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知識增益系列:知識增益系列:伊斯蘭文明的興起與中古時代歐亞的文化交流—4:伊斯蘭文明的科學成就(新辦) Enriching Knowledge Series: The rise of Islamic civilisation and cultural interactions between Europe and Asia in Medieval Times—4: Scientific achievements of the Islamic civilization(New)

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Scientific Achievements of Islamic Civilization

Overview

- Part 1: Understating of the Islam, its origin, spread and current status
- Part 2: Scholars, Philosophers, Engineers and Scientists in Islam
- Part 3: Time wise analysis; "Islamic Golden Age of Science"
- Part 4: Sector wise Major Achievements in Islamic Civilization
- Part 5: The House of Wisdom
- Part 6: Current Scientific Achievements in Islamic World Part 7: Q &A

Historical Background

- Birth of Prophet Mohammad (PBUH) 570 AD
- Invitation to accept the religion "Islam"; 610 from Makkah (Mecca)
- Travelling and settlement in Madina city 620/622 AD
- Conquest of Mecca (630-632 AD)
- Muhammad's (PBUH) death at Medina in 632 AD

- "lqra" first word of Quran
- Strong emphasis to read, and learn
- Encouragement to explore, investigate, understand and find the truth

Spread of Islam in new regions

Within **150** years after **Muhammad's death** in 632, Islam **spread** west to North Africa, and into present-day Spain. It also spread north into Persia and east to the borders of northern India and China.

- Arab merchants traveled to many parts of Asia and North Africa and along the Mediterranean Coast. Many of these traders were Muslims, and they helped to spread their new religious beliefs.
- Arab armies also conquered neighboring regions. This was another way that Islam spread.

Mixed Cultures and Diversity

During this time, cultural diversity was accepted, and Arab culture was mixed with other cultures.

Arabs	
Persians	
Egyptians	
Africans	
Europeans	
Indian	

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Arab culture

Egyptian culture

European culture

A large trading network was developed by the Abbasid Dynasty, which allowed Muslims to spread their ideas and become very wealthy.

Trade helped Islam spread into new areas.

Along with their trade goods, Arab merchants took Islamic beliefs to new lands.

Islam spread to India, Africa, and Southeast Asia.

Trade brought new products to Muslim lands.

- Travelers learned how to make paper from the Chinese.
- Merchants brought crops of cotton, rice, and oranges from India, China, and Southeast Asia.
- Muslim merchants set up trade businesses in Africa.

Growth of Cities

Baghdad (Iraq)

<u>Abbasid</u> – moved capital to Baghdad (750-1258)

- Capital of Islamic Empire
- One of the world's richest cities through trade and farming.
- Center of culture and learning
- Reasons for success:
 - Weakness of Byzantines and Persians
 - Aggressive and bold fighting
 - Strong unity under Islam

Cordoba (Spain)

Caliphate of Córdoba- ruled by the Umayyad dynasty from 929 to 1031

- By the AD 900s, was the largest and most advanced city in Europe
- Showplace of Muslim civilization

Three Mega Empires

- Three Muslim empires controlled much of Europe, Asia, and Africa from the 1400s to the 1800s.
- The great era of Arab Muslim expansion lasted until the 1100s.
- Three non-Arab Muslim groups built large, powerful empires that took control of much of Europe, Asia, and Africa.

1. Ottoman Empire

Ottomans were Muslim Turkish warriors who took territory in the mid-1200s.

Ottomans took control of the eastern Mediterranean and pushed farther into Europe from 1520–1566.

They would control these areas until the early 1800s.

2. Safavid Empire

The Safavid Empire began in 1501 when the Safavid leader Esmaʻil conquered Persia and made himself shah, or king.

Abbas became shah in 1588 defeated the Uzbeks and took back lands that had been lost to the Ottomans.

The Safavids blended Persian and Muslim traditions.

The Safavid Empire lasted until the mid-1700s.

3. Mughal Empire

Located in northern India and formed by Turkish Muslims from Central Asia.

Babur established the Mughal Empire, but it grew mostly under an emperor named Akbar.

Akbar's tolerant policies allowed Muslims and Hindus to live in peace.

In the late 1600s, an emperor reversed the tolerant policies, which led to conflicts and the end of the empire.

Current Islamic States

- <u>Muslims</u> number 1.8 billion people worldwide (2015), representing 24% of global population
- No of countries, follow Islam in majority: 20

Extraordinary Individuals in Muslim Civilization

Muslim Scientists in Islamic History

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One must not be afraid of new ideas, no matter the source. And we must never fear the truth, even when it pains us. ~ Al-Kindi

- Astronomy, mathematics, medicine, and music
- He mastered the Arabic language, the language of the Quran, memorised the Quran and studied Islamic Jurisprudence, Prophetic Narrations, and Islamic Theology.
- classical Muslim scholars prohibited the study of philosophy, it may deviate from basics of Islam, but he studied Philosophy

Al-Kindi, for example, refuted Aristotle's idea of the eternity of the universe because it contradicts the tenets of Islam. He also discusses the principle of causality to prove the existence of a "true One" (he means God) who is the source of unity of all creations and "the first truth and the cause of all truth."

