顺风。红海和东非之间的航程可以利用两种季风的组合，并在现代也门的亚丁等港口停留。

向东进一步航行到东南亚和中国（可能要经过马六甲海峡），也符合这一时间表。船只可以在12月底离开印度南部，在4月或5月抵达中国海，并在夏季抵达广州。回程将于秋季出发，1月份穿越孟加拉湾。从海湾港口出发的船只可能需要一年半的时间才能完成往返中国的航程。

在上述所有例子中，无论是古代还是中世纪，航行可以直接进行，也可以在沿途的港口停下来进行贸易。这样，两次季风为印度洋的水手们提供了一种在一定程度上相对确定和可靠地从一个地方航行到另一个地方的方式， 他们在特定的时间到达特定的港口，并根据下一个目的地在指定的时间离开。

这种定期航海时间表完全来自于当时的航海技术与可预测的季风天气系统的结合。这与北方海域的航海形成了鲜明对比，北方海域的航海技术大致相同，但天气却更加难以预测。

✳术语解释

季节风：一年中某些月份吹向某个方向的风。

导航：在规划和跟踪路线时确定自身位置的活动或过程。

港口：海港/船只停靠的地方。

季风：传统上被定义为季节性逆转风，伴有相应的降水变化，但现在用来描述与海陆非对称加热有关的大气环流和降水的季节性变化。通常，季风一词是指季节性变化中的降雨阶段，尽管从技术上讲也有干燥阶段。

茅坤图：现代中文资料通常称为《郑和航海图》，是明代军事著作《武备志》中刊载的一套航海图。

风向：与风向标指向的方向相反。

第三单元 帆船

300多年来，中国王朝不断将其强大的影响力扩展到海上。中国的造船工人建造了双层船体，分为不同的水密隔舱。这为船只提供了保护，使其在相互碰撞时不会沉没。此外，这些才华横溢的造船工匠还创造了一种为乘客和动物储存淡水的方法，以及在航行过程中保存新鲜捕获的鱼类的水箱。

宝船厂位于南京，郑和的庞大船队就是在这里建造的。中国宝船是郑和船队中的一种大型木船，郑和在15世纪初的1405至1433年间曾七次出海，远至东非和中东。郑和宝船的规模很大，有九个桅杆和四层甲板，可搭载500多名乘客和大量货物。据说有些宝船长137米（450英尺），宽55米（180英尺），至少是当时欧洲最大船只的两倍。

郑和的船队有大小二百多艘船只，蔓延十多里。船只分为五种：宝船用于旅客和贵重货物，战船用于防御，粮船用于储存大米和蔬菜等粮食，水船用于储存淡水，领航舰用于引导而小船用于通讯。通信是通过旗语、语言、大炮、鸽子和锣鼓进行的，这是中国人和世界各地其他水手的综合方法。

不同类型的郑和船队

领航舰	• 带领舰队
宝船	• 运送旅客 • 贵重物品的储存
战舰	• 保护和保卫舰队
粮船	• 储存大米和蔬菜等食物
水船	• 储存淡水

中国的造船工匠在发明新技术方面极富创造力。与此同时，他们还成功地将从中国南海和印度洋海员那里借鉴和改造的技术融入到自己的发明中。造船师们建造的船只有三桅和四桅，其设计目的是在风力作用下达到最佳效果。中国人在阿拉伯航海家的基础上增加了拉格风帆和拉德风帆。这样，在航行过程中就可以避开划桨手，逆风航行。

中国造船工匠最重要的发明是固定在船尾外侧的艉柱舵(或尾柱舵)。他们可以根据水深进行尾柱舵。他们还能在离岸较近的地方、拥挤的港口和狭窄的航道中行船。郑和下西洋用的船是大约2200年前首创的一种帆船设计，是一种古老的中国帆船。这种帆船速度快，操控性好，可以逆风航行，而且也是历史上第一艘使用艉柱舵的船，这一创新在中国使用了几个世纪后才传到欧洲。几个世纪以来，中国南方领土独特的地理和地貌造就了许多使帆船在当时如此创新的元素。

到郑和下西洋的时候，帆船不仅技术越来越先进，体积也越来越大。哥伦布到达美洲时使用的“圣玛丽亚号”长62英尺，有3根桅杆。15世纪中国船队中最大的船只是巨轮，长400英尺。九根桅杆支撑着用来推动这些巨轮的风帆。

尽管帆船很实用，但它在东亚以外地区仍是一个谜，对西方造船业影响甚微。中国人知道帆船是一种出色的设计，并小心翼翼地保守着它的秘密。历代皇帝通过法律禁止向外国买家出售帆船，这使得中国商人在很长一段时间内占据了印度洋和太平洋的海上通道。

活动3.1 如何让船漂浮

简介

与其他船只相比，宝船的宽度与长度成正比，这有助于它们实现稳定性。船体呈V形，龙骨较长，重量较大。宝船还使用从船舷抛出的浮锚，以增加稳定性。水密隔舱也用来增加宝船的强度。宝船还有一个可以升降的平衡舵，就像一个额外的龙骨，增加了稳定性。这些宝船能够抵御波涛汹涌的海面，易于操纵，移动迅速。坚固的结构使中国探险家能够远航。

