Al Khwarizmi

Al Khwarizmi wrote the first book on algebra. (The name "algebra" was first used by him.)

Al Khwarizmi was born about 790 in Baghdad (now in Iraq) and died about 850.

The word for "Algebra" comes from the Arabic word for "al-jabr" which means "restoration of balance" in both sides of an equation.. Algebra was based on previous work from Greeks, Alexandrians in Egypt, and Hindus who had preserved the work from ancient Egyptians and Babylonians.

In the ninth century, **al-Khwarizmi** wrote one of the first Arabic algebras with both proofs and examples. Because of his work, he is called "the Father of Algebra." Al-Khwarizmi was a Persian born in the eighth century. He **converted** (changed) Babylonian and Hindu numerals into a workable system that almost anyone could use. He gave the name to his math as "al-jabr" which we know as "algebra".

A Latin translation of al-Khwarizmi's book on algebra appeared in Europe in the 12th century. In the early 13th century the new algebra appeared in the writings of the famous Italian mathematician, Leonardo Fibonacci. So, algebra was brought into Europe from ancient Babylon, Egypt and India by the Arabs and then into Italy.

Al-Khashi

Introduction: Just as with science, the Muslims learned from the Greeks, Egyptians, Indians, and Babylonians. Many translations took place in the House of Wisdom in Baghdad, the capital of the Abbasid Empire. The Muslim scholars there translated the works of the Greeks who loved mathematics and geometry, including Euclid's work on geometry. They borrowed from India a number system that had a zero and rewrote it as their own. They borrowed from the Babylonians whose number system was based on 60 (just like the minutes in an hour), and from the ancient Egyptians who had the math and geometry skills to build incredible pyramids. So from the beginning, "Arabic math" was a mixing of international knowledge. But the Muslims made additional contributions of their own, and through their study and written work, they preserved the knowledge of mathematics that otherwise might have been lost to the world.

Al-Khashi was born in 1390 in Kashan, Iran and died in 1450 in Samarkand (now Uzbek). He calculated 1 (pi) to 16 decimal places which was the best until about 1700. He **considered himself the inventor of decimal fractions**. He wrote The Reckoners' Key which summarizes arithmetic and contains work on algebra and geometry.

Omar Khayyam

Omar Khayyam (1044 - 1123 C.E.): Another great Muslim mathematician was Omar Khayyam. He is best known today for his poetry, but his contribution to mathematics was great. He showed how to express roots of cubic equations by line segments obtained by intersecting conic sections. Khayyam was an outstanding poet, mathematician, and astronomer. His work on algebra was known throughout Europe in the Middle Ages, and he also contributed to a calendar reform. Khayyam refers in his algebra book to Pascal's triangle. The algebra of Khayyam is geometrical, solving linear and quadratic equations by methods appearing in Euclid's Elements. Khayyam also gave important results on ratios giving a new definition and extending Euclid's work to include the multiplication of ratios. He poses the question of whether a ratio can be regarded as a number but leaves the question unanswered.

Al-Biruni

Background: The scholars at the House of Wisdom in Baghdad and at universities in Cairo, Egypt also contributed to geometry. Geometry was highly developed by the Greeks, and the Muslims translated such great Greek thinkers as Euclid. Muslims used their understanding of geometry into designing wheels of all kinds, especially waterwheels and other systems for drawing up water, in improving farming equipment, and in designing devices of war such as catapults and crossbows. Geometry was also put to work in art, with beautiful geometric designs. Muslims further defined Euclidian geometry, and pointed the way toward the discovery of independent, non-Euclidean geometry developed in the most recent centuries.

Al-Biruni (973 - 1048 C.E.) was a philosopher, astronomer, **pharmacologist** (one who studies drugs and herbs used for health), **botanist** (one who studies plants), geologist and mathematician. He translated Euclid's work into Sanskrit (an Indian language), and calculated the **earth's circumference** (distance around the earth) and **radius** (distance to the center) with an accuracy that is close to today's measurements.

Nasir Al-Din Al-Tusi

Introduction: Trigonometry is also mostly a Muslim creation. It is a branch of mathematics which studies plane and spherical triangles. It developed from the need of astronomers to map points in the sky on a heavenly sphere. Trigonometry's functions, involving ratios such as sine and cosine, tangent and cotangent, were greatly developed and refined in the Islamic lands.

