اللوفر أبوظبي
LOUVRE ABU DHABI

EDUCATORS GUIDE

GLOBES
VISIONS OF THE WORLD

General Introduction

1. EXHIBITION *"GLOBES: VISIONS OF THE WORLD "*

Louvre Abu Dhabi's second exhibition, "Globes: Visions of the World", is devoted to the history of spheres, namely the invention of the spherical concept of the world in Antiquity and the confirmation of this notion by scientific discoveries in the following centuries. The exhibition is divided into four chronological sequences and explores inventions and scholars' reflections through the centuries from Antiquity to the present day.

The first part presents the invention of this spherical model in Antiquity. The second part is devoted to the reinterpretation of this model in the Islamic world and in the Christian West. The third part focuses on the acceptance of this representation and its circulation around the world during the time of great discoveries and explorations. Finally, the last part returns to the classical theory on spheres, in particular the domination of the heliocentric model in the 17th century up to the conquest of space in the 20th century.

This exhibition is an opportunity to discover numerous important objects from renowned cultural institutions and private collections: majestic terrestrial and celestial globes from across many eras in time, armillary spheres based on different systems of conceiving the world, astronomy and astrology treatises in Arabic and Latin, different cartographical instruments as well as paintings and coins which represent the globe and its embodiment of power.

Dates:
From March 23rd to June 2nd 2018

General Introduction

2. OBJECTIVES OF THE EDUCATION GUIDE

The main pedagogical objective of this Educators Guide is to facilitate the teacher and class' discovery of the exhibition. The different content offered in this guide will allow you to prepare for an exhibition visit. The observational cues proposed for each of the pieces presented help to orient the students and draw their attention to different elements of the work. These activities are sometimes supplemented by discussion questions which aim to develop the students' critical engagement and to promote exchanges in order to respond to questions which arise from the works they are looking at. There are no right answers to these questions. The idea is for the group to construct a discourse around the work in question.

The Educators Guide is divided into four **sequences** which follow the chronological layout of the exhibition. The 13 works chosen are divided between the sequences. Each sequence then offers **activities** adapted to the students' levels (from ages 5-16) that can be carried out in class after the visit. These activities have been designed to facilitate feedback and communication within the class. Each student will produce something to share with the class. Additionally, some more complex works are supplemented with a **focus** which calls for further explanation (in class or at the museum) in order to discover other ways to approach these works as well as their context and production.

Finally, a **glossary** is included at the end of this guide. This is an important tool for the visit and for the comprehension of the works and the proposed themes. This guide is designed for use before, during, and after the visit.

General Introduction

Before your visit

The Educators Guide allows the teacher to prepare for their visit with practical information and details of the works, divided according to the exhibition layout, which will allow them to guide their class autonomously.

The teacher can also present reproductions of the selected works in this manual and work on them with the students ahead of the visit in the classroom.
They can also compare the reproduction to the original during their museum trip.

During your visit

The observation and discussion questions presented in the guide book enable the teacher to orient the students towards details of the work. They can also reflect upon the work, the context in which it was made or invent dialogues which stage the characters represented. These questions allow the teachers to bring their visit to life.

After your visit

The observation and discussion questions can also be tackled in class, working with reproductions of the works seen in the exhibition. The **Focus Points** presented in connection with certain works provide an opportunity to go into more depth and expand the knowledge acquired during the visit.

The activities proposed at the end of each sequence are proposals to guide the teacher. They are suggestions for work which may draw on several subjects following the exhibition: art, documentary research, writing...

SEQUENCE 1

The Invention of the Sphere

From the 6th century BCE, scholars and philosophers of the Greek city-states, who inherited knowledge from Mesopotamian and Egyptian astronomy, imagined a spherical earth at the centre of a spherical-shpaed cosmos. They considered that a series of spheres moved around the earth and that these spheres carried seven stars, presumed to be planets by the Greeks (the Moon, Mercury, Venus, the Sun, Mars, Jupiter and Saturn). In their vision of the world, the universe was closed by the outer sphere of “fixed stars”. The Greeks conceived this spherical model based on their practical observations (circular shadow of the earth during a lunar eclipse or the appearance of the mast of a ship on the horizon before the prow on high seas) but also their philosophical considerations.
For the mathematician Pythagoras (circa 580-485 BCE) or the philosopher Plato (circa 428 -348 BCE), the sphere is the perfect geometrical figure (the centre being an equal distance from all the peripheral points). It is thus logical that the architect of the universe, the great Demiurge, would choose this shape to create a harmonious world. On the other hand, he considered the world of “sublunary” humans imperfect and subject to change. Only the world beyond the moon was perfect, immutable and spherical.

In the second century CE, the Greek astronomer Claudius Ptolemy (100-170 CE), who lived in Alexandria in Egypt, gathered much of the knowledge accumulated in the Greek world. This is a civilization which was open to influences from other cultures such as Egypt, Persia and Babylon. Ptolemy wrote three essays which formed the basis of astronomical knowledge in the West and the Islamic world for more than a thousand years.
These essays are: “Syntaxis Mathematica” (rediscovered in the West in the 12th century under the name of “Almagest”), “Geography” and an essay on astrology, “Tetrabiblos”.

According to historical accounts, the first globes and the first spheres must have been made as early as the 4th century BCE. The first mention of a celestial sphere crafted in the 4th century by a disciple of Plato, Eudoxus Cnidus (circa 400-355 BCE) appears in a later work by the Greek poet Aratus of Soli (circa 315-239 BCE). The Greek Geographer Strabo (64 BCE-circa 21-25 CE) mentions the construction of a large terrestrial globe by Crates of Mallus, a Greek philosopher from the 2nd century BC, which divides the Earth into four habitable continents separated by a double oceanic circle. However, the first known physical references to these globes (taking the form of images or objects) date from the 1st century CE. They take the form of Roman coins, metallic celestial spheres, sculptures and mosaics.

1. Printed Terrestrial Globe

© Bibliothèque nationale de France

Vincenzo Maria Coronelli
(1650-1718)

Printed terrestrial globe

Venice (Italy), 1688

Paper, wood and brass

Paris, Bibliothèque nationale de France

Description of the work

This globe was made by Vincenzo Coronelli, a venetian cartographer and famous globe maker during his time (active from 1678 to 1718). It is a terrestrial globe which, by definition, represents a map of the earth as opposed to a celestial globe which provides an image of the celestial vault.

In 1663, Coronelli made two large - terrestrial and celestial - globes of 3.85 meter diameter for Louis XIV, king of France from 1643-1715. The terrestrial globe can be considered as a library presenting the current knowledge of the period in terms of navigation, engineering, zoology, botany and commerce. His work had a resounding effect on the maps produced in Europe at the time, which allowed him to found a scholarly society in 1684 that financed reproductions of Louis XIV's large globes. This terrestrial globe presented in Abu Dhabi (and the celestial globe next to it) is one of these reproductions. These versions, reduced in size, were engraved in Paris and Venice and sent throughout Europe.

In his workshop, Coronelli worked meticulously, collecting numerous sources on the world known to Europeans, and summarized this knowledge on two spheres. This globe is rich in information and is almost like a mapped out encyclopedia covering many domains.

OBSERVATION QUESTIONS

Observe the terrestrial globe closely. Do you recognise the countries and continents represented?

This globe is presented in the exhibition next to the celestial globe. Compare the two. What are the differences and similarities?

FOCUS

Different Types of Globes

In Antiquity, the Greeks perceived the world as a sphere situated in the centre of a cosmos which was also spherical-shaped. As such, they invented tools which were able to represent these different spherical entities: solid terrestrial or celestial globes (decorated with pictures of the constellations) or armillary spheres representing the cosmos made up of rings. These types of tools continued to be produced throughout the following centuries, while being improved upon with geographical and astronomical discoveries contemporary to their era of production. The exhibition displays globes (terrestrial and celestial) and armillary spheres from Antiquity, the Muslim world and from Europe of the Middle Ages to the present day.