✳年龄

11-12岁

✳目标

学生应该能够：

1.识别组成帆船的部件。

2.说说每个部分是什么样的。

3.说说每个部分是由什么组成的。

4.确定制作小船的合适材料。

5.在船体上安装风帆。

✳聚焦问题

如果你想远航，你需要制造一艘稳定的帆船。什么样的船能利用风的力量呢？

＊探究

材料

泡沫板

空罐

矿泉水瓶

冰淇淋棒

一次性筷子

一次性托盘

剪刀

刀

超级胶水

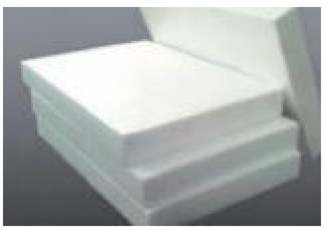
您想要的任何其他材料

步骤

1.观察

i.船是一种航行于海洋的大型水上交通工具。哪些材料适合制造船？

ii.哪些材料可以成功漂浮在水面上？

 泡沫板	 积木	 铝箔纸
 空饮料瓶	 鹅卵石	 冰淇淋棒

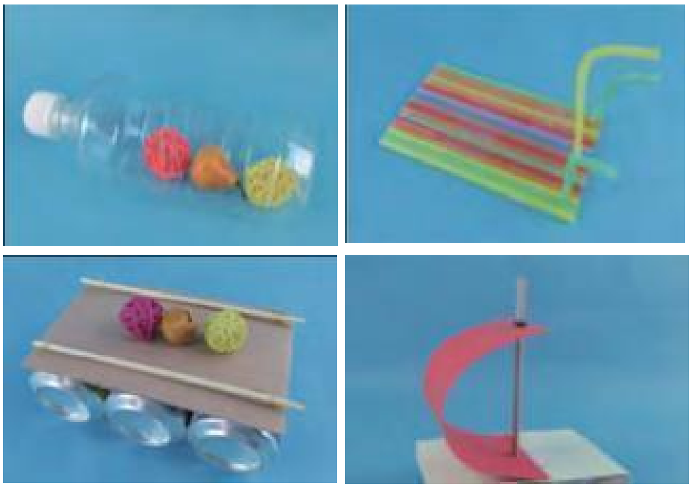
iii.思考它们的共同点。

iv.风帆如何推动船只？

从不同角度扇动纸张。放开手，观察纸被风吹起来的距离。并思考如何利用风力飞得最远。

2.设计你想制作的帆船，画出你的设计图。

3.用一次性饭盒、牛奶盒、一次性托盘等废旧物品制作一艘船。



。

5.最后，别忘了装饰你的船。

6.测试

i.用脸盆盛水。将帆船放入水中并观察船是否下沉。

ii.如果小船在5分钟内没有下沉，则扇动小船并观察其稳定性。

iii.尝试利用风力将船向前推进。

7.改进

i.如果你的船沉没了，观察船是否漏水或材料是否合适。思考如何改进。

ii.如果您的船在风中剧烈摇晃，说明船体不稳定。请考虑如何改进。

iii.如果您的船无法被风推动，请检查风帆的耐用性并改变风向。思考如何改进。

✳讨论

现代造船使用的材料有哪些？它们与早期造船所用的材料有什么不同？现代船舶如何航行？

✳教师阅读材料

中国有句古话："人以浮叶而发明舟"。这反映了人类早期对一些可以漂浮的物体的认识。也许正是因为这种自然现象，才使人们扬帆起航。如果一个人骑在一根圆木上，他就可以浮在水面上；如果他拿着一块木头，他就可以划船。如果把木头挖空，人们就可以舒服地坐在里面。这就是最早的船——独木舟。后来，人们逐渐获得了原材料，制造出了简单、稳定的大型木筏，如木排、竹排等。大约3000年前，中国开始出现木板船，这为船舶的发展和改进奠定了基础。

中国的帆船在世界上相当有名。早在秦代，人们就能制造出长30米、宽6-8米、载重6公斤的大型帆船。到了汉代，人们可以造出长约百尺的船。

到了在宋朝，人们建造了载重量超过20万公斤的大型船只。中国明朝组建了世界上最大、最强大的海军舰队之一，用于郑和下西洋和远征。据称，这些船只中最大的一艘长137米（450英尺），宽55米（180英尺）。

活动3.2 水线

简介

海上丝绸之路的主要贸易商品是丝绸、茶叶、瓷器、香料和玻璃。南海一号又称“南中国海一号”，是一艘中国商船，于南宋时期（1127-1279年）在中国南部沿海沉没。2007 年，中国开始打捞该船及其文物。沉船首次被发现时，共打捞出约13,000件宋代瓷器。该船长30米，载重约80吨。由此可见，在海洋活动中，运载能力是一个非常重要的指标。