Featured contributions

- Most important work on reflection of light.
- Discussed music from scientific point of view.
- Worked on geometrical optics
- Explained the laws related to gravitational fall of the bodies
- Sphere is the Largest of Bodily Forms That the Surface of the Sea is Spherical; Calculating the Azimuth
- An Explanation of the Cause of the Retrogression of the Stars;
- The Reason Why Rain Rarely Falls in Certain Places;
- The Reason Why the Highest Part of the Sky is Cold, While Near the Earth is Warm
- The Reasons for Cloud Formations;
- Calculation and Making an Instrument to Determine the Distances of Heavenly Bodies,

Ibn al Haytham (965-1039, born in Iraq)

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Father of Modern Optics, Founder of experimental psychology, psychophysics, phenomenology and visual perception in psychology

An Arab Mathematician, astronomer, philosopher, theologian and physicist during the Islamic Golden Age

Featured contributions

- He is more known for his optical works which were translated in Latin
- Explained the refraction of light rays through transparent objects
- Discovered magnifying lenses
- Function of retina as the seat of vision
- First scientist who elaborated two laws of Reflection of light
- Pinhole camera was contructed by him
- He was the first person who declared that Light is a form of energy.
- Identified Gravity as a force
- His fame lies in his book Kitab-al-manazir which is on optics.

Ibn al Haytham, invented the pinhole camera "Camera Obscura" which would later evolve into modern day camera.

- Ibn al- Haytham is most famously known for his seven volume magnum opus Kitab al-Manazir (Book of Optics).
- Ibn al-Haytham wrote 96 books on various topics physics, mathematics, theology, medicine, psychology, astronomy, philosophy, optics and others.
- According to medieval biographers, Ibn al-Haytham wrote more than 200 works on a wide range of subjects, of which at least 96 of his scientific works are known.
- Most of his works are now lost, but more than 50 of them have survived to some extent. Nearly half of his surviving works are on mathematics, 23 of them are on astronomy, and 14 of them are on optics, with a few on other subjects.

In 2015, International year of Light celebrated the 1000th anniversary of the works on optics by Ibn al Haytham.

Algebra Came to Exist Because of This Man!

Al-Khawarzimi (780-847)

- Great mathematician, astronomer, historian, geographer and musician.
- First person who used zero
- Composed oldest works on algebra and astronomical tables
- Systematized the Greek and Hindu mathematical knowledge
- Introduced the method of counting based on numerals and decimal systems for
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the first time

 Wrote famous book named Hisab-al-jabar wal Muqabla in which he gave analytical

solutions of **quadratic and linear equations** .This book was used as principal mathematical

textbook, until the 16th century by European universities.

• Composed his own astronomical tables known as Zijj (ZJ), which became a

model for astronomical pursuits in East and West.

• **Kitab-surat-al-ard** was a geography book in which he gave an idea about the shape of the earth

Origin of Modern Numbers, Basics of Computer Science

Chemist, Pharmacist, Physicist, Philosopher

Jabir Ibn Hayyan (721-815)

- Father of modern chemistry
- Prepared large number of important chemicals like
 - NITRIC ACID,
 - HYDROCHLORIC ACID,
 - SULPHURIC ACID,
 - WHITE LEAD etc.
- Introduced new chemical techniques and processes like
 - Calcination,
 - Reduction,
 - Sublimation,
 - Distillation,
 - Melting,
 - Crystallization etc.
- Gave a sound theory on Geological formation of metals.
- Prepared basic lead, arsenic, antimony and carbonate from their sulphides.
- He also dealt with refinement of metals, preparation of steel,

Who Used the word and method "Quarantine"? <u>"Doctor of all Doctor"</u>

IBN-E-SINA (980-1037) "AVICENNA in west"

- He was the most famous physician, philosopher, encyclopedias, mathematician and astronomer of his time.
- His major contribution to medical science was his famous book Al-Qanoon, known as the "Canon" in the West. The Qanun fi al-Tibb is an immense encyclopedia of Medicine extending over a million words.
- In addition the book described 760 drugs.
- His contribution includes recognition of the contagious nature of phthisis and tuberculosis; distribution of diseases by water and soil and interaction between psychology and health.
- He made rich contributions to Anatomy, Gynecology and child health.
- In Physics his contribution comprised the study of different forms of energy, heat, light and mechanical and such concepts as force, vacuum and infinity, specific gravity and use of air thermo-meter.