Nasir Al-Din Al-Tusi (1201 - 1274 C.E.) pioneered spherical trigonometry which includes six fundamental formulas for the solution of spherical right-angled triangles. One of his most important mathematical contributions was the treatment of trigonometry as a new mathematical discipline. He wrote on binomial coefficients which Pascal later introduced. (He can be called the "Father of Trigonometry".) He was also an astronomer philosopher, and medical scholar as well as a mathematician.

Jabir Ibn Haiyan (known in Europe as Geber)

Jabir Ibn Haiyan, known in Europe by the name Geber, is generally known as the Father of Chemistry. He was one of the leading scientists in Kufa (in present day Iraq) around 776 C.E. In his early days, he was supported by the advisor to the Abbasid Caliph. Jabir died in Kufa in 803 C.E.

Jabir's (Geber's) major contribution was in the field of Chemistry. He is famous for writing twenty-two books on chemistry and alchemy. He introduced experimental investigation into alchemy which led to modern Chemistry. Jabir emphasized experimentation and development of methods to show the same result when an experiment was repeated. He developed basic chemical methods and the study of various chemical reactions and thus helped develop chemistry as a science and away from the legends and "magic" of alchemy.

Al-Farghani

Introduction: Astronomy was important to Muslims because of their religion! They needed to know the beginning of the month of Ramadan, the hours of prayer, and the direction of Mecca. By observing the position of the sun and moon, Muslims could know the direction of Mecca. As Islam expanded to an empire over 6,000 miles wide, astronomers could help them know these things.
Muslims follow the Lunar, or "moon" Calendar as required by the Qur'an. Months change according to the phases (changes in time) and position [place, location in the sky] of the moon. Each month begins with the first sighting of the crescent moon. This is especially important in the Muslim holy month of Ramadan when fasting is during the day for one month.
Astronomy also led to developments in trigonometry, a field of mathematics important to the mapping of the earth and to the computation of planetary orbits.

Al-Farghani was one of the most distinguished astronomers in the the House of Wisdom. He wrote "Elements of Astronomy" , a book on **celestial** (heavenly) motion and science of the stars. It was translated into Latin in the 12th century and exerted great influence upon European astronomy. It supported the widely held view that the earth was the center of a system around which went the planets and the sun (first described by Ptolemy, a Greek astronomer who lived in Alexandria, Egypt).

Al-Sufi

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'Abd al-Rahman **al-Sufi** was a Persian astronomer who lived during the 10th century. In 964, he described the Andromeda galaxy, our closest neighbor, and called it "little cloud". This was the first record of a star system outside our own galaxy. Al-Sufi's book on stars was translated into many languages and had a big influence on European astronomy.

Al-Zarqali (known as Arzachel in Europe)

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In Muslim Spain, there were many famous astronomers. **Al-Zarqali** (known as Arzachel in Europe) lived from about 1029 to 1080. He was the most famous astronomer of his age. He made a kind of astrolabe that measured the motion of the stars. His work was translated into Latin and other languages and his books were studied later in Europe.

Al-Bitruji (known as Alpetragius in Europe)

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Al-Bitruji developed a new theory of stellar (star) movement. He was born in Morocco. He later migrated (moved) to Spain and lived in Seville. He died at the beginning of the thirteenth century around 1204 C.E.

Al-Idrisi (also known as Dreses)

Muslims traveled widely during the Middle Ages. They traveled on the hajj to Mecca, and on vast caravans for trade across Africa, the Middle East, and Asia.

Muslims further developed the earliest astrolabe, a great astronomical tool. (They improved upon the Greek invention.) It was used to determine one's latitude (or place on the earth) by looking at the position of the stars and sun. It was especially important to travelers.

Al-Idrisi (also known as Dreses), 1099-1166 C.E., is best known in the West as a geographer, who made a globe or sphere of silver weighing 400 kilograms for the Christian King Roger II of Sicily. Some scholars regard him as the greatest geographer and cartographer (mapmaker) of the Middle Ages. He put together a geographical encyclopedia with many maps.