年龄

11-12 岁

＊目标

学生应该能够

1.了解有的物体会浮，有的物体会沉

2.了解漂浮物可以下沉

＊聚焦问题

为什么船体要涂成两种不同的颜色？画在船头或船首的水平线是什么？这些线与船的运载能力有什么关系？


✳探究

材料

量杯

水

铝箔纸

塑料托盘

步骤

1. 观察：

i. 用玻璃杯装水，装到水会溢出来的位置。将一个方形块放入水中，观察会发生什么。思考水溢出的原因。

ii. 用铝箔制作一个平底船，略小于玻璃杯的直径。

iii. 取同样满的一杯水，把小船放在水面上，观察水面到船底的距离，用笔在水面上做记号。将方形木块小心放入小船，观察溢出情况，再次在水面上做记号。

iv. 想一想为什么要在船上划两条线？它们是如何工作的？

2. 用玻璃杯装水，装到水会溢出来的地方。

3. 用铝箔制作一个平底船，略小于玻璃杯的直径。

4. 将小船放在水面上，小心地将玩具模型放入小船中（注意保持小船平衡，防止小船转向），用笔在船体的水面上做记号。

5. 从船上取出玩具模型，放置适当的重量。

6. 使用电子秤称量玩具模型的重量，并与实验记录进行比较，观察玩具模型与溢出水的重量是否相同。

活动3.3 水钟

简介

在航海中，我们必须测量经度和纬度，以确定船只的准确位置和航向。纬度的计算方法是用象限仪或星盘观察太阳或海图上的星星在地平线上的高度，但经度的测量则比较困难。因此，探险者只能通过船速来估计自己的相对位置。除了时间，没有其他物理原理可以直接确定经度。由于一天有 24 小时，一圈有 360 度，太阳以每小时15度的速度在天空中移动（360°÷24=每小时15度）。因此，可以通过计算某点所在位置的时间与协调世界时（ UTC）之间的时间差来确定该点的经度。海洋航行需要计时装置。

年龄

7-8岁

✳目标

学生应该能够：

1.了解可以用来报时的工具。

2.设计一个测量时间的简单装置。

✳聚焦问题

在海上时间的测量非常重要。因为有了准确的计时，才能知道航行的速度和距离。那么，什么样的装置可以测量时间呢？设计并制作一个可以工作15分钟的水钟。

提问：

1.你要制作什么样的水钟？

2.您打算如何控制影响水钟的因素？

3.如何科学地划分比例尺？

✳探究

材料

4个透明塑料杯

锥子

带子

秒表

硬质背板（长于45厘米的木板或塑料板）

白皮书

棉线

水

步骤

1.观察：

i.找一个窄口瓶。将瓶子装满水，然后让瓶子朝上竖立，让水流出来。同时，用秒表记录水完全流出的时间。

ii.重复该活动数次，比较水流出所需的时间。你有什么发现？

2.设计

你想制作什么样的水钟？画出你的设计。

3.制作

i.剪下3根约10厘米长的棉线

ii.用锥子在每个塑料杯底部戳一个小孔，然后将棉线穿过小孔。

iii.往杯子里倒一些水，检查杯子里的水是否能顺利通过棉线。如果不能，则将小孔稍稍扩大。

iv.用胶带将三个塑料杯垂直贴在硬板上，并从上往下依次标记为1号、2号和3号。

v.在3号杯子下面粘贴一个塑料杯，并将其命名为4号。

4.测试

i.1号杯中放入100毫升水。记下时间，每5分钟检查4号杯中的水，并在杯上画线作为刻度。

ii.根据第一次滴下的水量，猜测全部水滴入4号杯子需要多长时间。

iii.记录所有的水滴入最后一个杯子实际需要的时间。

iv.测试一名学生用水钟计时15分钟。另一名学生用手表计时，检查水钟的准确性。

5.改进

i.您的水钟准确吗？为什么？

ii.根据结果，在4号杯子上标出时间刻度。

讨论

想想看还有哪些用于测量时间的方法？了解现在是否仍在使用钟表，以及为什么？

✳教师阅读材料

水钟是一种计时器，通过调节流入（流入型）或流出（流出型）容器的液体流量来测量时间。

水钟是最古老的时间测量工具之一。碗状出水是水钟最简单的形式，已知公元前16世纪左右在巴比伦和埃及出现过。世界其他地区，包括印度和中国，也有水钟的早期证据，但最早的日期不太确定。不过，有些作者声称，早在公元前4000年，中国就出现了水钟。

中国的水钟利用水流来测量时间。水钟有两种类型：流入式和流出式。在流出式水钟中，一个容器装满水，然后将水缓慢、均匀地排出容器。容器上的标记用来显示时间的流逝。水钟经过多次改进，其中以苏颂于1088年耗时十年制作的水钟最为精密。它由一个11英尺长、装有36桶水的水车提供动力，每天只转动100次。因此，它的走时相当精确。苏颂的时钟不仅能计时，还能让人们观测对中国占星术非常重要的星座。

有些水钟的设计是独立开发的，有些知识则是通过贸易传播而来。这些早期的水钟是用日晷校准的。水钟在很长一段时间内都是最先进、最常用的计时装置，直到17世纪欧洲更精确的摆钟取代了它。

水钟和火钟

活动3.4 了解你的帆船

✳介绍

帆船是中国古代的一种航船。帆船上的风帆有一定的排列方式，这样它们就可以将风引导到彼此之间，从而使帆船迎风航行，在大风和波涛汹涌的海面上航行。我们将对 帆船的各个部分进行识别。

✳年龄

4-7岁

✳目标

学生应该能够:

1. 识别帆船的各个部分
2. 给帆船的各个部分贴上标签
3. 说明帆船各部分的功能

✳聚焦问题

帆船是由哪些部分组成的?