The Origin of the Terrestrial Globe

The first terrestrial globe, 3 meters in diameter, seems to have been constructed by a Greek philosopher active in Pergamon (now Turkey), named Crates of Mallus. He represented the known part of the world (the Oecumene) which he separated from three hypothetical continents by the ocean. These parts were arranged symmetrically in each quarter of the globe.

The Celestial Globe in the Islamic World

The celestial globe is a two-dimensional representation of the sky. In the Islamic world it was one of the most widespread scientific instruments. There are more than two hundred specimens conserved today. Only ten or so of these globes date from before the 15th century. The oldest were made in Andalusia at the end of the 11th century. Together these globes show the 1022 stars and 48 constellations described in the Almagest by the Greek astronomer Claudius Ptolemy (100-170 CE), which was later translated into Arabic. The construction of a celestial globe is based on a catalogue of stellar coordinates, generally those of Ptolemy, Abd al-Rahman al-Sufi (died in 986) and Ulugh Beg (died in 1449).

In al-SufI's version, *Kitab Suwar al-kawakib* (*The Book of Fixed Stars*), the figures of the 48 constellations are drawn as they are seen in the sky and as they are represented on the globe. It is through the Islamic world that the knowledge from Antiquity was passed to the Christian West, enriched with the knowledge of Persian and Arab astronomers like Liber de Locis Stellarum Fixarum, the Latin translation of al-Sufi's astronomy treatise.

Armillary Spheres

Armillary spheres are crafted with a combination of rings and spaces which give a tangible form to the immaterial. As such, these spheres can, in theory, reflect any cosmological theory. They can be conceived for the purpose of observation and demonstration. However, no observational spheres have been conserved. The demonstrational spheres made from the 15th century onwards have survived. Yet they do not seem to have been used in the Islamic world. The history of this instrument is based on its ingenuity and on the variety of models conserved. Several are on display in the exhibition.

2. Celestial Sphere

© Collection Kugel, Paris

Celestial sphere
c. 200 BCE
Engraved silver
Paris, Collection privée Kugel

Description of the work

This small silver sphere was discovered in eastern Turkey. It is the oldest surviving celestial sphere we know of, and it dates from around 200 BCE. Forty-eight figures are represented symbolising forty-six constellations, the last two being groups of unnamed stars. The majority refer to the first Greek representations of the constellations: thus Libra is symbolized by a scorpion's pinchers (today it would be represented by a pair of scales) and Hercules, a Greek hero represented by a club and lion skin, takes the form of a man bowed by effort.

There is a notable absence of representation of the Zodiacal Band, with only the ecliptic (representation of the sun's path during the year), which usually marks the middle of the zodiac. Moreover, this line is not divided into twelve sections of 30°, according to the usual signs of the zodiac. This absence is characteristic of the first Greek spheres.
This piece is extremely rare. It is evidence of the beginning of globe production in Greece following in the wake of the Greek astronomer, Eudoxus of Cnidus, who described the celestial sphere during the first half of the 4th century BCE.

OBSERVATION QUESTIONS

What material is this sphere made of?

Describe the organisation of this sphere. How many lines can you see? How do they divide up the object?

Forty-eight figures are engraved on this sphere. Are they human, animal figures, or abstract forms? Try to recognise representations that make you think of signs of the zodiac (Capricorn, Aquarius, Pisces, Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius).

DISCUSSION QUESTIONS

What do you think this sphere shows?

Imagine how the Greeks may have used it.

FOCUS
Ptolemy and the Ptolemaic System

Claudius Ptolemy was a Greek scholar who lived in Alexandria in Egypt, born around 100 CE and died around 170 CE, who lived in Alexandria in Egypt. He was interested in different scientific domains: trigonometry, optics, acoustics, geography, astrology but above all astronomy. He is associated with a conception of the cosmos in which the Earth presides at the centre of the Universe, also known as a geocentric system.

He inherited much of the scientific, but also philosophical, traditions from the Greek world. He took up and pursued the work of his predecessors. His major work is the Mathematical Treatise, in thirteen books, which survived through its Arabic translation known as the Almagest. In this work, he displays the astronomical knowledge of his time and presents the Greeks' observational instruments of the sky. In particular, he presents his geocentric conception of the Universe with the Earth presiding immobile at the centre while successive spheres move around it, along the celestial bodies: the Moon, the Sun and the planets. The eighth sphere is the furthest away and bears the fixed stars, constituting the Universe's limit. In this conception, each planet follows a small circle (an epicycle) which in turn moves along a larger circle (a deferent). This system is the result of a long line of astronomers' theories. It is based on observations of time but also on the Greek philosopher Aristotle's (4^{th} century BCE) principles of physics. The *Almagest* also presents a catalogue of stars and a list of the 48 constellations that were accessible in the Greco-Roman world.

Additionally, he also wrote a geographical treatise entitled Geography and a treatise on astrology, *Tetrabiblos*, in which he analyses the presumed influence of the stars on human destiny. His work was passed down to the Byzantines and the Arabs and through them to the Christian West, thus shaping the vision of scholars for 1500 years.

3. Augustus Coin

© Bibliothèque nationale de France

Augustus (63 BCE-14 CE)
Winged Victory standing on a globe
Rome (Italy), 29 BCE
Silver denarius (reverse)
Paris, Bibliothèque nationale de France

Description of the work

This silver denier is a Roman coin dating from the 1st century BCE. The central figure represented is the goddess of Victory, dressed in a long Roman robe. She can be identified by her attributes: wings, the laurel crown she holds in her right hand and the palm leaf in her left hand. She is represented standing on a globe.

On the majority of Roman coins where a globe appears, it represents a reduced vision of the world. This spherical vision of the Earth has the advantage of being easy for the artist to execute and easy for the viewer to understand.

Octavius / Augustus (63 BCE-14 CE), emperor from 27 BCE, first used the image of the globe from the beginning of his new regime. The association of the globe with the goddess of Victory symbolises the power of the Emperor over the world. After Augustus, the emperors continued to associate these two images to legitimise their power and their domination.

OBSERVATION QUESTIONS

From what material is this denier minted?

Identify the goddess of Victory's attributes: a palm leaf, a laurel crown and wings.

Other coins in this display also represent the goddess of Victory. Compare them with each other. What are the differences and similarities?

DISCUSSION QUESTIONS

Imagine who Victory is holding the laurel crown for. What sort of achievement do you think she may be rewarding?

Describe the symbolic value of the globe. What does it represent? Why is it important for an official figure to be represented by a globe?

ACTIVITY

LEVEL: CYCLE 1

OBJECTIVES

The aim of this activity is for cycle 1 students to make a globe, inspired by what they saw in the exhibition. The activity may be collective (making a large scale globe) or individual.

Although the method used in class will not be the traditional globe production method, the teacher may refer to the **Focus** on globe production (work n° 8 in the book) to compare the different methods and help students to understand that they are using a simplified method.

DESCRIPTION OF THE ACTIVITY

Before the practical part of the activity, the teacher presents several globes (terrestrial and celestial) but may also show the students other stars and planets for inspiration when they come to crafting their globe.

The teacher may also give a more technical presentation on globe production (for older students, see the Blaeu globes focus).

To make a globe in class: *https://www.youtube.com/watch?v=Lac7DUv-OnQ* (the video shows how to make a solar system but can be adapted to a single globe per student or a large globe for the class).

Material: balloons (blown up to the desired size of the globe), newspaper, paper glue, and paint.

Step by step:

1. Blow up the balloon to the desired size and tear the newspaper into strips.

2. Dip the strips into the glue then shake off the excess glue from the strips.

3. Spread the strips evenly onto the surface of the balloon. This will have to be done in two or three layers (allow it to dry between the layers). The strips do not have to be placed in any particular order but they need to overlap in order to cover the whole balloon.