Chemist, Physician, AL-RAZI & Inventor of Alcohol

AL-RAZI (RHAZES) (864-930 C.E.)

- "FATHER OF PAEDIATRICS"
- AL-HAWI is a most monumental work of him.

It is the most comprehensive encyclopedia of medicine in 20 volumes.

- first to use animal for surgical operations .
- first to use Opium as anesthetic during surgery .
- First to classify substances into vegetables, animals and minerals.
- He correctly described the physiology of the heart and the function of its valves.
- Treatise on the venous system, accurately describing the function of the veins and their valves,
- He became the first to draw clear comparison between smallpox and chickenpox.
- **Kitab al-Mansoori** dealt exhaustively with Greco-Arab medicine. He compounded medicines and designed several instruments used in chemical investigations.
- Kitab al-Asrar deals with the preparation of chemical materials and their utilization.
- He paved way for organic and inorganic Chemistry. He was the first to produce sulphuric acid and prepared alcohol by fermenting sweet products.

Ibn Al Naafis (12th century CE)

- Reputed physician and a renowned expert on shafi'i school of jurisprudence
- Discover **pulmonary blood circulation**, which was rediscovered three centuries later
- First to describe the constitution of lungs, bronchi, and the coronary arteries
- Elaborated the function of the coronary arteries as feeding the cardiac
- muscle

Father of Modern Surgery (Albucasis)

Al-Zahrawi (Spain 936-987)

- Was a great Surgeon and Invented many surgical appliances
- an instrument for internal examination of the ear, urethra, and instrument for applying or removing foreign bodies from the throat.
- He gave perfection to the surgical science and performed surgery of eye, ear and throat.
- He was an excellent dentist: successfully set an artificial tooth in place.
- He performed cauterization, removal of stone from the bladder and dissection of animals.
- He wrote famous Medical Ecyclopaedia called **Al-Tasrif**, which is composed of thirty volumes covering different aspects of medical science.

Ibn Al-Baitar (12th century)

- Great Spanish muslim Botanist and Pharmacist .
- He Classified and gave names of plants kingdom over which modern

botany is based

 Gathered herbs and new plants from spain to Syria and extracted

medicines from them.

• Laid foundation of herbal medicines. His work was considered as

authority in plants.

- Kitab AL-Jami Fi Adwiya Al Mughani (20 chapters dealing with diseases of head, ear, cosmetics and fever)
- Kitab AL-Jami Fi Adwiya Al Mufzada (encyclopedia in Botany in which 1400 medical drugs are described)

Al Idrisi (1099-1166, Ceuta – Spain)

• He collected plants and data not reported earlier and added this to the

subject of botany, with special reference to medicinal plants. Thus, a large number of new drugs plants together with their evaluation became available to the

medical practitioners.

- He has given the names of the drugs in six languages: Syriac, Greek, Persian, Hindi, Latin and Berber.
- His book: 'Nuzhat al-Mushtaq fi Ikhtiraq al-Afaq,' is a geographical encyclopedia (The Delight of Him Who Desires to Journey Through the Climates)
- In 1166 Al-Idrisi, built a large global map He meticulously recorded on it the seven continents with trade routes, lakes and rivers, major cities, and plains and

mountains.

 Al-Idrisi's books were translated into Latin and became the standard books on

geography for three centuries, both in the east and west.

Al BIRUNI (973-1048)

- Explained the problems of advanced trigonometry
- Gave theory that light travels faster than sound
- Described and explained fully the concept of longitude and latitude
- He gave idea that earth is not stationary but rotate on its axis
- He learned Sanskarit language in order to investigate Indian knowledge
- He accurately determined the weight of 18 stones in physics
- Books

Tahqiq Al Hind (about history and social conditions of India in 11th century)

Kitab Al Jawahar (book of gems and stones of different types)

Qanun Al Masudi

Al-Jazari: The Mechanical Genius

• Al Jazari Water Raising devices

At a time when people still relied on wells and rivers as the sources for water, Al Jazari's invented the mechanical devices needed to create a water supply system. Al-Jazari described fifty mechanical devices in six different categories, including **water clocks**, hand washing device (*wudhu'* machine) and machines for raising water, etc.

Water supply system

al-Jazari developed the earliest water supply system to be driven by gears and hydropower, which was built in 13th century Damascus to supply water to its mosques and Bimaristan hospitals. The system had water from a lake turn a scoop-wheel and a system of gears which transported jars of water up to a water channel that led to mosques and hospitals in the city.