✳探究

材料

一个帆船模型

记号笔

便利贴

步骤

1. 让学生调查一个帆船模型。教师尽可能少引导。什么是帆船?你看到船了吗 ？ 船有很多形状吗？

2. 小学生从互联网上找到有关帆船和现代船舶的信息。

3. 要求学生识别帆船和轮船的部件，给这些部件贴上标签。

4. 讨论各部分的功能。

5. 让学生在课堂上呈现自己的调查结果

✳讨论

让学生讨论中国的帆船，帆船是一种优秀的设计，作为不让其他文明知道的秘密，被 小心翼翼地保守了几百年。你能找到与中国帆船有相似特征的现代船只吗?

✳工作表

姓名: 班级： 日期：

1.画一个帆船

用以下词语标出帆船的各个部分：
船体、帆、舵、桅杆、横梁。

	帆船的各个部分	功能
1		
2		
3		
4		
5		

活动3.5 让你的帆船走得更快

✳介绍

郑和的航船规模巨大，有九根桅杆和四层甲板，可以携带500多名乘客，以及大量的货物。据说其中一些船长137米(450英尺)，宽55米(180英尺)，至少是 当时欧洲最大船只的两倍长。郑和船队的设计和大小有许多种类，分别用于不 同的目的。我们来考察一下帆船桅杆的不同设计。

✳年龄

10-12岁

✳目标

学生应该能够：

1.做出的假设。

2.控制变量。

3.说明不同的材料有不同的特性。

4.示范合作学习。

5.应用“做中学 ”探究式科学教育模型。

6.欣赏前人的发现对现代的贡献。

✳聚焦问题

1.多少根桅杆能使船走得更快？

2.什么样的材料可以做一个更好的桅杆？

✳探究

材料

帆船模型

帆船各部分的名称卡

形状相同但大小不同的空矿泉水瓶

描图纸

棉布

竹签

热枪胶

吸管

细绳

台式风扇

秒表

步骤

1.讨论一下，如果你想让你的帆船跑得更快，你应该改变什么？

2.列出你们小组认为会让帆船跑得更快的东西。

3.让团队同意你想要改变的因素。画出你的帆船进行标注。

4.向全班展示你们小组的设计。听听同学们的评价，讨论如何回答。

5.再进行一次小组讨论，考虑班级给出的建议。如果需要，重新设计你的帆船，画草图并作出标注。

6.只获取建造帆船所需的材料，同时也请考虑一下其他材料。

7.将任务分配给小组成员。

8.你的帆船准备好后，在老师准备的设置条件下进行测试，用秒表测量你的帆船从一端移动到另一端所花费的时间。记录你的数据。

9.回到你的小组，替换掉你想要更换的部分，这将使你的帆船跑得更快。

10.你的帆船准备好后，在相同的设置上重复测试。确定你的帆船从一端移动到另一端所花费的时间。记录你的数据。

11.每个小组可以三次改变相同部分并测试，每次记录你的数据。

12.向全班展示你的发现。

步骤

1.向学生展示测试是如何进行的，以便确定更快的帆船。

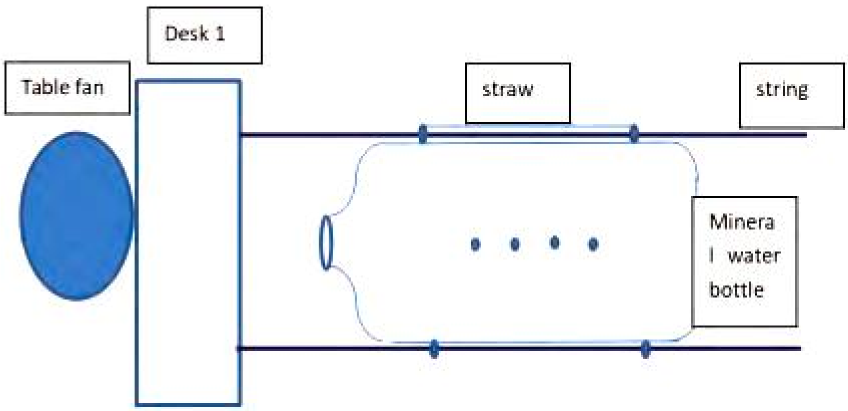
2.问学生他们希望改变帆船的哪些部分？为什么想改变它？

3.学生分组讨论并向全班展示。

4.班上的其他成员可以提问或提出建议。小组的所有成员在回答问题或为自己的观点辩护时互相帮助。

5.当团队同意一个设计时，他们需进行讨论、重新设计(如果可能的话)并确定所需的材料。

6.教师必须准备和提供所需的材料。



✳讨论

让学生讨论用于下列场合的同类中国帆船的特点：

1.现代造船。

2.如欧洲（圣玛丽亚）等其他文明。

✳工作表

姓名： 班级： 日期

1.列出你的团队认为会让帆船跑的快一点的所有办法。

2.让团队一致同意你想要改变的因素。画出你的帆船并对改动之处进行标注。

3.写下每个小组的因素和假设。

要做的改进	理由(假设)
例如：添加船帆的数量	更有效地利用风力，帆船才会走得更快。

姓名:　　　　　　　　　班级:　　　　　　　　　日期：

实验：造一艘帆船

目的-你想要知道什么？	
写一个假设：	你用的材料：
实验—你计划怎样测试你的假设？	
预测 （你的帆船到达终点所花费的时间）	观察 （帆船到达终点的实际时间）
结论一：你发现了什么？	