4. When the last layer has dried, paint the sphere with a white under coat and allow it to dry on a cylindrical support.

5. Next, paint the sphere in the chosen colour (2 layers). The students can paint with large brushes or sponges (with a circular motion) to give the painting some texture.

6. Once the final layer has dried, they can add detail (draw the continents, planets, or constellations...) so that the sphere becomes a terrestrial or celestial globe or another celestial body.

ACTIVITY

LEVEL: CYCLE 2 AND 3

OBJECTIVES

This activity shows students how the representation of the globe was a symbol of power from Roman Antiquity until modern times (see the painting of Colbert illustrated in **Sequence 3** of the guide). The activity leads them to reflect on the visual staging of power, throughout history into the contemporary period.

DESCRIPTION OF THE ACTIVITY

The teacher may refer to different objects seen in the exhibition which show the link between the globe and power such as coins, medals, manuscripts and paintings. They may support their remarks with the presentation of the antique coin in this sequence. The suggested **Observation** and **Discussion questions** in the description of the work can also be addressed in class.

Initially, using the coin with winged Victory atop a globe from the reign of Augustus, the teacher asks the students to find out about the different Roman emperors (Augustus, Diocletian, Constantine, Theodosius, Anthemius, Justinian II, Constantine XI, Septimius Severus...) and the geography of the Empire over time, the division between Rome and Byzantium (West and East), and then the fall of the Roman Empire in the West (476 CE).

In the second phase, the teacher encourages them to think about visual displays of power by these emperors, particularly on coins as seen in the exhibition. For younger students, the teacher may make a selection of images to present and discuss (modes of representation, why the globe is a symbol of power...)

Finally, the activity can be expanded to the representation of power during different periods (such as the painting of Colbert in the exhibition), including the present day.

SEQUENCE 2

Tradition and Reinterpretation of the Spherical Model in the Islamic World and the Christian West

In 476 CE the Barbarian Invasions led to the fall of the Roman Empire in the West. Much of the astronomical knowledge acquired during the proceeding centuries was lost in this part of the world but was preserved in the Eastern Roman Empire and its capital Constantinople (Istanbul today). The Christianised eastern empire passed on this knowledge to the Muslim world, in particular because of the Abbasid Caliphate's interest in science. The Caliphate (750-1258 CE) extended from present day Tunisia to central Asia (present day Uzbekistan) at its peak. The research of scholars and Syriac translators also supported the transfer of this knowledge to the Muslim world.

From the 8th to the 15th centuries, Muslim astronomers were at the forefront of research in astronomy. In particular, they reinterpreted the traditions of the Persian, Indian and Hellenistic worlds. In the service of Islam, this knowledge saw the regulation of the lunar calendar and determined the five daily times of prayer as well as the direction of Mecca (qibla). Knowledge of astronomy was also used for astrology, as in Antiquity. Astronomy could determine the influence of celestial bodies over the Earth and thus over human destiny. Only celestial spheres were made in the Islamic world although it seems that the spherical shape of the cosmos and of the Earth were generally agreed on. We know of 125 celestial globes from the Islamic world, the oldest dating back to the 11th century. The figures of the constellations employed were inspired by the legacy of the Greek astronomer Ptolemy (100-170 CE) and the treatise by Persian astronomer Al-Sufi. Written around 956 CE, Al-Sufi's Book of Fixed Stars is one of the key reference texts of Arabic astronomy. Scientists in the Muslim world were also developed the astrolabe early on. A two-dimensional representation of the sky, the earliest known astrolabe examples date back to the 10th century.

From the 10th century on, the Christian West rediscovered ancient sciences, essentially through Arab sources coming from Muslim Spain. The hypothesis of a spherical world was accepted very early on by most clerics. Gerbert d'Aurillac, who was Pope (head of the Catholic church) from c. 999 to 1003 under the name of Sylvester II, made several types of celestial spheres and spherical astrolabes. The knowledge of astronomy in Western Europe was modified in the 12th century with the rediscovery of the philosophical texts of Aristotle (4th century BCE) and Ptolemy thanks to Arab-Latin translations of these Greek authors. In the 13th century, the first treatises appeared in local vernacular, such as *L'Ymage du Monde* by Gossuin de Metz, presented in the exhibition. As in Antiquity and in the Islamic world, astronomy and astrology were closely linked. Up until the Renaissance, the objective of gathering knowledge about the world was to help understand the link between the Cosmos and mankind. Clerics reinterpreted these concepts according to the Christian faith. For example, the figure of the Demiurge became known as "God".

4. Arabic Astrolabe

© Bibliothèque nationale de France

Ahmad ibn Khalaf

Arabic astrolabe

One of the earliest known Arabic astrolabes, made for an amateur scientist, Jafar bin al-Muktafi bi-llah, son of the Abbasid caliph al-Muktafi bi-llah.

Bagdad (Iraq), 10th century

Brass

Paris, Bibliothèque nationale de France

Description of the work

The astrolabe is a disk-shaped instrument. It is a flat representation of the celestial sphere but mainly an instrument of astronomical calculation. It can determine the hour, of the day or night, as well as the time elapsed since sunrise or sunset. It gives the exact latitude of one's position through an angle formed by the horizon and a celestial body.

The astrolabe presented here is engraved in Kufic characters. It is made up of a disk-box that forms the back of the device. The upper part of the back is divided into 180° and the inner rim into 360° (with principal divisions of 5°). The astrolabe also contains four double-sided mobile dials which bear the divisions of the day into twelve (unequal) hours as well as a rete with an unequally divided zodiac. Finally, you can see sights and an alidade with vanes (fixed by a bolt) which goes through the device. (see illustration on next page)

The astrolabe was already known in the 8th century. The astronomer Al-Fazari is known as the first astrolabe-maker in the Islamic world. However, few instruments have survived.

OBSERVATION QUESTIONS

What material do you think this instrument is made of?

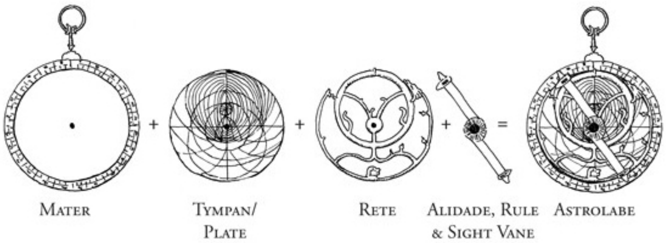
How many circles can you make out?

Identify the different parts of this object.

Imagine what this instrument would be used for.

FOCUS
The Composition of an Astrolabe

An astrolabe is made up of five parts: the mater, the tympans, the rete, the back and the alidade (a rotating arm for aiming).



The Mater
This is the main body of an astrolabe which consists of a brass disk, pierced in the centre to attach the other brass plates. It anchors the tympans and the rete. Its face may be engraved (generally with a geographical index). Its graduation over 360° is divided at intervals of 5 or 10° and subdivided in degrees.

The Tympans
These are disks that attach to the face of the mater, specifying a precise latitude. Amongst other things, you may find are the Equator, the Tropics and the horizon. It is a representation of the terrestrial map at a certain latitude. For astrolabes used in the northern hemisphere, the reference point for the projection is situated at the south celestial pole. The plane of projection is generally the equatorial plane.

The Rete
This is an openwork disk, placed over the mater and tympans and fixed to the centre of the instrument.
It is made up of the index of fixed stars, an arc of the Equator and circles representing the ecliptic and the zodiac.
The rete pivots around the centre of the instrument.
It simulates the daily movements of the sun and stars.

The Back
On the back of the mater there is often engraved a number of scales that are useful in the astrolabe's various applications.

The Alidade
This is a mobile rule which is directed at celestial bodies. The alidade is principally used to measure the altitude of the Sun and stars in order to adjust the rete.