Leo Africanus (Hasan a-Wazan)

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Leo Africanus (Hasan a-Wazan) was a traveler and map-maker who lived from 1485-1554. He was captured by Christian pirates and presented to the Pope as a slave. He later was commissioned to write about and make maps of his travels in West Africa. His description of Timbuktu (now in the country of Mali) tells of the city famous for trade of African products and for scholarship with a thriving trade in books. (From "Leo Africanus: Description of Timbuktu" Washington State University.)

Al-Biruni

Al-Biruni (973-1048 CE) made original and important contributions to science. He discovered seven different ways of finding the direction of the north and south, and discovered mathematical techniques to determine exactly the beginnings of the season. He also wrote about the sun and its movements and the eclipse. In addition, he invented a few astronomical instruments. Many centuries before the rest of the world, Al-Biruni discussed that the earth rotated on its axis and made accurate calculations of latitude and longitude.

Al-Biruni was the first to conduct elaborate experiments related to astronomical phenomena. He stated that the speed of light is immense as compared with the speed of sound. He described the Milky Way as a collection of countless fragments of the nature of nebulous stars.

When the Sultan sent him three camel-loads of silver coins in appreciation of his encyclopedic work, Al-Biruni politely returned the royal gift saying, "I serve knowledge for the sake of knowledge and not for money."

Al-Biruni is considered to be one of the greatest scientists of all times.

Ibn Sahl

Optics is the study of light and vision.

Egyptians were already making glass in 3500 BCE, although it was not perfectly transparent. A number of Greek and Roman references from about 200 BCE cite the usefulness of curved glass lenses in starting fires.

The Islamic Empire, through its massive work of translating Greek and Roman texts into Arabic, learned about the manufacture of glass lenses. Islamic scientist **Ibn Sahl** (984) developed the first accurate theory of refraction of light. He gave Islamic science the understanding needed to develop all the optical tools and theories later developed in 17th century Europe.

Abu Ali Hasan Ibn al-Haitham (known in Europe as Alhazen)

Optics is the study of light and vision.

Abu Ali Hasan Ibn al-Haitham (965 - 1040 C.E.) was known in Europe as Alhazen. He studied the human eye and describe how we see. His Book of Optics recognized that sight is visual images entering the eye, made perceptible by adequate light.

Hunayn ibn Ishaq (Joanitius)

Background: In medieval times, the Middle East had the most advanced medical knowledge and hospitals in the world. While European "hospitals" at this time were usually simply monasteries where the sick were told they would live or die according to God's will, not human intervention, Muslim hospitals pioneered the practices of diagnosis, cure, and future prevention.

The first hospital in the Islamic world was built in Damascus in 707, and soon most major Islamic cities had hospitals, in which hygiene was emphasized and healing was a priority. Hospitals were open 24 hours a day, and many doctors did not charge for their services. Later, a central hospital was established in Baghdad by order of the Abbasid ruler, the first of thirty-four hospitals throughout the Muslim world, many of them with special wards for women.

Traveling clinics with adequate supplies of drugs toured the countryside, and others paid regular visits to the jails.

One of the most famous scholars of the House of Wisdom was **Hunayn ibn Ishaq** (Joanitius) who eventually translated the entire set of Greek medical books into Arabic, including the Hippocratic Oath. Later as a director of the House of Wisdom, he also wrote at least twenty-nine original works of his own on medicine and a collection of ten essays on ophthalmology (the study of the eye) which covered the anatomy and physiology of the eye and the treatment of various diseases which affect vision. His book was the first known medical work to include anatomical drawings (pictures showing parts of the body), the book was translated into Latin and for centuries was used in both European and Middle Eastern universities.

Al-Razi

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Al-Razi, a 9th century Persian physician, made the first major Muslim contribution to medicine when he developed treatments for smallpox and measles. He also made significant observations about hay fever, kidney stones, and scabies, and first used opium as an anesthetic.

Ibn Sina (known in Europe as Avicenna)

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Ibn Sina was one of the greatest physicians in the world, with his most famous book used in European medical schools for centuries. He is credited with discovering the contagious nature of diseases like tuberculosis, which he correctly concluded could be transmitted through the air, and led to the introduction of quarantine as a means of limiting the spread of such infectious diseases.

Al-Zahravi

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In the 10th century, **Al-Zahravi** first conducted surgery for the eye, ear, and throat, as well as performing amputations and cauterizations. He also invented several surgical instruments, including those for the inner ear and the throat.