姓名：　　　　　　　　　班级：　　　　　　　　　日期：

分析：

1.你在实验中改变了什么？

2. 在实验中保持什么不变？

3.你想在实验中观察什么？

4.为什么每次实验都要保持某些相同的因素？

✳术语解释

桅杆：船上一根又高又直用来挂帆的柱子。

船体：船的主体。

帆：挂在桅杆上的一块材料，用来捕捉风并推动船只。

船舵：用来操纵船只的主要控制器。

货物：船上可以携带的物品的数量。

浮力（上推力）：由流体施加的一种向上的力，与浸入物体的重力相反。如果船的重力等于水的上推力，船就会浮起来。如果船的重力大于水的上推力，它就会下沉。

时间的测量方法：用匀速运动来测量时间是准确的，不需要先进的测量仪器。因此，古代计时主要靠滴水、蜡烛或香烛的燃烧或沙子的流动来计时。由于滴水计时器每两滴水之间的时间间隔是固定的，古人就以此来计时。

第4单元 香料

随季节而来的帆船带来了宝贵的贸易，把海峡上的许多港口，包括马六甲和槟港，变成了世界性的中心。

以马六甲和槟城为例，随着贸易的繁荣，这两个州开始有来自不同地方的多民族人口，如科罗曼德尔海岸、马来亚-印度尼西亚群岛、中国和欧洲。除商品贸易外这些商人还与当地人通婚，从而创造了新的民族和文化群体。这进一步为当时的复杂贸易社会增添了更多有趣的特征，从而导致了该地区文明实践的融合。

除了提供贸易设施之外，马六甲还提供天然产品，如樟脑、檀香、香料、鱼卵和海藻。马六甲从香料岛上收集丁香、肉豆蔻和肉豆蔻。丁香则从马六甲出口。




来自中国的货物有人参、漆器、青瓷、金银、硬木和其他木制品等，还有象牙、犀牛角、翠鸟羽毛、姜、瓷器和丝绸；来自朝鲜和日本的有马和牛；来自越南和暹罗的是当地盛产的硫磺和锡；而来自苏门答腊、爪哇和摩鹿加群岛的有丁香、肉豆蔻、蜡染织物、珍珠、树树脂、鸟羽毛。




✳介绍

香料可以在每家每户的厨房里找到。很久以前，人们就开始使用香料了。香料是非常重要的物品，在世界各地都有买卖。直到今天，人们对香料的需求和使用都在不断增加。世界各地的人们使用香料的原因有很多。香料最常见的用途之一是让食物的味道更美味。让我们一起来了解更多关于香料的信息，以及你喜欢的食物中的香料。

✳年龄

10-12岁

✳目标

学生应该能够：辨别香料的名称。

1.说明香料的重要性。

2.说明香料的来源。

3.尊重彼此的文化和不同的饮食。

✳聚焦问题

1.人们使用香料有不同的目的？

2.香料有什么用途？

3.你最喜欢的食物里有什么香料？

4.香料有多少种？

5.为什么香料对我们如此重要？

✳探究

材料

香料样品(如姜黄粉、丁香、黑胡椒和香菜)。

配方样品(必须有香料)

步骤

1. 让学生触摸、闻、看和品尝(如有必要，在老师的监督下进行)几种当地可用的香料，如姜黄粉、三叶草、黑胡椒和葛缕子。

注意：老师可能会在观察中加入其他香料

2. 让学生有机会简要地写下他们最喜欢的食物，并与他们的朋友分享。老师可以用一些引导性的问题来引导学生。

你最喜欢的食物是什么?

你为什么喜欢这些食物?

食物中哪些成分让食物味道好

3. 给学生提供含有香料的配方样品。让学生阅读和研究配方是如何写的。让他们识别配方中的香料。让学生从网上找到他们最喜欢的食物的配方信息，并指出所使用的香料。

4. 让学生找出香料的重要性和来源。

✳讨论

与学生讨论不同的香料来自不同的地方，但香料和香料的使用已经通过贸易迅速传播到其他地方。这说明来自不同国家和地区的人们为了更好的生活是相互依赖的。

✳工作表

姓名： 班级： 日期：

1. 在下表中记录你的感官观察

	香料	用感官观察
1		嗅觉： 味道： 外形： 触觉：
2		
3		
4		
5		

姓名: 班级: 日期:

分析:

我最喜欢的食物

1.列出你最喜欢的食物中的香料。

2.在下表中说明香料的重要性。

	香料	重要性
1		
2		
3.		