What is an astrolabe used for?
The astrolabe is an instrument used for calculations in astronomy to measure the height of stars and to calculate the hour of the day or night. It was the principal instrument used in medieval astronomy.

Measuring the height of stars
The alidade is rotated on its axis to point towards the sun or a star and thus to read the marker on the disk. This angle represents the height of the sun in relation to the horizon.

An astrolabe is held vertically by a ring. The alidade is turned to aim at the stars, until a star is visible through both ends. The degrees obtained on the curve by the viewfinder are then converted into degrees of latitude from the observation point.

Calculating the time
The height and orientation of the stars can be used to determine the time using an astrolabe. The lines engraved on the plate represent a stereographic projection of the celestial sphere. This projection is the mathematic means through which we obtain a 2D representation of the celestial sphere. A frame can be turned all around with points representing the fixed stars, such as the polar star. The position of the stars moves around the plate and you can read the height and direction. Once the height is known, the frame is turned until the star coincides with the graduation of the height on the plate and the time is subsequently revealed. Note that you also need to know whether the star comes from the East or the West.

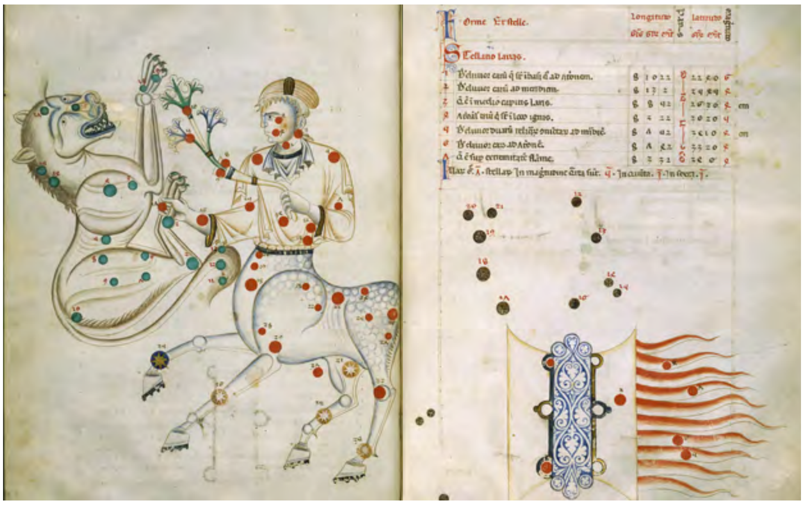
TO FIND OUT MORE

Arab World Institute, The Astrolabe:
https://www.youtube.com/watch?v=c6Ab5oMIMoc

Short film on using an astrolabe:
https://www.youtube.com/watch?v=7COCkxpEvzs

Demonstration of the 13th century astrolabe:
https://www.youtube.com/watch?v=yioZhHe1i5M

5. The Book of Fixed Stars



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Abd al-Rahman al-Sufi
(903-986)

Constellations of Centaurus, Lupus and Ara, in Liber de stellis stellarum fixarum, a Latin translation of the treatise by al-Sufi

Copy made in Bologna (Italy), 1250–1275

Manuscript on parchment

Paris, Bibliothèque nationale de France

Description of the work

This volume is a collection of several Arab astronomy treatises. It begins with a Latin translation of a manuscript written by the Persian astronomer Abd al-Rahman al-Sufi (903- 986 CE). This astronomer's description of the sky was used in the production of Islamic globes made in the Middle East but it also had a long term influence on astronomy in the Christian West.

The 48 constellations illustrated in this book are positioned as they appear on the globe. The two pages presented are illustrated with the constellations of Centaurus and Lupus on the left and Ara on the right. These three constellations are situated in the southern celestial hemisphere, near to each other as Ara is between Centaurus and Lupus.
They are mentioned in *Almagest* by the Greek astronomer Ptolemy (100-170 AD) and are accompanied by a column of text that lists the stars of the constellation and gives their latitudes and longitudes.

This manuscript remains the oldest complete copy of al-Sufi's treatise in Latin conserved today. It is testament to the importance of the diffusion of Arab descriptions of the sky in the West. Moreover, the different representations which figure in the book place the Book of Fixed Stars in the tradition of Ptolemy and of Arab iconography of the constellations.

OBSERVATION QUESTIONS

Describe the constellations represented. How is the wolf positioned?
What is the centaur doing? What type of creature is it?
Try to count the stars that make up each constellation. They are represented by coloured dots. Which constellation has the most?

DISCUSSION QUESTIONS

Centaurus, Lupus and Ara are three constellations that have been known since Ancient Greece. Do you know any other constellations?
Imagine a short scene between the characters of Centaurus and Lupus. How did they get there? What are they saying to each other?

TO FIND OUT MORE

Since 1930, the International Astronomical Union has listed 88 official constellations. This list includes 47 of the 48 constellations identified by Ptolemy in the 2nd century CE in his book the Almagest and illustrated in, amongst others, *The Book of Fixed Stars* in the 13th century.
Website of the International Astronomical Union (IAU) with list of the 88 constellations identified to this day:
https://www.iau.org/public/themes/constellations/

ACTIVITY

LEVEL: CYCLE 1

OBJECTIVES

The objective of this activity is to introduce the students to the constellations. The idea is to have them work on a collaborative project: to create a mural of stars where they represent the constellations shown to them in class by the teacher. They can then make a sort of flattened out celestial sphere.

DESCRIPTION OF THE ACTIVITY

Firstly, the teacher explains to the students what a constellation is (they may refer to the definition given in the glossary of this manual). Older students may research the constellations using works from the exhibition as a starting point (like the *Book of Fixed Stars* or the Krugel sphere) to demonstrate how they appeared in antiquity.

Secondly, children can represent on overall image of the main constellations on a fresco or create their own imaginary constellations.

DRAWING THE CONSTELLATIONS

https://www.youtube.com/watch?v=eBIS17Va9sA
https://www.space.com/15722-constellations.html
http://www.constellation-guide.com/constellation-map/zodiac-constellations/
https://www.youtube.com/watch?v=23rZtlbQ0i8

ACTIVITY

LEVEL: CYCLE 2 AND 3

OBJECTIVES

The objective of this activity is to draw up a list with the students of the 88 constellations. Showing them that 48 were already identified in Antiquity, help them to understand, through the works in the exhibition, how this knowledge was passed from the Muslim to the Christian world.

DESCRIPTION OF THE ACTIVITY

Present the works linked to this sequence: the Arab astrolabe and the *Book of Fixed Stars*. Explain the interest of these objects for astronomy at the time but also how the Arab World passed on antique knowledge as well as its own to the West.

In presenting the astronomical knowledge of the period, concentrate on the constellations and the work of Al-Sufi and explain to the students that the constellations are groups of stars (decided arbitrarily) that are associated with a shape. The 48 identified in the Ancient world are associated with mythological figures, heroes of Antiquity.

Research for pupils:

Draw up a list of the constellations presented in the *Book of Fixed Stars* and inherited from Ptolemy (48) and compare them to the International Astronomical Union's (IAU) current list of 88 constellations: *https://www.iau.org/public/themes/constellations/*

The students are encouraged to pursue their research to associate some of the constellations with myths of ancient figures (Pegasus, Centaur, Andromeda...). They may put together a folder presenting the results of their research.

For younger students you may consider a writing or art workshop centering the activity on the link between myth and constellation and suggest that they illustrate their research themselves, either reproducing a myth or imagining a story around a constellation and creating their own myth (for example: invent the story of the wolf (Lupus) and how he came to be transformed into a constellation).

