

# **3. The Greek Civilization**

## **(700 BC - 500 AD)**



## **Introduction**

The ancient Greek civilization appeared around 8 centuries BC and has left a lasting influence on the world, including today, through its scientific discoveries in fields such as mathematics, physics, philosophy, politics, and medicine

Historically, it was in ancient Greece that science, as a form of rational thought, began to develop, driven by philosophers who were simultaneously thinkers, physicists, and often religious leaders. However, the distinction between science and philosophy was not clearly defined.

Reasoning is considered rational when it employs clearly defined concepts and proceeds to a demonstrative chain, meaning that the outcome is necessary if logical rules are applied. The concepts underpinning the reasoning must be realistic, coherent with each other and suitable for the context.

The Greeks were skilled *dialecticians*, seeking to persuade their interlocutors. The Greek philosophers were experts in persuasion, functioning as the advertisers of their time.

## **Factors influencing the rise of Greek science**

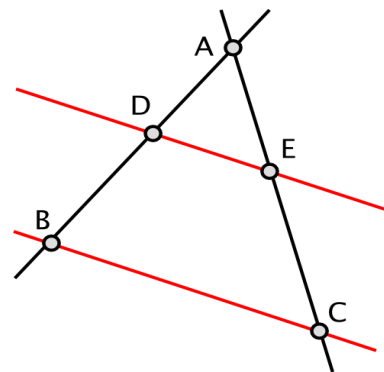
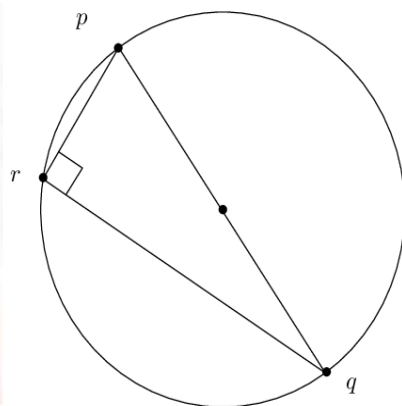
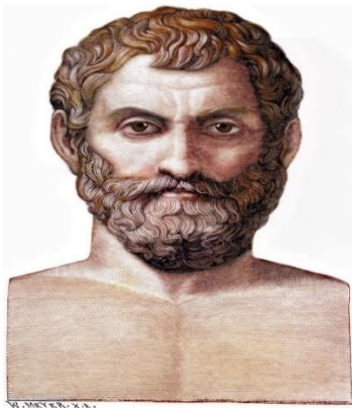
- **Economic and sociological cause:** Trade, crafts and navigation play an important place in the Greek economy.
- **Adoption of alphabetic writing:** Unlike the Egyptians, the Greeks utilized an alphabetic writing system that was easier to learn and more accessible to the general population, rather than being limited to a class of scribes.
- **Openness to Other Cultures:** Greek society was receptive to external cultures and new ideas.
- **Conquests of Alexander:** The Greeks ultimately came to dominate the ancient East through Alexander's conquests, effectively assimilating the scientific knowledge of prior civilizations, such as Egypt and Mesopotamia.

### **Known Greek Philosophers and Philosophical Schools**

Greek philosophy is characterized by its emphasis on logical reasoning. The earliest known Greek philosophers resided not in mainland Greece, but on the periphery of the Greek world. They are credited with developing the concept of Nature. Philosophy was a major activity in ancient Greece, raised to a prominent intellectual activity and shaped by various influences and currents.

- **Thales of Miletus (from -640 to -548)**

The first known philosopher is Thales of Miletus, one of the “seven wise men” of ancient Greece. He lived in the 7th century BCE. Thales is credited with the discovery of electrical phenomena (static electricity and magnetization) and in geometry, the theorem stating that a triangle inscribed in a semicircle is necessarily right-angled, he was the first to calculate the occurrence of the eclipse by mathematics.



Thales was not only interested in numbers, but also tried to explain the world through the principle of observation, he put forward the idea that life originated in water (Water is the origin of all life).

- **Anaximander (from - 610 to -546)**

Of a generation younger than Thales, Anaximander, also of Miletus, was perhaps his pupil. He thought that the earth was placed in the middle of the world and was its centre and that it was spherical; that the moon did not give off its own light but reflected the light of the sun which

was an absolutely pure fire. The first Greek physiologist, he believed that animals were born in the sea, that man would come from another species and that at the origin of life would come from water and would have evolved to adapt to life on land.

- **Anaximenes (-585 to-525)**

He is a Greek philosopher, last representative of the school of Miletus and perhaps a disciple of Anaximander, Anaximenes believes that matter is none other than air, which gives earth and water by condensation



**Anaximander**



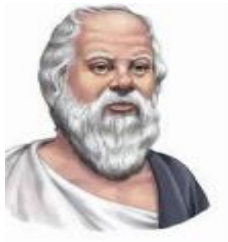
**Anaximenes**

- **Pythagoras (around -530)**

He studied sea level changes

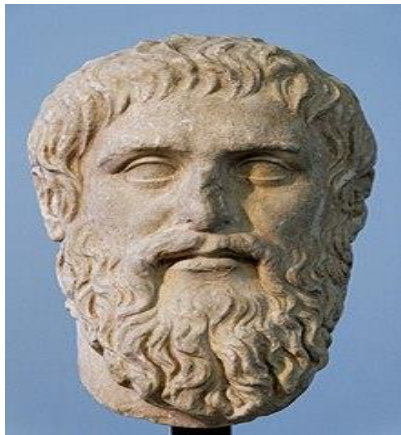
- **Socrate**

The V century BC marks the height of classical Greek culture. It was at this time that the Athenian Socrates (-470/-399) lived, one of the most famous philosophers in history. Socrates was not interested in pure sciences, he was very interested in the Human, in morality and the process of knowledge, in reason. Socrates was nicknamed "*the midwife of reason* »for his dialectical method which consists of guiding his interlocutor towards a rational conclusion rather than directly exposing his ideas to him.



- **Plato Unlike Socrates :**

Whose most important student he was, Plato was interested in the physical world and the means of knowing it. He was above all an idealist: he distinguished between the sensible world (that of sensations) and the intelligible world (that of ideas). According to Plato, ideas precede sensations. Furthermore, Plato attached great importance to the study of geometry and the stars. In this he was strongly influenced by the Pythagorean school. It is said that he wanted to affix the inscription "Let no one enter here unless he is a geometer." at the door of his school, the academy. Plato associated each of the 4 elements with a regular polyhedron: the tetrahedron with fire, the cube with earth, the octahedron with air and the icosahedron with water. Thus, the properties of substances were reduced to geometric shapes.



- **Aristotle (-384/-322)**

Was a student of Plato, he developed the concept of metaphysics. His curiosity led him to the sciences (Physics, biology), he put forward theories and experiments to confirm the truth. He founded his own school in Athens (in competition with the Academy) which was called High school, because of its location on a site dedicated to the Lycian Apollo.

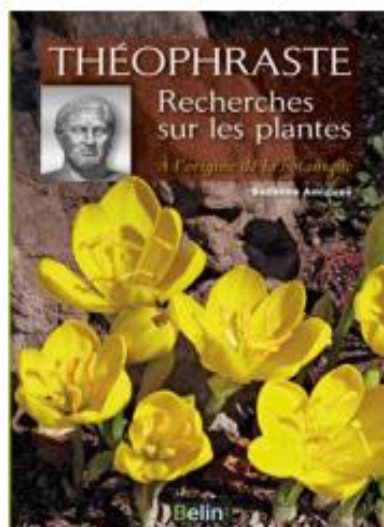
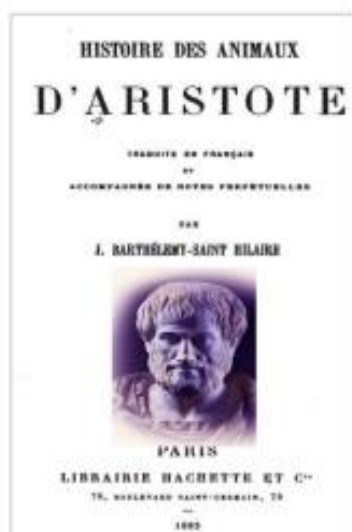
Aristotle's school is referred to as peripatetic, because Aristotle often gave his lectures while walking with his students.

For Aristotle, inanimate (immobile) objects and living beings are made up of the same natural elements, the same matter; nature constitutes a whole. Furthermore, life is characterized by autonomous movement (mobility and transformation). Living beings are therefore animated, that is to say they possess a soul (anima in Latin). Unlike inert matter, the soul allows the movement and transformation of matter to arrive at the final form of the adult. Philosophy but Biology constitutes a third of Aristotle's works. Zoology was founded by Aristotle but after his disciple Theophrastus it fell into oblivion, so to speak. Aristotle wrote "*History of Animals*", general biology of animals and a comparative anatomy and physiology of animals. In this book he distinguishes two major categories: animals that have blood (**Enaima**) and animals that do not have it (**Anaima**). The former represent the Vertebrates, the latter the Invertebrates .

- **Theophrastus (372-287 BC),**

To whom he made discover the secrets of the living world. He is the author of the first "History of Plants" written in 360 BC and which deals with the morphology and classification of plants. He is the first to distinguish between the animal kingdom and the plant kingdom. He is considered the father of botany. His botanical classification is artificial.

He distinguishes four main groups: herbs, subshrubs, shrubs and trees. He classifies 500 plants in them.



➤ **Greek Medicine and Biology**

In ancient Greece, two distinct types of medicine were in opposition: temple medicine and the practices of various medical schools.

**The most famous doctors are:**

- **Herophilus (330-320 BC - around 260-250 BC)**

Famous for his contributions to anatomy. These advances were facilitated by the fact that human dissections, impossible in Greece, were tolerated in Alexandria (Egypt). His main contributions include:

- The study of the nervous system. He distinguished nerves from ligaments and blood vessels. He placed the seat of the soul and sensations in the brain, unlike Aristotle who placed it in the heart.
- He distinguished the veins from the arteries. He is the first known doctor to have taken the pulse of his patients. - He is also the discoverer of the Fallopian tubes, 1800 years ahead of Fallopian himself.
- Finally, was common in the Greek world, he considered diet and physical exercise (gymnastics) to be important factors in maintaining health.

- **Erasistratus (-304 to -258)**

He was the first physician to perform autopsies in order to determine the cause of death. He studied metabolism. He distinguished between sensory and motor nerves. He stated that All parts of the body are woven of veins, arteries and nerves. Erasistratus teaches that the heart acts as a pump.

- **Claude Galien (129 / - 200)**

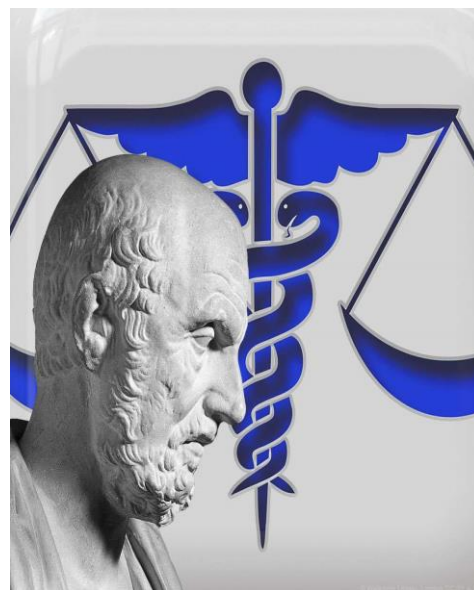
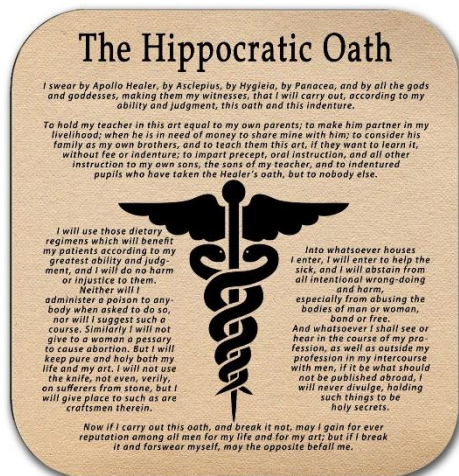
He practiced surgery for some years. However, it seems that he much preferred medicine to surgery. Galen's views on the vascular system are peculiar and deserve mention. Like Aristotle, Galen believed that it is the blood that nourishes and preserves the body.

- Hippocrates of Cos (from -560 to -477)

He was a physician but also a philosopher, traditionally considered the "**father of medicine**". He founded the Hippocratic school which intellectually revolutionized medicine in ancient

Greece. He made medicine distinct and autonomous from other fields of knowledge, such as theurgy and philosophy, to make it a profession in its own right. He wrote several medical treatises under the name of "Hippocratic Corpus» about embryology, pathology, physiology and gynecology. According to him:

- The heart is the center of intelligence.
- Nerves serve as tendons (fibrous cord that connects a muscle to the bone) for organs.
- Breathing serves to cool the heart, which is where blood and air meet.
- The brain is moist and cold and its mucus is evacuated through the nose.
- Flies and mosquitoes are born by spontaneous generation.
- The human body is composed of 4 elements (**fire, air, water, earth**). He is the initiator of a style and method of clinical observation, and the founder of ethical rules for doctors, through **the Hippocratic Oath**, still in force today





## **Greek Astronomy**

- **Eratosthenes (-275 to -175)**

He is famous for giving the first estimate of the diameter of the Earth.

- **Hipparchus (-161 to -127)**

He was the greatest astronomer of Antiquity. He made precise and methodical astronomical observations, using instruments that were sophisticated for the time. Let us mention some of his contributions: - He built a catalog of at least 800 stars. - From the periodicity of eclipses known to the Babylonians, Hipparchus estimates the duration of the month at 29 days, 12 hours, 44 minutes and 31 seconds, or less than half a second more than the currently accepted value

- **Claudius Ptolemy (85 to 165)**

He lived in the 2nd century AD in Alexandria, and was a Greek astronomer, mathematician and geographer. He is known to have made astronomical observations between 127 and 141. His main work, one of the most remarkable scientific treatises left to us by Antiquity, is entitled "Mathematical composition »In this book he sets out the mathematical theory of astronomy, the main part of which consists of a system intended to describe and predict the position of the stars (moon, sun and planets).

# **4. ROMAN Civilization**

## **(500 BC - 476AD)**



## GENERAL

At the time of their apogee (when they were most powerful) the Romans dominated all the countries around the Mediterranean Sea. The Roman contributions are more technological than scientific. So we deduce that during the Roman Empire, biological sciences begin to decline.

Rome had many engineers who built works whose magnitude still surprises us. On the other hand, these scholars were most often slaves of Greek or oriental origin. The Roman mentality was more interested in the practical domain than in the intellectual domain. At the time when Rome became a great power, it received through the conquered kingdoms everything it needed from the sciences for practical uses.

But fortunately, the Roman Empire did not completely abandon everything that was not strictly utilitarian. The Roman Empire also trained its own scholars, writers, poets, and sculptors.



### ➤ Scientific and biological practices

#### • Architecture

They are responsible for the development of the vault which allowed for remarkable achievements, for example grandiose aqueducts. The Romans were able to contribute to the development of mathematics, and of science in general. They used the knowledge of the

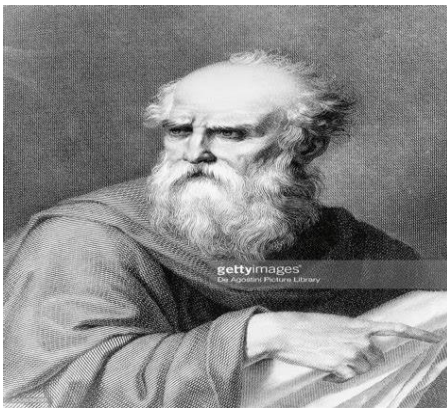
conquered peoples (Phoenicians, Greeks, etc.). They were great architects; we know of temples, baths, ports, aqueducts as well as villas, notably those found in Pompeii.



### **Marcus Vitruvius Pollio**

He is an engineer and architect. Wrote in – 25 a work «From architecture» where he explained the theoretical and aesthetic principles of architecture but also the basics of physics and mechanics known at the time.

For Vitruvius, the architect must have extensive knowledge of geometry, drawing, history, mathematics, and optics. They left us a system of numbering and units of measurement that have lasted for a long time

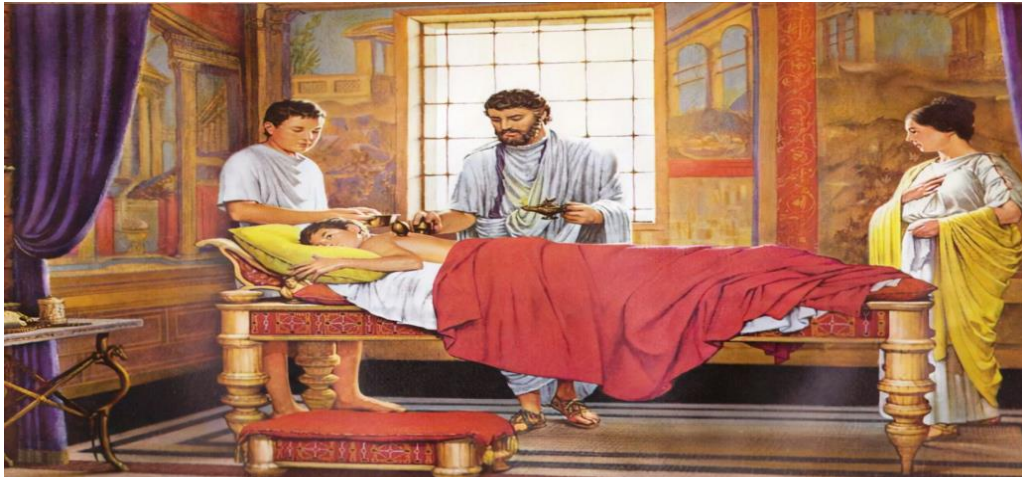


- **Medicine**

Initially, it did not make any progress. Ancient Roman medicine was a direct inheritor of the Ancient Greek Medicine. The first doctors to appear in Rome were Greeks, captured and brought as prisoners of war.

Doctors used a variety of techniques involving different instruments and, like the Greeks, also practiced various religious rituals to obtain healing, because they believed in the supernatural

origin of many diseases. Unlike the Greeks, where health was a personal matter, the Romans encouraged the improvement of public health. Also, along side private medicine, a public medical community had been established and the authorities believed in the prevention of diseases by improving sanitary conditions through the construction of aqueducts to bring water to the cities, the construction of public baths and sewage systems (network of pipes).



Medicine was specialized, such as ophthalmology and urology, and Roman surgeons had a tool kit containing forceps, scalpels, catheters, and arrow extractors. These instruments had different uses and were boiled in hot water before use. For operations, surgeons used painkillers such as opium, and acetic acid (the acid in vinegar) was used to wash wounds.

The first doctors to appear in Rome were Greeks, prisoners of war. For the Romans, Greek doctors practiced invasive and brutal medicine (bloodletting, cauterization, surgery or abscess or cataract operations) to the point that some were nicknamed *carnifex*, "butchers"). The main doctors are:

➤ *Gallienus*

He was a Roman emperor, who made many anatomical charts from animals (due to religion). He was an experimental physiologist who understood that arteries carry blood and not air.



➤ *Dioscorides*

He was a Greek physician, pharmacologist and botanist, who practiced in Rome. Dioscorides is famous for having written a five-volume book of "Materia Medica»which is the precursor of all modern pharmacopoeias and is one of the most important medical botany books in history.



**Stone work in Ancient Rome**

The Romans understood the importance of roads that could be used to transport troops and facilitate trade. They were built by legions. Rome used cut stone for this.



**Machine manufacturing**

In addition to simple instruments such as the lever, there were inventions by Greek engineers such as the winch (a lifting device which controls the winding and unwinding of a cable), the pulley (a wheel-shaped part which transmits movements, used with a rope, chain, crane, etc.).



### **Use of animal power**

They invented the horse-drawn sling (for pulling goods, war), some other animals were used to pull goods with their horns.

**Use of natural forces**, like the invention of water and wind mills.

- **Roman geometry**

Roman geometry took over the knowledge of the conquered peoples. The Romans applied this knowledge in surveying and in the construction of roads and baths. The Romans also applied their knowledge of geometry, for example, calculate the slope of aqueducts to allow the transported water to flow regularly.

- **Natural sciences**

### **Gaius Pliny the Elder (23-79)**

He was a naturalist, a Roman leader (procurer and then admiral) who left us an interesting compilation of the knowledge of his time on biology entitled "*Natural Histories*". This work will serve as a reference although his writing is influenced by beliefs.