3.说出这些香料起源于哪些国家和地区。

	香料	重要性
1		
2		
3.		

活动4.2 食品保存实验

＊介绍

在任何一次探险中，旅行者都会携带足够的食物来维持整个航程。他们带了大量的生鲜和腌制的食物，足以满足整个航程中每个人的需要。香料和其他混合 物被用来保存食物。来自世界不同地区的人们用不同的方法来保存食物。在这个活动中，你会了解更多关于各种食物保存方法的信息，并尝试用你的方法来保存所给的食物。

＊年龄

10-12岁

＊目标

学生应该能够:

1. 讲出一些保存食物的方法。
2. 设计一个关于食品保鲜的实验。
3. 开展食品保鲜实验。
4. 讨论保存食物/不浪费食物的重要性。
5. 小组合作，互相帮助。

＊聚焦问题

1. 人们如何保存食物?
2. 为什么我们需要保存食物?
3. 香料的什么特性使它们能够用来保存食物?

(强调抗菌和抗微生物的特性)

＊探究

材料

泡菜

干果/干鱼

盐渍食物/咸鱼

盐

糖

蜂蜜

＊步骤

1. 让学生观察腌菜、干果/干鱼、咸鱼等腌制食品。观察过程中可以品尝食物，但须由老师采取安全预防措施 。

2. 让学生有机会分享他们如何在家里保存食物。

3. 让学生讨论并从各种资源中找到关于如何保存食物的信息。让他们研究几种保存的方法。

注：

老师可以用一些引导性的问题来引导学生：

盐有助于储存食物吗？

盐是如何起作用的？

脱水有助于保存食物吗?它是如何工作的？

辣椒有助于保存食物吗？

哪种效果更好？脱水、腌制还是香料？

还有哪些香料适合保存食物？

4. 给提供学生实验用的材料并解释实验的目的。

5. 让学生分组学习。

6. 让学生讨论他们想要测试什么，并制定他们的假设，确定被控变量，操作变量和响应变量。

7. 让学生测试他们的假设并得出结论。

步骤：

i. 准备一些合适的食物容器。在食物容器上贴上相应的标签。

ii. 每个容器准备3片芒果(重量相同)。

iii. 把一个容器放在冰箱里。

iv. 将一个容器放入温度为 600 摄氏度的烤箱中 5 分钟。向其他容器中加入 $10cm^3$的液体。学生可从以下溶液中选择液体：蒸馏水、稀氯 化钠溶液、浓氯化钠溶液、稀糖溶液、浓糖溶液、醋、蜂蜜和姜黄溶液。

v. 盖好食物容器。

vi. 预测48小时后芒果片会发生什么变化。

vii. 48小时后检查容器，记录芒果和溶液的外观

✳讨论

老师与学生讨论:

1. 食品保存的重要性。

注：老师可以用一些引导性问题来指导学生：

为什么我们需要保存食物？食物不保存会怎么样？

如果食物不保存，食物会发生什么变化？

2. 保存食物的方法从很久以前就开始尝试，并一直延续到今天（为了显示文明之间的联系）。保存食物的方法不断改进，而且发现了更多的方法（比如使用人工防腐剂）。

＊工作表

姓名：　　　班级：　　　日期：

用感官观察腌制食品的样品

	腌制食品样品	用感官观察
1		嗅： 尝： 触： 看：
2		嗅： 尝： 触： 看：
3		嗅： 尝： 触： 看：
4		嗅： 尝： 触： 看：

姓名：　　　班级：　　　日期：

目的–你想要知道什么	
创造一个假设	你要用的材料:
实验-你将如何测试你的假设	
预测(针对每个容器)	观察(针对每个容器)
结论：你发现了什么?	

姓名: 班级: 日期:

分析：

1.你在实验中改变了什么？

2.你在实验中保持什么不变？

3.你想在实验中观察什么？

4.为什么每个容器里要放3片芒果？

5.简要解释你认为每个容器里发生了什么。

活动4.3 测试我自己的叻沙配方

✳介绍

叻沙是一种辣味面汤，流行于马来西亚、新加坡、印度尼西亚和泰国南部。叻沙由米线或米粉配上鸡肉、牛肉、虾或鱼等食材，和辛辣的汤一起食用，汤中有浓浓的或辛辣的咖喱椰奶，也有酸的阿萨姆(酸豆、胶瓜或科库姆)。它是一种淡黄色的酱汁，但也有在沙捞越发现的白色叻沙酱。

叻沙是从哪里来的?关于叻沙的起源有很多故事，但历史学家认为，这道配方产生于中国沿海定居点与东南亚海上航线沿途当地烹饪习惯之间的结合。目前，由于影响叻沙味道的调味料和调味品(食物上桌后添加的香料)的不同，叻沙的配方在各个地区都有很多变化。 让我们来了解更多关于叻沙的知识，并在家里制作自己的叻沙配方。