SEQUENCE 3

Success and Circulation of the Spherical Model (16th-17th century)

From the 16th century, the era of the European Renaissance and voyages of discovery around the globe, scholars, navigators and philosophers confirmed the spherical shape of the earth. The Portuguese navigator, Magellan (1480-1521) made the first voyage around the world between 1519 and 1522, leaving from and returning to Seville in Spain. Cosmography was the major discipline of the 16th century, based on the knowledge of geographers and astronomers. Cosmography integrated new observations of the sky and of the earth into these theories in order to determine the earth's place within the cosmos. The numerous journeys undertaken by explorers and merchants during this period widened Europeans' horizons and enriched their perception of the world. But it also allowed them to export their vision of the world to other countries like China.

The terrestrial globe became both a tool used by explorers and a way of rendering their discoveries. It became an established instrument and an object of knowledge, like the celestial globe. From the 17th century these two globes were made in inseparable pairs. In the first half of the century, Holland was the centre of the globe market in Europe and contributed to their circulation and popularization. As such, globes were established the canonical model of worldly representation, in addition to the atlas. At this point, celestial and terrestrial globes lost their unique character as they became reproducible through printing on gores. At the same time, the representation of the world was circulated through world maps and atlases. Both terrestrial and celestial globes were continually supplemented and updated and became familiar objects for contemporary 17th century observers. Their presence in the arts stemmed from this interest as they assumed a great variety of shapes and symbolic meanings.

6. The “Green Globe”

© Bibliothèque nationale de France

Attributed to Martin Waldseemüller
(1470-1520)
Terrestrial globe, called the “green globe”
Saint-Dié ? (France), c. 1506
Paris, Bibliothèque nationale de France

Description of the work

This globe, painted on to a sphere made out of several layers of paper and plaster, owes its name “Green Globe” to the colour of its oceans, whose blue pigments have turned green over time. It includes a meridian and a horizon and rests, through a central pivot, on a four- footed stand.

For the first time, the new world is called “America” in tribute to the navigator Amerigo Vespucci (1454-1512) who explored the American coasts between 1497 and 1504. This globe is also one of the very first to represent America as a continent distinct from Asia. The rest of the globe takes its inspiration from the antique heritage of the Greek astronomer Ptolemy (circa 100-170 CE) and the travel writing of the Italian merchant Marco Polo (1254-1324).

The globe is unsigned and undated so its attribution has raised many questions. The resemblance to a world map by Martin Waldseemüller dated 1507, in particular the latitude errors in Africa, tend to attribute this globe to the German geographer.

OBSERVATION QUESTIONS

How is this globe organised? Which colours are used?

Look carefully at the visible parts. Can you recognise the continents represented? Or the countries?

DISCUSSION QUESTIONS

In the exhibition: some other globes are displayed around this one. Identify them and compare them with each other. What are the differences and similarities?

Imagine what this globe may have been used for. Is it a decorative or functional object?

FOCUS

Great Expeditions and Explorations of the New World

The European Renaissance (15th and 16th centuries) was a period of artistic, intellectual and also scientific proliferation. Several expeditions were launched and navigators set out looking for the new world. In 1492, a Genoese navigator in the service of the Spanish crown called Christopher Columbus (1450-1506) travelled to the west and reached the West Indies for the first time. He then made two more voyages in 1493-1496 and in 1498 towards Dominica, Guadeloupe, Puerto Rico and finally the American coastline. The name America comes from Amerigo Vespucci, an Italian navigator who worked closely with Christopher Colombus on the preparation of his two voyages. He then participated in two missions to the new lands.

Between 1519 and 1522, the expedition led by Portuguese navigator Fernand de Magellan (1480-1521) was the first to travel around the world. The flotilla set off from Seville (Spain) reached the strait at the southern tip of Chile, which now bears the name Magellan, and then went on to cross the Pacific Ocean and reach one of the islands of the Philippines where Magellan died. The rest of the expedition continued to the Maluku islands then reached Africa, which was then circumnavigated at the Cape of Good Hope, before the expedition returned to Seville in 1522.

The earth's spherical-shape was confirmed by these voyages and the earth's geography became known through the discovery of new continents and the exploration of new countries. These voyages were also an economic boom for Europe after overland trade routes to Asia were blocked following the fall of Constantinople (Istanbul in present-day Turkey) in 1453 and Ottoman domination.

7. The Astronomers

© Musée du Louvre, Dist. RMN-Grand Palais / Harry Bréjat

Manufacture de Beauvais
The Astronomers.
Wall hanging from The Story of the Emperor of China
Beauvais (France), 1722-1724
Low-warp tapestry made of wool and silk
Paris, Musée du Louvre

Description of the work

This tapestry, woven between 1722 and 1724, represents a group of Jesuits (members of a Catholic religious order) astronomers at the Beijing Observatory in discussion with Shunzhi, the emperor of China, before a celestial globe. A number of astronomical instruments are recognisable: a compass, an armillary sphere, a telescope and a globe. This tapestry was part of a wall hanging of six pieces depicting life at the Chinese court under the first Quing emperors: Shunzhi (1664-1661) and Kangxi (1661-1721). The coat of arms which appear on the blue borders are those of Joseph-Jean-Baptiste Fleuriau d'Armenonville (1661-1728), Lord Chancellor from 1722-1727, to whom this tapestry was given.

The central composition demonstrates the emperors' interest in astronomy and geography. The Jesuit missionaries in China at this period were given important positions in the court from the end of the 16th century because of their reputed excellence in astronomy and geography. They were thus able to circulate European knowledge in these domains, cosmology in particular, while also enriching their knowledge from Chinese civilisation.

OBSERVATION QUESTIONS

How many people can you see? What are they doing?
Which instruments used for astronomy? Can you identify in this tapestry?
Where do you think this scene takes place?

DISCUSSION QUESTIONS

In the exhibition there are other works related to China and Chinese astronomy placed near the tapestry. Look and comment on them in relation to the tapestry.
Imagine what the people are saying to each other in this scene.

8. Globes

© Bibliothèque nationale de France

© Bibliothèque nationale de France

a. Willem Janszoon Blaeu (1571-1638)
Terrestrial globe
Amsterdam (Netherlands), 1606
Paris, Bibliothèque nationale de France

b. Willem Janszoon Blaeu (1571-1638)
Celestial globe
Amsterdam (Netherlands), 1606
Paris, Bibliothèque nationale de France

Description of the work

These globes were made by a Dutch cartographer and publisher, Willem Janszoon Blaeu, in 1606. They are the same dimension and have matching stands. The association between the terrestrial and the celestial shows the complementary nature of knowledge in geography and astronomy of the period. The Blaeu globes are remarkably correct for the time. The main competitor in the Amsterdam market (the Netherlands) was Jodocus Hondius. A pair of his globes are also on display in the exhibition.

The globes displayed were designed as a pair, one celestial and the other terrestrial, with the same craftsmanship. But this association between a terrestrial and celestial globe was not yet a evident fact. At the beginning of the 16th century a globe was often a unique object, designed for its own sake. By the end of the 16th century globe-making flourished in Amsterdam with Blaeu, Hondius and their successors in particular. These Dutch globes contributed to popularising the globe as a scientific but also a domestic object. The Dutch domination of globe-making declined from the 1640s as other production centres emerged in Europe.

OBSERVATION QUESTIONS

Look at these two globes. What differences can you see between them? What are the similarities? What do they represent?

Try to identify the known continents on the terrestrial globe.

Imagine which constellation may be represented on the celestial globe.

DISCUSSION QUESTIONS

What do you think these 16th century globes were used for? Imagine them in the study of a rich merchant or aristocrat. What might they do with them?

In the exhibition, two other Blaeu globes and two Hondius globes are also displayed in this room. Try to compare the globes, then compare the terrestrial globes with each other, and the celestial globes with each other.

How do you think these globes were made?

FOCUS
Globe Making

Since ancient times, globe making processes have continually evolved. Ptolemy explained how to make a terrestrial globe in his Geography. In the Islamic world, treatises dedicated to globe making deal with drawing and engraving the surface. However, it is the analysis of objects that have survived to the present day that give us an idea about the construction methods. For metal globes, two methods prevailed. They were either made of one piece, or they were made from two hemispheres stuck together.