Omer Khayyam

- Almost <u>1,000</u> years ago, Persia boasted great <u>scientists</u>, <u>mathematicians</u>, and <u>poets</u>. One man was all three. <u>Omar</u> <u>Khayyam</u> was a skilled Muslim astronomer, one of the most famous mathematicians in the world, and a great poet.
- Khayyam lived during a time when mathematics, science, and poetry were all making new **breakthroughs** and expanding the boundaries of knowledge. It was called the **golden age** of Muslim civilization, and it took place across a wide geographic area.
- He was the first person who proved **BINOMIAL THEORUM**
- He Classified algebraic equations
- He Introduced the Jalali calendar

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 Recognized 13 different forms of cubic equations and arranged them in their order of complexity

Hasan al-Rammah (13th Century)

- Born in Syria, al-Rammah was the first Muslim chemist to successfully create and <u>engineer</u> <u>modern explosives</u>.
- Hasan al-Rammah described 107 gunpowder recipes.
- He improved upon the gunpowder that was invented in China.
- He was the first Muslim to invent **Explosive Rockets**.
- The **Torpedo** is also invented by Hasan al-Rammah, who shows illustrations of a torpedo running on water with a rocket system filled with explosive materials and having three firing points.

Al-Farghani- An astronomers

 He was Muslim astronomer and one of the famous astronomers in 9th century who involved in the measurement of the diameter of the Earth together with a team of scientists under the patronage of Al-amun and his successors in Baghdad.

- He determined the diameter of the earth to be 6,500 miles, and found the greatest distances and also the diameters of the planets.
- His most important work, written between 833 and 857, he wrote "Elements of a Astronomy" the book on celestial motion and thorough science of the stars), thorough, readable, nonmathematical summary of Ptolemaic astronomy.
- This was the book, which circulated in several Latin editions, was widely studied in Europe from the 12th to the 17th century and exerted great influence upon European.

AL-BATANI (858-929 A.D.)

- Batani was a famous astronomer, mathematician and astrologer.
- He determined the solar year as being 365 days, 5 hours, 46 minutes and 24 second, which is very close to the latest estimates.
- He was an excellent observer of lunar and solar eclipses.
- He also prepared the Islamic lunar calander.
- He determined the length of the seasons and the true and mean orbit of the sun.
- He proved the variation of the apparent angular diameter of the sun and the possibility of annular eclipses.
- His treatise on Astronomy was extremely influential in Europe till
- Renaissance, with translations available in several languages.

Recent Muslim Scientist

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National Academy of Inventors names Rafi Ahmed as Fellow

Fazul Rehman, structural engineer and architect, who initiated important structural systems for <u>skyscrapers</u>

Maryam Mirzakhani

Female Muslim Scientists

Egypt: Aisha Elsafty

Elsafty is a Computer Scientist at the University of Cambridge. She specialises in 'AdHoc networking,' the connecting of computational devices via wireless technology that are used to establish

networks in disaster areas and developing countries.

Iran: Anousheh Ansari

Ansari immigrated to the US as a teenager; she immersed herself in education, earning a BSc in Electronics and Computer Engineering from George Mason University, followed by a Master's degree in Electrical Engineering from George Washington University. She captured headlines on 18th September 2006 for being the first female private space explorer. She also earned a place in history as the fourth private explorer to visit space and the first astronaut of Iranian descent.

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Saudi Arabia: Dr Hayat Al Sindi

Dr Hayat Sindi is a Saudi Biotechnologist from Makkah. She was the first woman from the Middle East to hold a PhD in Biotechnology. She was also head hunted to join George Whitesides' famous laboratory. Sindi co-founded 'Diagnostics-For-All,' which aims to bring easier technology to developing countries. She raised money for the project by winning the prestigious Harvard Enterprise Competition and the \$100,000 MIT award, attracting a further \$10m from Bill Gates.

India: Sameena Shah

Shah is a Senior Research Scientist at Thomson Reuters, New York. She is the winner of the 2009 Google India Women in Engineering Award. Shah works extensively in Artificial Intelligence. She presented an algorithm in computerized cognitive leaning that she and a team of colleagues developed at IIT Delhi, India.

Mauritius: Dr Ameenah Gharib Fakim

Fakim is the current (and first female!) President of Mauritius. She obtained her PhD degree in Organic Chemistry from Exeter University. She is known for having finished the first full inventory of Mauritius and Rodriguez Island's aromatic and medicinal plants She has penned more than 28 scientific books, which have sold worldwide and

are used as reference books by students and researchers worldwide.

Syria/UK: Dr Rim Al Turkmani

Dr Turkmani is a Syrian born astrophysicist. She gained her BSc in Electrical Engineering from the University of Damascus before moving to Sweden to study her Masters and then her PhD in Astrophysics. Dr Turkmani works on the physics of the solar corona – the halo around the sun – and through the use of computer simulation, observations and theoretical modelling, she tries to understand the dynamics of energy release in solar surface explosions, known as solar flares.