✳年龄

10-12岁

✳目标

学生应该能够：

1.用香料做一道新菜。

2.测试他们的配方。

3.欣赏来自不同文化的各种食物。

✳聚焦问题

1.什么香料能给叻沙带来更多的味道？

✳探究

材料

根据所选叻沙配方确定食材

步骤

1.让学生们分享他们吃叻沙的经验，以及制作叻沙所用的香料。

2.让他们列出区分马来西亚各种叻沙的标准，比如阿萨姆叻沙、咖喱叻沙和沙捞越叻沙。说明它们之间的区别。

3.给学生提供不同国家的叻沙配方样本（印尼叻沙、新加坡叻沙、马来西亚叻沙、泰国叻沙）。老师也可以播放人们吃叻沙的视频。

4.让学生们讨论他们可以在配方中加入什么香料来让叻沙更有味道。

5.学生可以在父母的帮助下在家尝试新配方。

6.学生记录自己的发现并与全班分享。

✳讨论

老师可以和学生讨论食物是如何将世界不同地区的文明和文化联系起来的。老师可以通过提问来引导学生：

1.面条起源于哪里？

2.香料是从哪里来的？

3.准备叻沙需要什么？

✳工作表

姓名：　　　　　　　班级：　　　　　　　日期：

1. 说明叻沙类型之间的区别。

评判标准	阿萨姆叻沙	咖喱叻沙	沙捞越叻沙
例子：是否使用椰奶	使用椰奶	不使用椰奶	使用椰奶

2. 写下自己的叻沙配方。

✳教师阅读材料

如今，有许多种类的叻沙，如加东叻沙(新加坡)，女士叻沙(马来西亚)，巴达维亚叻沙

（印度尼西亚）和叻沙盖（泰国）。它们有不同的配方、口味和上菜的方式，甚至配菜和饮料的种类也不一样。当我们享用叻沙时，它们会产生不同的感觉简直是无法抗拒。

基本的叻沙基于配方中使用的汤底;要么是浓郁而美味的椰奶，要么是鲜而酸的阿萨姆（就像马来西亚的拉克萨）或者两者的结合。叻沙有三种基本类型：咖喱叻沙，阿萨姆叻沙，以及其他可以被识别为咖喱叻沙或阿萨姆叻沙的变体。咖喱叻沙是一种椰奶咖喱汤加面条,而阿萨姆叻沙是一种酸汤加面条，最常见的是罗望子（酸豆）。粗米粉也被称为叻沙粉，是最常见的，虽然细米粉也很常见。有些配方可能会从头开始制作米粉。一些叻沙配方的变体可能会使用其他类型的面条；比如柔佛叻沙会使用意大利面，而融合配方可能会使用日本乌冬面。

咖喱叻沙、阿萨姆叻沙和沙捞越叻沙的大致区别如下

咖喱叻沙	阿萨姆叻沙	沙捞越叻沙
使用椰奶	不使用椰奶	使用椰奶
咖喱汤（咖喱作为配料之一）	鱼酱汤，因用了罗望子（阿萨姆）而有酸味	红咖喱汤（不使用咖喱）
除豆芽外，不使用其他蔬菜	菠萝、黄瓜丝、生洋葱都可以用	除豆芽和新鲜香菜作配菜外，不用其他蔬菜
用油豆腐	不用油豆腐	不用油豆腐
配粗的或细的米粉（通常是粗的）偶尔配黄面条	配粗的或细的米粉（通常是粗的）	只配细米粉食用

可加水煮蛋	不加水煮鸡蛋	加煎蛋卷切片
加炸鱼饼、大虾或鸡肉	通常用鲭鱼	加整只大虾和等级较高 的鸡肉
衍生品种 • Laksa Lemak，在咖喱叻沙加入了椰浆 • Katong Laksa，咖喱叻沙的主要表现形式 • Nyonya Laksa，加更多的椰浆和香料，甜味重 • Joh or Lak s a，唯一使用意大利面的叻沙	衍生品种 • Asam Laksa，罗望子调 味，汤底浓稠 • Penang Laksa，亚参的升级版，酸味最重	衍生品种 (无)

巴达维亚叻沙配方

材料：

- ●水400毫升
- ●鸡胸肉250克
- ●橙叶2片
- ●月桂叶3片
- ●柠檬草2根，铺好
- ●食用油2汤匙
- ●从200克椰子取200毫升椰奶
- ●4颗蔬菜杨桃
- ●100克磨碎的椰子，烤熟，做成泥
- ●1汤匙盐
- ●2汤匙糖
- ●调味酱，果泥
- ●大蒜4瓣

●洋葱碎5粒
●月桂豆4粒
●姜黄根4cm
●姜3cm
●芒果泥4cm
补充：
●粉丝100g，浸入沸水中
●芽菜100g，浸在热水中
●鸡蛋2个，煮熟，切成两半
●罗勒叶6片
●炸洋葱1汤匙
●红辣椒调味，捣碎
制作方法：

●水烧开后加入鸡肉、橙叶、月桂叶和柠檬，煮至鸡肉变软，捞起鸡肉，切丝备用。

●将香料炒香后，放入煮开的鸡水。加入椰浆、杨桃和椰子，煮至杨桃变软，椰浆变稠。加入盐、糖，搅拌。

●在碗里装满粉丝、豆芽、鸡蛋、罗勒和鸡肉。倒入鸡汁。撒上炒好的洋葱配。上辣椒碎即可食用。

＊术语解释

美味的：非常愉快和可口的味道。

配料：混合在一起做成一道菜的任何食物或物质。

辛辣的：形容辣的，加有香料的，有刺激性的。

调味料：为增强食物风味而添加的香料或调味料。

调味品：为改善味道而添加的盐、胡椒等物质。

保存：对食物进行处理以防止其变质，或添加某些东西使食物在良好状态下保存更长时间。

混合物：将不同的材料混合在一起形成另一种物质。

第三部分“评估”