Before 1500, all globes were made by hand. Engraving techniques allowed more to be produced at a lower cost. At the end of the 15th century in the West, map publishers began to use printing which led to the birth of printed globes at the beginning of the 16th century. These globes were spheres covered with stuck-on printed segments of paper (some are visible in the exhibition) called gores. The construction of the sphere itself involved making a paper-maché shell with a slightly smaller diameter than the final globe. The shell was made by sticking paper strips over a shape, a solid wooden ball for small globes or hemispheres in wood or copper for the larger models. The North and South Poles were always marked by a metal point. When the whole thing was dry, the original shape would be removed. In the case of a solid ball, the shell would be divided into two hemispheres. In the case of a hemispherical shape, two shells would be produced. The two halves obtained were then assembled around a support and stuck together with glue. Sometimes they were also stitched together. The joints would then be masked by strips of paper or fabric. Finally, to obtain a globe of the desired size, the shell would be placed in a semi-circular mold of the required diameter. The shell was then covered with wet plaster and the shell rotated allowing the mold to eliminate any excess plaster. This would thus make a perfect sphere. Once the plaster was smoothed out, the process of applying the gores could begin.

Until the 19th century the reproduction of gores was done on sheets of paper by copperplate engraving. Then, gradually, lithography took over as it was less costly and easier to correct. At the end of the century, manufacturers used another technique, wax engraving, a method introduced in the USA as a way of printing maps in colour.

TO FIND OUT MORE:

Globe-making in the 1950s:
https://www.youtube.com/watch?v=4RWcWSN4HhI&t=25s

9. Portrait of Jean-Baptiste Colbert

© Château de Versailles, Dist. RMN-Grand Palais / Christophe Fouin

Claude Lefèbvre
(1632-1675)
Portrait of Jean-Baptiste Colbert (1619–83), Minister of Louis XIV
1666
Oil on canvas
Versailles, musée national des châteaux de Versailles et de Trianon

Description of the work

This painting is a portrait of Jean-Baptiste Colbert, Minister to King Louis XIV of France from 1661 to 1683. He stands dressed in black with the order of the Holy Spirit on his shoulder. The background of the painting is very simple. The only visible object is a clock topped with a statuette of Hercules, the hero of antiquity, holding up a terrestrial globe on his shoulder. This image acts as a symbol of the Minister taking on the burden of the State alone. On the other side, the column represents the stability of public power embodied by the Minister.

In the 17th century, the globe had become a familiar object and could be found in books, prints, sculpture and painting. The globe appeared in the portraits of several ministers of the French kings Louis XIII (who reigned from 1610 to 1643) and Louis XIV (who reigned from 1643 to 1715).
These globes illustrate their power, but also the magnitude of the task with which they are entrusted, as in this portrait of Colbert.

OBSERVATION QUESTIONS

How is Colbert represented? What is he doing?
What can you see in the background? Describe these objects.

DISCUSSION QUESTIONS

What impact does this painting have on you? What about the person represented?
You saw a reproduction of the Farnese atlas in the first room of the exhibition. Identify the similarities and differences in this miniature representation.

ACTIVITY
LEVEL: CYCLE 1

OBJECTIVES

The objective of this activity is to have students trace out a voyage on a planisphere. Like Magellan and Christopher Columbus' voyages (the two explorers will be briefly presented in class), the students will make a fictional journey around the world, talking about real and imagined journeys on the way.

DESCRIPTION OF THE ACTIVITY

Firstly, the teacher presents the voyages and great expeditions of the Early Modern Period to the pupils. With the help of works presented in the exhibition (the Green Globe, the Astronomers Tapestry...), students will be shown the great discoveries (America) and exchanges (Asia) that came out of these expeditions.

Secondly, the teacher invites the students to discuss their own journeys (real or planned). Older students may be encouraged to do some research to illustrate the visited countries with images. Finally, the teacher will print a world map (in very large format) and put it up in class. The teacher marks the UAE with a coloured pin. Each pupil (with the teacher's help for younger pupils) will come and put a pin of another colour (a different colour for each pupil or simply a different colour from the UAE pin) on a country they have visited, would like to visit, or their country of origin. The UAE pin can be linked to the other pins by a thread to visibly mark the journeys on the map.

Example of a map:

Source : http://d-maps.com/carte.php?num_car=13183&lang=fr

ACTIVITY

LEVEL: CYCLE 2 AND 3

OBJECTIVES

The objective of this activity is to encourage students to research the explorers' expeditions of the early modern period and to produce an imaginary travel journal in class inspired by the voyages of these explorers (Magellan, Christopher Columbus, Vespucci).

DESCRIPTION OF THE ACTIVITY

Firstly, the teacher invites students to do some preliminary research on the expeditions of the early modern period and of the great explorers. This research may lead students to extend the chronology of the expeditions and find out about later explorers.

In a group or individually, the students will choose an explorer, whose travel journal they will recreate. They will thus go into more depth with their research in order to find the material to complete and illustrate this journal. Together they will imagine life on board the Renaissance ships and the discoveries made by these explorers.

SEQUENCE 4

Spheres in Revolution (17th-21st centuries)

During the Age of Enlightenment in the 18th century, scholars called into question the founding principles of the theory of spheres. They pursued the same lines of inquiry as their predecessors such as Polish astronomer and mathematician Nicolaus Copernicus (1473-1543), Italian mathematician Galileo (1564-1642) and French mathematician and philosopher René Descartes (1596-1650). Their reexamination of previous theories then saw the sun took the earth's place at the centre of the universe. Eventually, scholars began to consider the possibility of other inhabited worlds and other systems with their own skies.

At the same time, they reviewed other scientific notions: the fixed celestial firmament, the shape of celestial bodies' orbits and the matter of spheres in the universe.
English physicist, mathematician and astronomer Isaac Newton's establishment of gravity led to a change in the perception of the earth. It was no longer seen as a perfect sphere but rather flattened at the poles. This idea was proved by the expeditions of French mathematician and astronomer Maupertuis (1698-1759) to Lapland and French explorer La Condamine (1701-1774) to Peru. Rapid progress in the development of observational instruments led to the discovery of new stars, which demonstrated the limit of the figurative representation of the constellations. Scholars came to know more about neighbouring celestial bodies and, in parallel, discovered new planets. Their new vision spread little by little through the century's elite who were passionate about globes.
The exhibition ends on a contemporary artwork that presents the Earth using an image of the planet taken by the astronauts on the American space mission Apollo 11 (1969 - Walking on the moon).

10. Armillary Spheres

a. Anonymous

Geocentric armillary sphere of the Ptolemaic system

c. 1725

Paris, Bibliothèque nationale de France

b. Anonymous

Heliocentric armillary sphere of the Copernican system "which holds that the Earth moves and the Sun is fixed at the centre of the world"

c. 1725

Paris, Bibliothèque nationale de France

Description of the work

These two armillary spheres represent two visions of the Universe. The first is a geocentric sphere representing the system of astronomy devised by Greek astronomer Ptolemy (circa 100-170 CE). The second is a heliocentric sphere based on the system of Polish astronomer Nicolaus Copernicus (1473-1543).

Ptolemy's sphere is tilted on the ecliptic with a central rod passing through an engraved terrestrial globe. The device also includes a golden copper piece which supports the copper orbits of the sun and moon; two meridians, a graduated zodiac with the names of the signs and months in French, an equator, the two tropics, and the two arctic circles. The apparatus is incomplete and as such the device does not function anymore.

The second sphere, of the Copernican system, also includes a central rod inclined on the ecliptic as well as the orbits of planets in the solar system (the planets and the sun are represented by little globes). On the rim of the device you will notice the meridians. There is also a zodiac bearing the names of the months and signs in French.
The clockwork mechanism which allowed the system to move no longer works.

The first armillary sphere can be dated back to the Greek scholar Archimedes (circa 287-212 BCE). Up until the 16th and 17th centuries, the majority of spheres were made according to Ptolemy's model. The Copernican model was not established before the beginning of the 18th century. The armillary spheres can be adapted to various uses (demonstration, observation) and can represent different cosmological systems, which explains their longevity throughout history.

OBSERVATION QUESTIONS

Describe the composition of these two devices. What can you see? How are they arranged?

Observe these two spheres closely. What are the similarities and differences between them?

DISCUSSION QUESTIONS

Imagine what these two instruments might be used for. How could you make them work?

FOCUS

Copernicus and the Copernican System

Nicolaus Copernicus was a Polish astronomer born in 1473 and died in 1543. He was destined for a career in the church and studied theology and canon law (ecclesiastical law), but he mostly pursued classes in astronomy and mathematics. In the 16th century the traditional image of the world was still based on the Ptolemaic system (100-170 CE): a finite world made up of concentric spheres with the Earth at its centre. Copernicus returned to this image but with the sun at the centre of our planetary system. However, the representational diagrams of the world in the Ptolemaic system and the Copernican system remain very similar: the only change is the position of the Sun and the Earth and the presence or absence of the ninth and tenth skies. The Sun becomes the centre of the concentric spheres imagined by Ptolemy. Copernicus was, however, the first to understand the apparent movements of the planets as a result of the combined movements of the Earth and of the planets.

Copernicus' fundamental work, *De revolutionibus orbium coelestium*, was published in 1543. However, Copernicus' ideas did not circulate until after his death.
The conception of the heliocentric system (with the sun at the centre) was not evident until the beginning of the 18th century in exchange for the geocentric vision (with the Earth at the centre) which had prevailed since Antiquity.

Thus the first armillary sphere representing the Copernican system was not produced until 1725. In the 18th and 19th centuries armillary spheres were most often made as a pair: one Ptolemaic (geocentrism) and one Copernican (heliocentrism).

11. Louis XVI gives instructions to Captain La Pérouse

Nicolas-André Monsiau
(1754-1837)
Louis XVI Gives Instructions to Captain La Pérouse, 29 June 1785
1817
Oil on canvas
Versailles, musée national des châteaux de Versailles et de Trianon

Description of the work

This painting portrays Louis XVI, King of France (1774-1792) on the right. Opposite him is the ship's captain, Jean-François Galaup de Lapérouse (1741-1788). Behind the King stands Marshall Castries (1727-1800), his Naval Minister. To the left of Lapérouse, the two young men have been identified as the Laborde brothers, sons of the court banker. Louis XVI and Lapérouse look at a map on which the king is pointing out Australia, which was the subject of an expedition organised during this meeting in June 1785. In the background a terrestrial globe is clearly visible, strategically placed in the centre of the composition. The scene takes place in the king's study at the chateau de Versailles. This painting was commissioned by Louis XVIII, brother of Louis XVI and king of France from 1815 to 1824. It is a retrospective representation of the event.

In the 18th century the main European powers set out to conquer new worlds and establish new commercial prospects. France conducted a first voyage around the world in 1766-1769 under the command of Bougainville (1729-1811). A second expedition was organised in 1785 with Lapérouse at the head. The aim was to expand upon and complete the British discoveries in the Pacific. After three years of exploring, the expedition disappeared in 1788 on the reefs of Vanikoro Island in the Santa Cruz archipelago.

OBSERVATION QUESTIONS

How many people do you see in this painting?
Describe the interior in which this scene is taking place.
What are the striking elements?

DISCUSSION QUESTIONS

Have a good look at this painting. Imagine what the people are saying.
How are they preparing for an upcoming expedition?

12. Pocket Terrestrial and Celestial Globes

© RMN-Grand Palais / Jean-Gilles Berizzi

Didier Robert de Vaugondy
(1723-1786)

Pocket terrestrial and celestial globes

Paris (France), 1756

Paris, Musée du Louvre

Description of the work

These reduced size globes, 0.77m in diameter, form a matching pair. One represents the terrestrial world and the other the celestial sphere. They were made in 1756 by French geographer Didier Robert de Vaugondy (1723-1786). The celestial sphere serves as a case for the terrestrial globe. The two globes fit into each other forming a global representation of the universe.

The 18th century in Europe was a prosperous period in the production and distribution of pairs of printed globes. Elites got hold of their own pair and as such learning geography became part of an "respectable man's"education. This abundant distribution of globes also led to the diversification of their production. Previously, Holland dominated the globe market with a monopoly on the production of printed globes. In the 18th century, workshops appeared in England, France and Germany. These new workshops produced globes of different sizes, on different supports adapted to a large clientele. For example, the pocket globe could be worn. It was a fashionable type of globe until the middle of the 19th century.

OBSERVATION QUESTIONS

Have a close look at these two globes. What is particular about them?

Despite their small size, can you make out known elements on these globes or similarities to other elements you may have seen in the exhibition?

DISCUSSION QUESTIONS

In the exhibition, compare these globes with other pairs that you have seen in the other rooms. What is the major difference with this pair?

Imagine that you are a member of the 18th century elite. What purpose does this pocket globe serve?

13. Reflexion of a Golden Egg

Alain Jacquet
(1939-2008)

Reflexion of a Golden Egg

1988

Synthetic pigments on linen

Paris, musée national d'Art moderne,
Centre national d'art et de culture Georges-Pompidou

Description of the work

This piece made in New York in 1988 is a photograph of a terrestrial globe in the shape of an egg (an image reminiscent of the origin myth), reproduced on an immense linen canvas. It is part of a huge series of earths that the artist began developping in 1972. He was interested in the image of the planet taken by the astronauts on the American space mission Apollo 11 in 1969, when they walked on the moon.

Alain Jacquet's aim was to detach himself from the perfection of terrestrial representation -contrary to the photos taken by astronauts from the moon. Using a mechanical screen print technique and computer printing the artist has more freedom in reworking the scientific photograph. The sphere then takes a variety of shapes: egg, donut, flat or cuboid shapes, rigid or malleable. Reflexion of a Golden Egg is one of the most accomplished versions of his work on the Earth.

OBSERVATION QUESTIONS

How has the artist represented the Earth?

What colours did the artist use?

DISCUSSION QUESTIONS

Identify which part of the Earth these colours might correspond to.

What does this artwork make you think of? What do you feel while looking at this representation of the Earth?

Imagine what the streaked part on the left of the work represents.

ACTIVITY

LEVEL: CYCLE 1

OBJECTIVES

The aim of this activity is to give the students a tangible form to heliocentrism and lead them to represent a solar system in 2D or 3D, depending on their age.

DESCRIPTION OF THE ACTIVITY

With the help of works presented in this book (in particular the armillary spheres), the teacher explains to students the evolution of the conception of the universe from geocentrism to heliocentrism. A little research could be done to show the colours of the planets to the pupils. The students are then invited to represent the solar system.

For younger students this will be an individual 2D activity. The students draw (or paint) the sun, then draw circles around it representing the orbit of each planet. On a separate piece of paper, they draw the planets before cutting them out and sticking them on their orbits.

As it is difficult to respect the real proportions of the planets, here is an idea of the scale that may be used:

Mercury: 1cm

Venus: 4 cm

Earth: 4 cm

Mars: 2 cm

Jupiter: 48 cm

Saturn: 38 cm

Uranus: 20 cm

Neptune: 20 cm

Pluto: 0.8 cm

For older pupils, the activity can be collaborative. Together they construct a model of the solar system taking inspiration from this video:
https://www.youtube.com/watch?v=Cxv_kxq5vlg

Step by step:

1. Take balls of foam and acrylic paint. The balls should be of different sizes to try and respect the proportions between of planets.

2. Paint the balls the colour of the planets and the sun.

3. Put the balls in order (Sun, Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto) on a support of your choice: a shoe box, a flat surface… the planets can be stuck to the same support or fixed with rods driven into the foam ball and the support (preferably also made out of foam).

ACTIVITY

LEVEL: CYCLE 2 AND 3

OBJECTIVES

In connection with the last part of the exhibition, this activity invites students to discover the history of the conquest of space and the importance of the different missions which have enabled man to go into space and walk on the moon.

DESCRIPTION OF THE ACTIVITY

The teacher supervises the students in their collective or individual research on subjects in relation to the conquest of space. The students explore different space missions up to the present day. They may divide up one mission per pupil/group and do a presentation to the whole class.

NASA also has a website for children which may enable the teacher to organise class activities around space topics.

ADDITIONAL LINKS:

NASA website: *https://www.nasa.gov/*

NASA for children: *https://www.nasa.gov/audience/forstudents/index.html*

Al Sadeem Astronomy: *http://alsadeemastronomy.ae/*

List of space missions: *https://en.wikipedia.org/wiki/List_of_International_Space_Station_expeditions*

GLOSSARY

ARMILLARY SPHERE An instrument made up of interlocking circles which simulates certain movements of celestial bodies. It represents noteworthy elements of the celestial sphere (horizon, meridian, equator...) for educational or decorative purposes. It can be simple (2 perpendicular circles) or extremely complex.

ASTROLABE An ancient instrument of astronomy used to make observations and calculations. It can calculate the height of a celestial body as well as determining the hour of day or night according to the position of the sun and stars.

ASTROLOGY A discipline which takes interest in the influence of celestial bodies on human destiny. Its subject of study is based on the correlations between the configuration of the sky (as it is seen from the Earth) during a terrestrial event and the nature and developments of this event.

ASTRONOMY The scientific study of the nature and movement of celestial objects.

ATLAS A volume of maps which represents a given space while showing one or several themes (geography, economy, history, astronomy...). The term appeared at the end of the 16th century even though volumes of maps existed long before. During this period, different voyages of exploration, of the Italian navigator Christopher Columbus (1451-1506) or the Portuguese explorer Magellan (1480-1521), for example, demonstrated the necessity of renewing cartography.

BCE Abbreviation for “Before the Common Era”. This is used alternatively to BC (Before Christ). Use of BCE is now preferred to BC.

CARTOGRAPHY The practice of making, drawing up and producing maps. Cartography brings together all the means that allow man to represent space.

CE Abbreviation for “Common Era”. This is used alternatively to AD (Anno Domini). Use of CE is now preferred to AD.

CELESTIAL SPHERE An abstract sphere with an arbitrarily large radius at the centre of which is the eye of the observer or the system of reference which can define the direction of the celestial bodies. This concept of spherical astronomy allows all celestial bodies visible from the Earth to be depicted and positioned on a sphere. It may be geocentric when the Earth is at the centre or heliocentric when the Sun is at the centre.

CONSTELLATIONS Arbitrary groups of stars situated in the same zone of the celestial sphere. Together they form imaginary outlines of meaningful patterns which are then given a name. There are 88 official constellations.

COSMOGRAPHY — The science that maps the general features of the universe. In the Middle Ages this discipline overlapped with geography, geology and astronomy. This science is purely descriptive.

ECLIPTIC — A large circle representing, on the celestial sphere, the projection of the sun's annual trajectory as seen from the Earth.

EQUATOR — An imaginary line around the middle of a planet or other celestial body which rotates on its axis, halfway between the North Pole and the South Pole. The Earth is divided into the Northern and Southern hemispheres on each side of the equator.

FIXED STARS — During Antiquity and then in the Middle Ages, the celestial bodies that appeared to be fixed on the celestial vault were called "fixed stars". The geocentric system supposed that the celestial bodies were fixed on to spheres which turned on their axes. The fixed stars were attached to the most distant sphere known as the "fixed stars".

GORE — Segments of paper on which a map is drawn or printed to fit a globe. The 360° of a globes was most often dived into 12 sections. The oldest example of a globe with 12 gores is the Martin Waldseemüller's terrestrial globe, designed in 1507.

GEOCENTRISM — The term used for an astronomical system which places the Earth at the centre of the Universe. In the 2nd century CE, this theory was championed by the Greek astronomer Claudius Ptolemy.

GLOBE — A spherical model which turns on its axis and represents either a map of the Earth with its latitudes and longitudes (terrestrial globe) or the whole universe with the Earth at its centre (celestial globe). Globes can also be made to represent other planets.

HELIOCENTRISM — An astronomical system which places the Sun at the centre of the Universe. The planets rotate around this star. This system of representation was theorised by the Polish astronomer and mathematician Nicolaus Copernicus (1473-1543) in particular.

HELLENISTIC — A historic time period, Hellenism corresponds to Ancient Greek civilisation which covers the conquest of Alexander the Great (331-323 BCE) to Roman domination (31).

HEMISPHERE — The two halves of a globe (terrestrial or celestial) separated by a line around the centre. For example, the terrestrial globe is separated into the north and south hemisphere by the Equator.

KUFIC — A style of ancient Arabic calligraphy, developed in the city of Kufa, in Iraq.

LATITUDE	A geographic coordinate that specifies, with the longitude, the position of a point on the Earth's surface in relation to the equator. It is the measurement of an imaginary angle formed by the Equator and the half line which meets the centre of the Earth and the selected plane.
LITHOGRAPHY	A printing technique which emerged at the beginning of the 19th century involving drawing in ink or pencil on a limestone surface and printing the design on to paper with the help of a press. This process also enabled the reproduction of a document.
LONGITUDE	A geographic coordinate that specifies, with the latitude, the position of a point on the Earth's surface in relation to the Equator. It is calculated from the Prime Meridian, the Greenwich Meridian. It is an angular measurement formed by the meridian plane of the location in question and the Prime Meridian.
MERIDIAN	An imaginary semi-circle drawn on to the Earth's surface joining the two poles. The Prime Meridian, numbered 0, is the Greenwich meridian, situated in the south-east of London. It serves as a reference point to calculate longitudes and universal time. The Earth is divided into 360 meridians each spaced by 1°, 180° to the west of the Prime Meridian is 180° to the east.
OECUMENE	The term used by Greek scholars to describe their world in opposition to the unknownworld, which was considered the world of Barbarians.
REVOLUTION	A periodic rotation movement (an orbit) of a celestial body around a dominating mass. For example the movement of the Earth around the sun or a satellite around a planet.
STEREOGRAPHIC PROJECTION	A particular cartographical projection that projects a sphere onto a plane. This type of projection was used particularly for the conception of Arab astrolabes in the medieval period.
TROPICS	The tropics are parallel to the Equator, one in the north (the Tropic of Cancer) and one to the South (Tropic of Capricorn). They correspond to the highest (northern) and lowest (southern) latitude where the sun can be directly overhead.
WORLD MAP	A flat cartographic representation of the entire Earth.
ZENITH	The point at the summit of the celestial vault (90° height above the horizon). During the winter solstice, the 21st of December, the sun passes its zenith over the Tropic of Capricorn in the southern hemisphere. During the summer solstice, the 21st of June, it passes its zenith again but this time in the northern hemisphere over the Tropic of Cancer.
ZODIAC	A zone of the celestial sphere with an ensemble of constellations divided into bands that extend approximately 8° of latitude on either side of the ecliptic and in which the planets and stars move. The signs of the zodiac come from the twelve constellations visible in this band.

PRACTICAL INFORMATIONS

GENERAL INFORMATION

Educational activities are offered in **Arabic, English and French**
Sunday, Tuesday, Wednesday and Thursday, at 9.30am
Museum is **closed on Mondays**
Guided Tours: 60 minutes. **Workshops:** 90 minutes

CONTACT US!

To plan your visit: https://www.louvreabudhabi.ae/en/visit/plan-your-visit
Contact the Call Centre: 600565566

QUESTIONS?

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