SPACE awareness

JOURNEY OF IDEAS:
INTRODUCTION CHAPTER 1

INTRODUCTION TO THE ISLAMIC HERITAGE KIT AND TO THE EVALUATION CONCEPT

1.1 SCIENCE AS A TRANSCULTURAL ENTERPRISE

Since the dawn of history, astronomy has played an important role in human development. The beauty, regularity and persistency of the starry night sky have been a source of wonderment. The ability to predict the motions of the Sun, planets and stars were decisive factors in the emergence of agriculture and navigation in early civilisations. Mathematics, geometry and the first measuring instruments were developed and used to accurately track stars in the sky. The interplay between observations and explanations triggered ideas that eventually led to the development of modern astronomy and space exploration. These ideas were however not developed in a single place and time, but made a long journey through many regions, where they met other ideas from other cultures, became enriched and triggered new ideas. This is the story of this journey.

1.1.1 The journey of astronomical ideas

In prehistoric times observations of the sky led to the discovery that several objects in the sky moved in a regular pattern that could be predicted. The Sun rose and set periodically. The Moon changed its shape continuously, in a repeating order. Groups of stars became visible, disappeared behind the horizon and became visible again after some time.

In Babylon and Egypt the first astronomers started to measure and record their observations. They made use of the observed regularity to measure time and make calendars. Astronomy was used for determining the time of religious festivals, for letting farmers know when to plant crops, for helping sailors to navigate their ships and for the collection of taxes. For many centuries the Babylonian, Egyptians, Chinese, Indians and Mayans used astronomy in this way as a practical tool. They sometimes also projected their gods onto the sky, making them responsible for all earthy events including weather, earthquakes, rain, births and deaths.

As time passed by, many cities in the Middle East and around the Mediterranean Sea became important places for people from different cultures to meet, especially cities located near harbors or at the crossing points of trade routes. Lots of merchandise, instruments and ideas were exchanged in these places. Within these different cultures astronomy was used as a tool that made daily life and the organisation of the growing cities easier to handle.

However something special happened in the 6th Century BCE in the Greek harbor city of Miletus (today´s Turkey). Another way of thinking and approaching the world arose among a small group of people. Thales, who is often referred to as "the first philosopher", attempted to explain natural phenomena without reference to religion, mythology or connections with the practical use of his ideas. He asked himself how the world was created and suggested that water was the basis of everything. He also explored rules and relations in geometry and mathematics, again without any practical purpose. By emphasising the value of knowledge on its own, Thales can be viewed as laying the cradle of modern science.

The ideas of Miletus were brought to Athens, where they inspired the philosopher Aristotle in the 4th Century BCE to define the fields and the methods of logic, metaphysics, mathematics, physics, biology, botany, ethics, politics, agriculture, medicine, dance and theatre. His work was used later by astronomers in Alexandria and Rhodes (among them Hipparchus, Eratosthenes and Ptolemy) to give astronomy an inquisitive character by posing problems and exploring the sky through observations. Astronomy had previously proved itself to be an important tool in agriculture, navigation and religion, and now it started to have a value itself as a science to obtain knowledge about the world in which we live.

1.1.2 The role of the Islamic culture in the development of modern astronomy

After conquering Greece in 146 BCE, the Romans never developed an interest in following the scientific tradition initiated by Greek astronomers. In the 4th Century EC Christianity became the official religion of the Roman Empire, 200 years later all pagan books (including the Greek texts) were forbidden by the Emperor Justinian I. By that time members of a small Christian sect called the Nestorians1, that had also been prohibited, fled eastwards, settling in Persia (today´s Iran) and joined the East Church. The Nestorians, who placed an enormous value on science, took with them the most precious books of Greek astronomers. The Greek legacy was received with eagerness and great interest by Persian astronomers, who themselves had a long tradition of observing the sky. The Nestorians were the first civilisation to initiate the journey of astronomical ideas from West to East!

In the centuries after the death of Muhammad, Muslim armies brought a huge part of Asia, North Africa and Europe under their control, including India, Persia, Spain and Iberian Peninsula. After the fall of the Persian Empire in 651 CE, the ancient Greek texts were brought to Baghdad. Once there, they were translated into Arabic by scholars under the mandate of the Abbasid caliph Harun al-Rashid (786 to 809) and his son, Al-Ma'mun (813 to 833) at the House of Wisdom, a major intellectual center in Baghdad.

The inauguration of the House of Wisdom marks the beginning of the Islamic "Golden Ages" which lasted from the 8th to the 14th Century. Knowledge and advances in the fields of astronomy, mathematics, engineering, navigation, geography, medicine, architecture, chemistry, gardening, finance and poetry were spread over a vast region of the Islamic world that extended from India to the South of Spain and Portugal. Arabic became the language of science and the huge Islamic empire was used as a connecting corridor, not only for trade, but also to compile, exchange and communicate knowledge. The power of rational thought and debate, previously championed by Aristotle in Athens was rescued and treasured by the Islamic World, who applied this way of thinking not only in science but also in philosophy and religion.

From the 7th to the 13th century AD, the Islamic world was ruled by several dynasties of leaders or "caliphs", who were considered to be the religious successors to the prophet, Muhammad (see the table below). These dynasties were characterized by their openness to diverse views. They cultivated and valued science and the acquisition of knowledge. The Islamic culture of that time was called "the culture of ambiguity"2. It allowed diverse and sometimes contradictory norms, thoughts and beliefs, to coexist. Also, solving practical problems in the areas of public health, hygiene, water supply, food and education were important goals of this society.

In Spain and Portugal, the Muslim´s open spirit led to the foundation of important schools that continued the translation of scientific texts, such as ones in Cordoba and Toledo. Muslims, Christians and Jews worked together in these schools to facilitate the most intensive exchange endeavor of that epoch. The Islamic schools in Cordoba and the book market of the city employed dozens of women, whose job it was to copy and translate texts.

Important accomplishments of scholars in the Islamic world were gathering together existing scientific texts, translating them and communicating them throughout the Islamic world and beyond. Thanks to the dedicated work of these translation schools Latin Europe recovered not only the thoughts of the ancient Greek philosophers, such as Aristotle and Plato, but received impulses from Islamic thinkers in the key fields of medicine, physics, mathematics and astronomy. Many experts claim that the European renaissance from the 14th to the 17th Century was triggered by the influence of the Islamic culture3,4.

During the golden ages scholars in the Islamic world also made fundamental contributions themselves to the development of astronomy. Examples of these innovations include:

(a) Mapping the sky with the constellations as a reference
(b) Using instruments to measure the positions of objects in the sky
(c) Developing a theory to explain light (optics) and developing the scientific method
(d) Communicating astronomical knowledge to the public

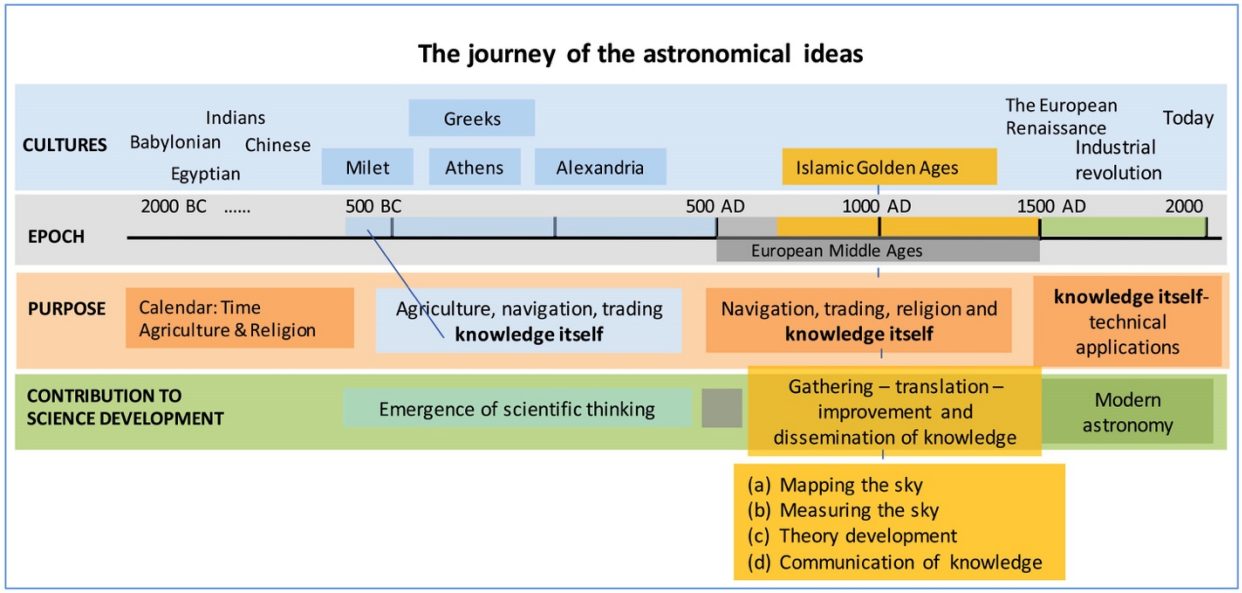

Figure 1. Graphic showing the development of scientific thinking and the contributions of the Islamic Golden Ages to astronomy. (Credits: Scorza)

1.2 THE ISLAMIC ASTRONOMY HERITAGE KIT: DESCRIPTION

The Islamic Astronomy Heritage Kit contains didactical materials that use hands-on activities to illustrate the journey of astronomical ideas. This kit shows how these ideas arose in ancient Babylon and Egypt, met in Millet, moved to Athens, to be further developed in Alexandria and Rhodes. Later on, when these ideas were forbidden by the Roman Emperor Justinian I, they found a safe place in Persia and later in Baghdad, where they were translated, improved and disseminated for more than 800 years by scholars in the Islamic world.

Figure 2. The Islam Heritage Kit (Credits: Scorza)

Each chapter in this kit begins with an introduction describing the historical context, the prominent figures and the open questions which were driving research at that time. By means of storytelling and activities (illustrated by orange marks on the margin), children are invited to acquaint themselves with the early instruments and to follow the development of the ideas that gave rise to modern astronomy. The impact of the ancient legacy on modern astronomy is shown in yellow blocks throughout the text and activities.

Our didactical approach relies on key findings of cognitive psychology. Both disciplines state that information that is not linked into a context gets lost. Therefore, we focus on linking the information in a senseful way, similar to a puzzle that will give a whole picture when all pieces come together. The second aspect is the enhancement of the self-esteem of refugee children via the identification with figures of the Islamic world. We want to inspire them and make them realise that they belong to a rich heritage of distinguished scientists who helped shape the global history of astronomy and space sciences during the Islamic Golden Ages. We want to make them feel that the Islamic background is highly appreciated.

In the kit, four scholars of the Islamic world, two women and two men, were chosen as representatives of the Islamic contribution to the development of astronomy. They are: the astronomer Al-Sufi from Rayy (Persia), the instrument maker Miriam al-Astrulabi from Allepo (Syria), the physicist Ibn al-Haytham from Basra (Iraq) and the founder of the first university of the world Fatima al-Fihri in Fes (Morocco).

Figure 3. The four key figures of the Islam Heritage Kit (Credits: Provot)

We emphasise the role played by women in the foundations of many Islamic educational institutions: Fatima al-Fihri, for example, founded of the University of Al-Qarawiyyin in 859 CE. This continued through the Ayyubid dynasty in the 12th and 13th centuries: of 160 madrasas and mosques established in Damascus, 26 were funded by women through the charitable trust system. Half of all the patrons for these institutions were also women.

In the 12th century, according to the scholar and historian Ibn 'Asakir, there were opportunities for female education in Damascus. He wrote that women could study, earn academic degrees, and qualify as teachers and scholars. In the 15th century, the historian al-Sakhawi of Cairo devoted an entire volume of his 12-volume biographical dictionary to female scholars, providing information on 1,075 of them.

As a guide, we summarise in table 1 the Islamic dynasties and places in which our four main historical figures lived.

Dynasty	Period	Regions / Main cities	Important scholars
Abbasid	750 – 1258	Middle-East, foundation of Baghdad (House of Wisdom)	al-Sufi (Isfahan) Miriam al-Astrulabi (Aleppo)
Idrisids	788 – 974	Morocco	Fatima Al-Fihri (Fes)
Almoravids Almohads	1040 – 1147 1147 – 1269	Iberian Peninsula, Morocco	Averroes (Cordoba)
Fatimid	969 – 1171	Egypt (Cairo), Yemen, Syria	Ibn al-Haytham (Cairo)
Ayyubid	1171 – 1250	Egypt (Cairo), Syria, Mesopotamy	Ibn al-Schatir (Damascus).

Table 1. Islamic dynasties

1.3 EVALUATION OF THE IMPACT ON CHILDREN: UNDERSTANDING LEGACY

The evaluation concept used for these materials is based on the evaluation methodology of the EU-UNAWE programme developed by Scorza and Kimble 20136. We have adapted it to the goals of the Islamic Heritage Kit. Like the UNAWE programme, the Islamic Heritage Kit covers a range of domains for active learning: **motivation, development of scientific skills, knowledge acquisition,** and **intercultural attitudes**. An additional key element has been added, namely the role that legacy plays in the enhancement of the self-esteem of children with a Islamic background living in Europe. The evaluation concept was adapted as follows:

	Domains of active learning	Evidence (to be collected)
1. Motivation	1. Enjoyment 2. Inspiration 3. Creativity 4. Persistence	1. Smiles, laughter, positive exclamation 2. Further ideas related to the intervention 3. Construction game/ activity 4. Overcoming setbacks to complete a task
2. Scientific Skills	1. Curiosity 2. Observation 3. Identification 4. Classification 5. Making interconnections 6. Changing perspective 7. Communication	1. Questions, practical intervention 2. Using direct observation or instruments 3. Correct use of vocabulary to name objects and phenomena 4. Grouping figures, objects and astronomical phenomena 5. Verbal linking of new information within the historical, geographical context 6. Demonstration of understanding what others will see in different countries 7. Showing others their new knowledge e.g. friends or family
3. Knowledge acquisition	**Observing, exploring and discovering:** 1. The birth of the astronomical ideas Measuring time, calendars 2. The rise of astronomy as a science: New way to explain phenomena 3. The long way to Baghdad: how the astronomical ideas were brought to Baghdad. 4. The contribution of four scholars to the further development of astronomy.	Storytelling, drawing, construction of instruments to perform direct observations, linking phenomena, recording of naming, first explanations, discussing.
4. Intercultural attitudes	1. Valuing different cultural perspectives 2. Recognising science as a transcultural endeavor 3. Recognising the contribution of the Islamic culture to the development of science. 4. Recognising different physical and time (historical) perspectives 5. Positive attitudes towards astronomy and space sciences	1. Demonstrating awareness of different cultures through dance, performance, gesture, discussion, interaction with objects, creative responses 2. Ability to recognise differences in phenomena in different countries and to respond verbally or physically 3. Statements of future activity with regards to astronomy

LITERATURE CHAPTER 1

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