“一带一路”文明融合课程评估

评估是教与学的有机组成部分。教师需要知道使用这个模块的结果。学生的表现需要一个标准的衡量指南来帮助教师评估他们的学生。

评估项	接近熟练 1	熟练 2	非常熟练 3
观察： 利用感官收集有关物体和事件的定性和定量数据。			
预测： 使用证据模式对结果做出合乎逻辑的猜测 。假设是一种形式化的预测。			
测量： 确定物体的定量性质(长度/面积、体积、质量/重量、时间等)和事件过程中的变化。			
分类： 根据物体或事件的相似点、不同点和相互关系进行分类。			
推断： 根据以前的经验和观察创造新的解释。推理的过程包括不断地构建和修改知识。			
解决问题： 用不同的方式解决不同的问题。			

教师评估可以在每个单元或每个活动之后进行。以下是建议的标准，用以指导教师在使用该模块后对学生进行评估。以识别知识科学的过程为共同途径。

沟通： 口头、书面描述事件、动作或物体的过程。在解决给定的问题/任务时，运用文字、图表和/或其他视觉表达和数学方程来组织思想。			
分数			

2.描述早期发明之间的发展与联系来展现现代的创新。

评估项	接近熟练 1	熟练 2	非常熟练 3 .
将早期的发明与他们的发明区分开			
证明从早期发明到现在发明的改进是合理的			
分数			

3.描绘不同文明的发现所做出的贡献。

评估项	接近熟练 1	熟练 2	非常熟练 3
给出来自不同文明的创新的例子			
识别在创作中不同文明的濡染			
证明不同文明作品的价值			
分数			

4.展示团队合作，促进和平与和谐。

评估项	接近熟练 1	熟练3 2	非常熟练 3
成员们自由地表达自己的思想、感情和观点。			
成员们可以自由地表达不同意见，不用担心被嘲笑或报复。			
成员们可以随时改变步骤以应对新情况。			
每个成员的能力、知识和经验都得到充分利用。			
分数			

参考文献

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/

12. groupprojects/tools/index.html

13. https://www.aacu.org/value/rubrics

14. www.newworldencyclopedia.org/entry/Zheng_He

15. https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-h

16. www.eiu.edu/eiutps/Constellations.pdf

17. www.skymaps.com/downloads.html

18. https://www.windows2universe.org/?page=/the_universe/Constellations/.../ursa.

19. https://www.space.com › Skywatching

20. www.newworldencyclopedia.org/entry/Zheng_He

21. https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-he

22. https://www.britannica.com/biography/Zheng-He

23. https://study.com/academy/lesson/food-preservation-experiments.html

24. www.newworldencyclopedia.org/entry/Zheng_He

25. https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-he

26. https://www.spicesinc.com/t-list-of-spices.aspx

27. https://www.asian-recipe.com/china/china-information/story-of-zheng-he.html

28. https://www.britannica.com/biography/Zheng-He

29. https://study.com/academy/lesson/food-preservation-methods-les- son-for -kids.html

30. https://study.com/academy/lesson/food-preservation-experiments.html

31. http://moocs.southampton.ac.uk/shipwrecks/2014/10/02/mari - time-rhythms-indian-ocean-monsoon/

32. Wynne Harlen (2013) Assessment & Inquiry Based Science Education. Global Network of Sciecen Academies (IAP) Science Education Pro-gramme, TWAS – Strada Costiera, Trieste. Italy

33. www.newworldencyclopedia.org/entry/Zheng_He

34. https://www.khanacademy.org/partner-content/big-history.../exploration.../zheng-h

35. www.eiu.edu/eiutps/Constellations.pdf

36. www.skymaps.com/downloads.html

37. https://www.windows2universe.org/?page=/the_universe/Constellations/.../ursa.

38. ttps://www.space.com › Skywatching

全球科学院联合建立的科学院间伙伴关系组织（IAP）

在全球科学院联合建立的科学院间伙伴关系组织（IAP）的保护下，大约140个国家、区域和全球成员学院共同努力，支持科学在寻求世界上最具挑战性问题的循证解决方案方面的重要作用。特别是，IAP利用世界科学、医学和工程领导人的专业知识来推进健全的政策，改善公共卫生，促进卓越的科学教育，并实现其他关键的发展目标。

IAP的目标之一是“建立一个具有科学素养的全球社会”。科学教育计划（SEP）成立于2003年，是IAP用来帮助实现这一目标的主要机构。IAPSEP的活动由IAP成员提名的专家组成的全球理事会进行指导。自该方案开始以来,一直集中在促进基于探究性的科学教育（IBSE），特别是在小学。2013年，IAP执行理事会还要求SEP全球理事会在科学素养领域的活动。

With the support of: