People's Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research

Abbes Laghrour Khenchela University

Faculty of natural and life sciences

BIOLOGY DEPARTMENT

Universal History of Biological Sciences Courses

1st Year L.M.D

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Subject: Universal history of biological sciences

Name of the course/Teaching Unit, level: Universal History of Sciences

Biological, UET, 1st year (S1)

Number of credits: 2

Coefficient: 1

1- Teaching objectives:

The course "Universal History of Biological Sciences" is intended for students of the first year -Biology-.

This course focuses on:

2- Course program:

1. Prehistory
2. Antiquity
3. Middle Ages

   -In Occident

   -In the East (Muslim civilization)
4. Sixteenth and seventeenth centuries:
5. Eighteenth century: Darwin
6. Nineteenth century: cellular theory (microscopy), Sexuality Embryology, Biology, Molecular (DNA) Genetics.
7. Twentieth century: gene therapy and cloning

Figures List

I. Introduction

1. Definition of Science

The word science comes from the Latin scientia, "knowledge") is "what we know about having learned it," which means "to know."

Le Robert defines *science* as any body of knowledge having a specific object and recognized and clean method; it is the domain of knowledge in this sense. There is no science but sciences, each characterized by a set of practices more or less differentiated and based on verifiable objective relationships.

The word science mainly covers three concepts:

- Knowledge is knowledge of certain things which are used for the conduct of life or for that of business.
- All knowledge is acquired through study or practice.
- Hierarchy, organization, and synthesis of knowledge through general principles.

The definition of *science* is instead a systematic attempt to understand Nature rationally. In other words, we only consider the sciences of Nature, what was formerly called Natural Philosophy. In modern parlance, this means physics, chemistry, biology, and the disciplines related (astronomy, geology, etc.), to which mathematics is added. The place of mathematics is unique because it is a set of concepts and methods, including the object, which is not exclusively the study of Nature but extends to practically all human activity. We still include them in our study because of their fundamental importance in the evolution of knowledge features and their central place in human thought.

The American Physical Society (APS) submitted the following definition of science: Science enlarges and enriches our lives, opens our imagination, and frees us from the servitudes of ignorance and superstition.

There are three types of science:

- Exact sciences, including mathematics and mathematized sciences like theoretical physics
- Physico-chemical and experimental sciences (natural sciences and of the subject, biology, medicine);
- The human sciences concern Man, his history, behavior, language, social, psychological, and political.

2. Definition of the technique

A technique is a body of practical knowledge to act on the material effectively. In general, ancient techniques were developed without a rational and systematic knowledge of Nature being necessary. Each practical field had rules of thumb, perhaps obtained by trial and error over time generations and transmitted without general explanations. It is the period of artisans and professional corporations.

3. Definition of the history of science

It is the study of the evolution of scientific knowledge, a progressive approach to approaching and understanding the world since ancient times to build new science.

The objective of this subject is to study the gradual development of biological sciences since prehistory. It is impossible to know a science without knowing its history, the history of its trial and error, and its mistakes. The history of science is closely linked to the history of societies and civilizations.

Through its discoveries, science has been able to leave its mark on civilization. The history of science and science can take place along two axes:

• The history of scientific discoveries, on the one hand.

• the history of scientific thought, on the other hand

Chapter1. Prehistory

1. Prehistory

The term "prehistory" refers to the chronological period of the existence of humanity, beginning with the appearance of man and ending with the development of writing.

Prehistory was initially defined as the period between man's appearance and the first writings' appearance. It is based solely on the analysis of objects discovered during archaeological excavations. The first furnaces appeared at the same time when the age of metal began.

Prehistory is divided into two main parts, the Paleolithic (the age of carved stone) and the Neolithic (the age of polished stone), and they are divided into different sub-periods.

The transition phase between these two significant periods is called the Mesolithic.

2. "Paleolithic " The first period

Which lasted between 10,000 and 12,000 years, is called the "Paleolithic." The term "Paleolithic" comes from the Greek "palaios" (ancient) and "lithos" (stone). He can therefore be translated as "old stone." This is the most ancient and is marked by the appearance of the cut stone technique and a method of nomadic life ignoring Livestock or agriculture, as well as an economy of predation and picking. Humans then lived by hunting and gathering (Fig.1).

This era began three million years ago. Among the techniques developed during the Paleolithic, we note the domestication of fire, the manufacture of clothing and containers from animal skins, and the manufacture of hunting tools and canoes. The domestication of the dog probably dates from the Paleolithic. The Lower Paleolithic began with the manufacture of adjustable pebbles, called "choppers," by the Australopithecines, then by the Homo species.

The population density in the Paleolithic is estimated at less than 0.01 inhabitants per kilometer square (hot and cold deserts included in the average). During the Paleolithic era, which spanned from around 2.5 million years ago to 10,000 B.C., our ancestors resided in caves, basic houses, or tepees and subsisted as hunters and gatherers. They utilized

rudimentary stone and bone implements, including primitive stone axes, to pursue avian creatures and untamed fauna. They utilized controlled fire to prepare their prey, encompassing woolly mammoths, deer, and bison. In addition, they engaged in fishing and gathered various types of berries, fruits, and nuts.

Since very ancient times, probably even before the appearance of modern man, human beings passed on their knowledge about animals and plants to increase their chances of survival. For example, they had to know how to avoid (or sometimes use) poisonous plants and animals and how to track, capture, and hunt different animal species.

Among the techniques developed during the Paleolithic, we note: - The domestication of fire: between - 800,000 and - 500,000 years ago, men discovered fire. Their life is transformed: the fire allows the meat to be smoked for its preservation, to heat, to light, to keep wild animals away, to harden the wood (for example, spear points for hunting), and to heat the water.

The manufacture of clothing and containers from animal skins - hunting tools and canoes. To make his tools, man uses the raw material: pebbles and flint. These tools are becoming more perfect, efficient, and multifunctional over time.

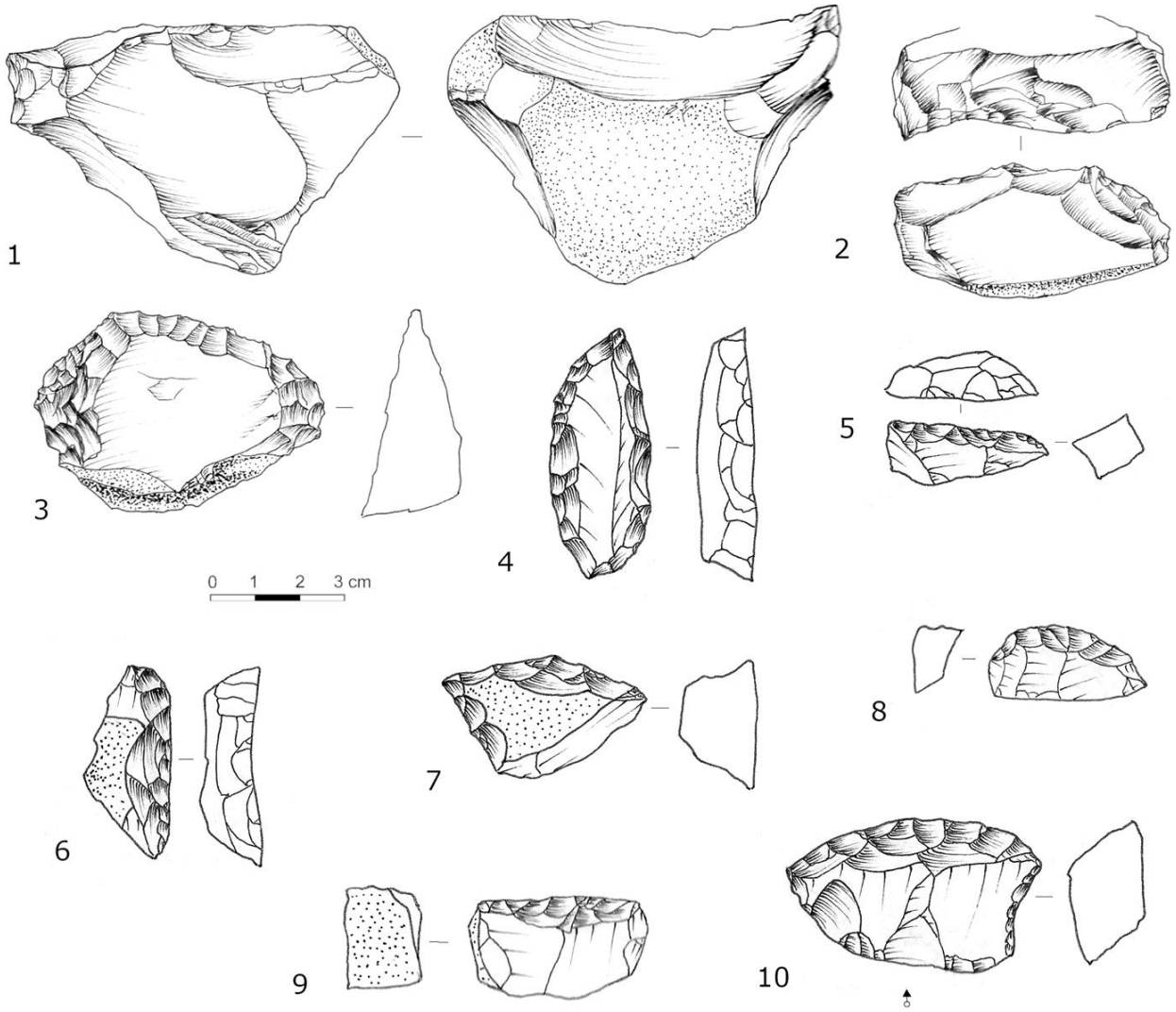

Figure1. Artifacts. (5)

3. The Neolithic

The word "Neolithic" (from the Greek "neos," new, and "líthos," stone) designates the "new stone age." The use of polished stone initially defined the use of stone tools in this period. However, it is also marked by the emergence of livestock farming (domestication of goats, pigs, etc.) and agriculture, leading to a sedentaryization of populations.

During the Neolithic era, which spanned from around 8,000 B.C. to 3,000 B.C., early humans transitioned from a lifestyle of hunting and gathering to one focused on agriculture and food production. They tamed animals and grew cereal crops. They utilized refined hand axes and adzes to cultivate and prepare the soil, establishing permanent settlements in the plains. Progress was achieved in developing equipment and techniques for farming and in the construction of homes. Additionally, advancements were made in various art forms,

such as pottery, sewing, and weaving.

The Neolithic has also often been referred to as the "Polished Stone Age" (distinguished from the Paleolithic, the "age of cut stone") since, in many regions, it is marked by the systematization of the polishing of specific stone tools. Man makes polished stone tools. This stone is smoother, stronger, and sharper.

The oldest signs of a Neolithic population are found in the Middle East, dating between 9,000 and 6,000 BC. Meanwhile, the art of pottery, weaving, and stone construction also developed. The creation of the wheel can be traced back to this period. The development of agriculture was the most important revolution in the evolution of the human species. In addition to the sedentaryization of the population, long-term work planning is also necessary.

At this time, the art of pottery was also developed (for food conservation), as well as weaving and stone construction. The invention of the wheel dates back to this era. In the Neolithic, human groups no longer exclusively exploited resources natural resources available but were starting to produce some of them. Hunting and gathering continue to provide a substantial part of food resources, but agriculture and Livestock play an increasingly important role.

Prehistoric empirical practices linked to the field of biology: The oldest sources of information (petrography, cave paintings, etc.) on the history of humanity have provided essential data on:

· The geographical distribution of plants

· The existence of currently extinct animal species (prehistoric horses, etc.)

· The history of civilizations – ethnology, particularly the technical aspect.

Paleolithic man was able to observe and represent animals that are now extinct: by train to walk or run, in hunting positions, and in combat states. Neolithic men practiced stone polishing and became animal breeders.

Paleolithic man used plants for various purposes because plants were a power source and had healing power. Man became a plant cultivator in the Neolithic.

The use of plants subsequently led (in China and Egypt) to the appearance of the following professions: Collectors of plant roots, Doctors, and pharmacists.

4. Metallurgie age

4.1. Bronze Age

Significant progress was achieved in metalworking between 3,000 B.C. and 1,300 B.C. during the Bronze Age, when the discovery of bronze, an alloy of copper and tin, took place. The more brutal metal, now employed for weaponry and tools, supplanted its stone precursors, catalyzing advancements such as the ox-drawn plow and the wheel.

During this era, there were notable advancements in building and art, such as creating the potter's wheel and developing textiles. The predominant clothing material was wool, with garments commonly used in skirts, kilts, tunics, and cloaks. Residential structures transformed into what is known as roundhouses, which included a circular stone enclosure topped with a thatched or turf roof. These roundhouses were equipped with fireplaces or hearths, so further settlements and urban areas started to emerge.

The Bronze Age witnessed the emergence of structured governance, legal systems, military strategies, and the initial stages of religious practices. Notably, the ancient Egyptians constructed the pyramids during this period. The oldest documented records, such as Egyptian hieroglyphs and petroglyphs (engravings on rocks), can also be traced back to this period.

The Bronze Age refers to a historical period characterized by the widespread use of bronze.

4.2. The Iron Age

The Iron Age commenced with the advent of heating and forging iron techniques and lasted from around 1,300 B.C. to 900 B.C. During that period, metal was considered more valuable than gold, and the production of wrought iron, which would later be replaced by steel through iron smelting, was more straightforward than bronze.

In addition to the widespread manufacturing of iron tools and weaponry, this era witnessed significant construction progress. Four-room dwellings, some with animal

stables, were constructed alongside more basic hill forts. Furthermore, royal palaces, temples, and other religious edifices were also built. Early urban planning was implemented, with the construction of residential blocks along paved or cobblestone roadways and establishing water systems.

The fields of agriculture, art, and religion experienced advancements in complexity while the development of writing systems and written records, such as alphabets, started to take shape, marking the onset of the Early Historical Period.

Egypt and Mesopotamia were Bronze Age civilizations. These civilizations were shaken in the middle of the second millennium BC with the arrival of the Iron Age, whose historical significance was immense. Iron is more difficult to work than bronze due to its higher melting temperature, requiring more sophisticated ovens. Note that bronze was cast in molds, while iron was softened and forged (Smelting iron requires even more efficient furnaces and was only carried out later, first in China (2nd century BCE) and India before reaching the Middle East and Europe).

On the other hand, iron ore is much more abundant than copper ore. During the Bronze Age, the metal's rarity made it a luxury item, the prerogative of nobles and warriors. The peasants only owned stone tools, making agriculture difficult outside narrow areas near rivers, where the land was easy to work with, such as Egypt and Mesopotamia. Agriculture was a state enterprise in these countries because of the vital community work it involved (irrigation, distribution, etc.). Their limited bronze technology, therefore, imposed a rigid and stable social system based on robust and influential cities.

Chapter 2

Antiquity and the appearance of civilization

1. Definition of antiquity

Antiquity's name is derived from the Latin antiquus, meaning anterior or ancient. It is an era in history. Through the development or adoption of writing, Antiquity succeeds Prehistory: certain civilizations of these pivotal periods had no writing but are mentioned in the writings of other civilizations. Therefore, the transition from Prehistory to Antiquity occurred at different periods for the different peoples.

Antiquity saw considerable progress in the medical field. As such, Egypt is a pioneer since it left the most critical medical treatise known to date. Egyptian doctors had even described the meninges, the three coverings surrounding the brain and spinal cord.

It is an era in history. Through the development or adoption of writing, Antiquity succeeds Prehistory: certain civilizations of these pivotal periods had no writing but are mentioned in the writings of other civilizations. Therefore, the transition from Prehistory to Antiquity occurred at different periods for the different peoples.

Likewise, in Western historiography, Antiquity precedes the Middle Ages before the modern era.

Civilization comes from the Latin civitas, which means "citizen." It is, therefore, a society in which a group of people plays a specific role: the tasks are specialized, and relationships between individuals are governed by rules organized around links of authority. In particular, legal and judicial systems are designed to resolve disputes between individuals while avoiding individual resolution as much as possible. Hippocrates was a doctor; he left us essential works written by himself or his students. These articles describe diseases and treatments empirically. However, there are attempts to develop specific biological theories.

2. Antiquity in the east

2.1. Far East

2.1.1. China

Various sources indicate that China's history is considered to have started around 4000 B.C. or 2700 B.C. During this time, wise emperors established fundamental aspects of civilization, including clothing, food preparation, marriage, and a state structure. These emperors imparted their knowledge to the people, making China reach an impressively advanced cultural state as early as the third millennium B.C. Nevertheless, the available knowledge regarding the origins of civilizations renders this scenario highly unlikely, as this is the only civilization in the world that has emerged through a similar process. Over time, Chinese historians progressively discovered further information on ancient periods. All of these narratives were gathered in the magnificent.

The world is filled with diverse and vibrant civilizations, each distinguished by unique attributes. They are collaboratively contributing to the progress and growth of human society through exchanges and reciprocal learning. The Chinese civilization, being a significant participant in the global tapestry of civilizations, is intricately intertwined with the fate of the Chinese country. The Chinese civilization, which has spanned over 5,000 years, has consistently adapted and grown, serving as a solid internal source of inspiration for the ongoing progress of the Chinese country.

The Chinese civilization, which serves as the foundation of the Chinese nation's confidence, plays a vital role in propelling the Chinese people to the forefront of the global arena and in their pursuit of national revitalization. The Chinese culture stands alone as the sole ancient civilization in the world, possessing specific characteristics and a singular allure compared to other civilizations.

The Chinese already had significant biological knowledge about various animals and insects, hunting and fishing birds, fish, certain livestock, etc. Silkworms: In China, silk was used to make clothing (exceptionally long dresses, dresses, and jackets). The Chinese also provided the first known human anatomy charts. For them, the organism is summed up in five organs (lungs, heart, liver, spleen, and kidneys) and is linked to the five cosmic elements (wood, earth, metal, water, and fire). Applied to physiology, the Theory of the Five Elements

combines a Movement in each organ by its primary function: The Liver is Wood, The Heart is Fire, the Spleen/Pancreas is Earth, the Lung is Metal, and the Kidneys are Water.

During the Zhou dynasty, there was a significant growth in culture and the expansion of civilization. The act of writing was systematized, and the development of iron metallurgy progressed in a more advanced manner. Confucius, Mencius, Mo Ti (Mot Zu), Lao-Tzu, Tao Chien, and the potentially fictional military strategist Sun-Tzu are all renowned Chinese philosophers and poets who emerged during the Zhou dynasty in China, which was characterized by the presence of the Hundred Schools of Thought. Initially invented during the Shang dynasty, the chariot saw further advancements and refinement throughout the Zhou dynasty.

It is essential to acknowledge that the periods and dynasties mentioned did not have clear-cut beginnings or endings, as shown in history books. Additionally, the Zhou Dynasty exhibited numerous similarities with the Shang Dynasty, such as language and religion. Historians consider it essential to divide historical events into periods for clarity. The Zhou Dynasty continued to exist during two well-known periods: the Spring and Autumn Periods and The Conflicting States Period.Traditionally, the compass, printing, paper, and gunpowder are considered the "Four Great Inventions" of ancient China. In medicine, acupuncture, and medicinal plants were developed early and developed. They were the first to vaccinate (the old-fashioned way): they knew that if they fell ill, they could be vaccinated without giving in.

China has significantly contributed to the advancement and evolution of human civilization throughout history. Notable contributions include the invention of papermaking, gunpowder, printing, and the compass. Additionally, China has made significant contributions to astronomy, calendar systems, and philosophy. Currently, China is making significant efforts to advance global peace and development. We are confident that China will persist in making more significant contributions to improving the globe in the future.

Surgery was very advanced in ancient China. They had more or less empirical biological knowledge about various animals, including breeding, observation of fish habitat, adaptation and breeding season, ecological demands and requirements of certain insects, and iron fusion in medicine.

2.1.2. India

The ancient Indian concept of human biology is reminiscent of the Chinese concept. They assume that the human body consists of five elements (earth, water, fire, wind, and space) in nature and use them to explain physiological phenomena. They coined the term "Ayur Veda," which means "the science of long life." The fundamental treatise of Hindu medicine is Ayurveda. The latter explained that illnesses are due to an imbalance and that it is necessary to replace harmful elements with harmonious ones to cure a sick person. Certain remedies, therefore, gain the reputation of panacea, which reveals a systemic understanding of the human body. Explanations of various surgical operations are also present.

The Indians are credited with inventing the zero and number systems, considered two of the most significant advancements in human history. India is the birthplace of various mathematical concepts such as the decimal system, the value of pi, algebra, trigonometry, and calculus. Greeks and Romans utilized numerals up to 10^6, while Indians had already used numbers as large as 10^53 before 5000 B.C.

Albert Einstein once acknowledged the significant contribution of Indians, stating that their teachings on counting were indispensable for making meaningful scientific discoveries.

In medical science, Sushruta is credited as the progenitor of medicine, pioneering the technique of conducting surgical procedures using anesthetics. Ayurveda, the first form of medicine, was founded on a comprehensive understanding of herbal remedies and continues to be successfully used today. Ancient Indian writings contain extensive information on anatomy, embryology, digestion, metabolism, physiology, genetics, immunity, psychology, and causation.

Metaphysics pertains to the philosophical exploration of the fundamental essence of reality, whereas astronomy involves the scientific examination of celestial structures and occurrences.

Several of Europe's most significant findings originated in India millennia before the existence of Europe itself. Gravity, for example, was explained not by Isaac Newton but rather by an Indian individual named Brahmagupta, a whole millennium prior to the establishment of the British Empire.

Ancient Indians possessed extensive information regarding the genesis and antiquity of the universe and Earth, as well as the circumference of Earth and other celestial bodies. Bhaskaracharya, a mathematician, precisely determined the duration of our planet's orbit around the sun to be 365.258756484 days, predating the calculations of Western astronomers.

2.2. Middle East

2.2.1. Mesopotamia in history

Mesopotamia, the land between two rivers, the Euphrates and the Tigris. Mesopotamia, currently known as Iraq, is the oldest nation on Earth, with a profound historical and cultural heritage. The ancient Greeks bestowed the designation of the area. The Greek term translates to "between the rivers." The civilization was termed "Mesopotamia" due to its location between the Tigris and Euphrates rivers.

Babylon, the capital of Mesopotamia, is the most ancient city globally and is referenced in three revered holy texts: the Koran, the Bible, and the Torah. Alternatively called "Babylon" in Greek, it was situated 65 kilometers south of modern-day Baghdad, adjacent to the Euphrates River. Mesopotamia served as the focal point for the Sassanid and Babylonian civilizations. This region has been instrumental in teaching the world the art of writing.

The inventation of writing: The earliest writing we know of was invented by the Sumerians, living in major cities with centralized economies in what is now southern Iraq.The earliest known account of the invention of writing in Mesopotamia is generally interpreted as antecede to Ur III (2112-2004 a.v. J.-C.). It represents one of the earliest examples of proto-Cunéiform Uruki writing, dating back thousands of years (Fig.2).

The invention of writing has fascinated both modern scholars and their historical counterparts. Because all ancient peoples with written histories have stories about the invention of writing, these anecdotes, embedded in their literature, reflect the comments they have been able to provide regarding the genesis of their writing systems (Fig.3). As these stories are written versions of oral traditions, the details of their beginnings are lost in the tale. Writing systems developed to the point where they could tell such stories (Fig.5). As a result, the written versions of the stories surrounding the invention of writing generally appeared some hundred years after the invention (Fig.5).

Figure 2. Hierarchically structured proto-cuneiform Wiriting (3).

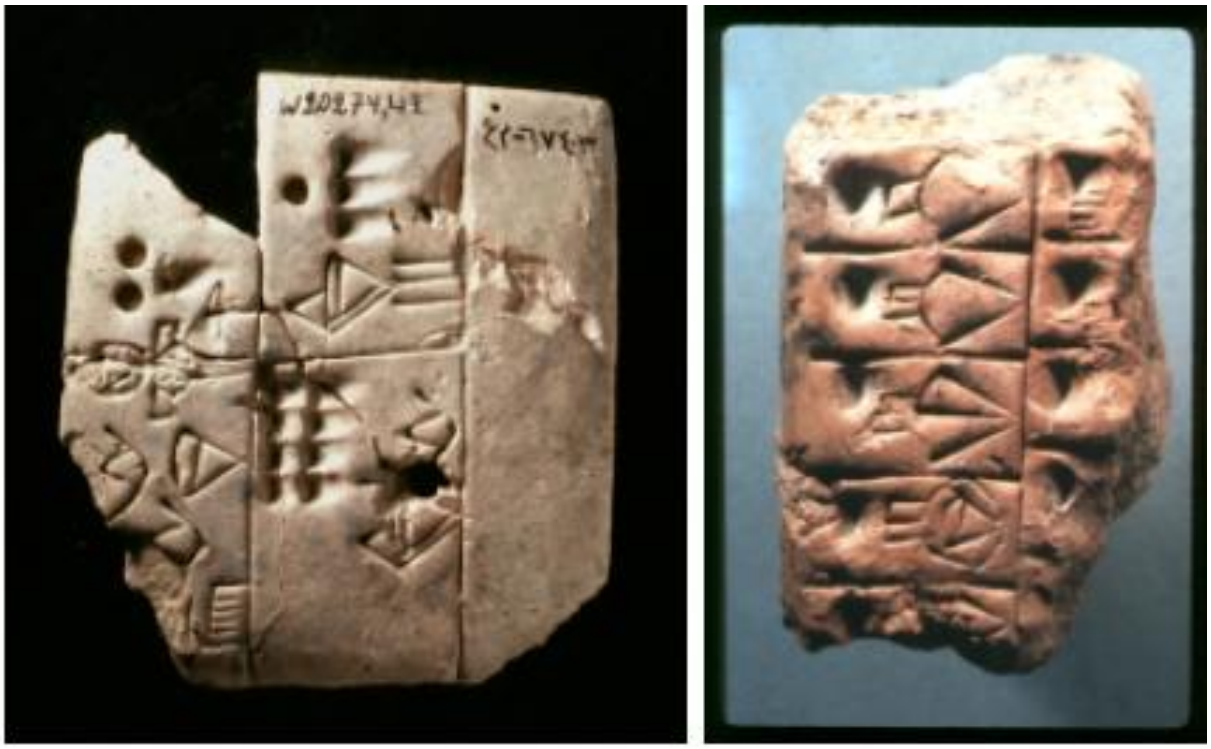

Figure 3. Proto-cuneiform text (3).

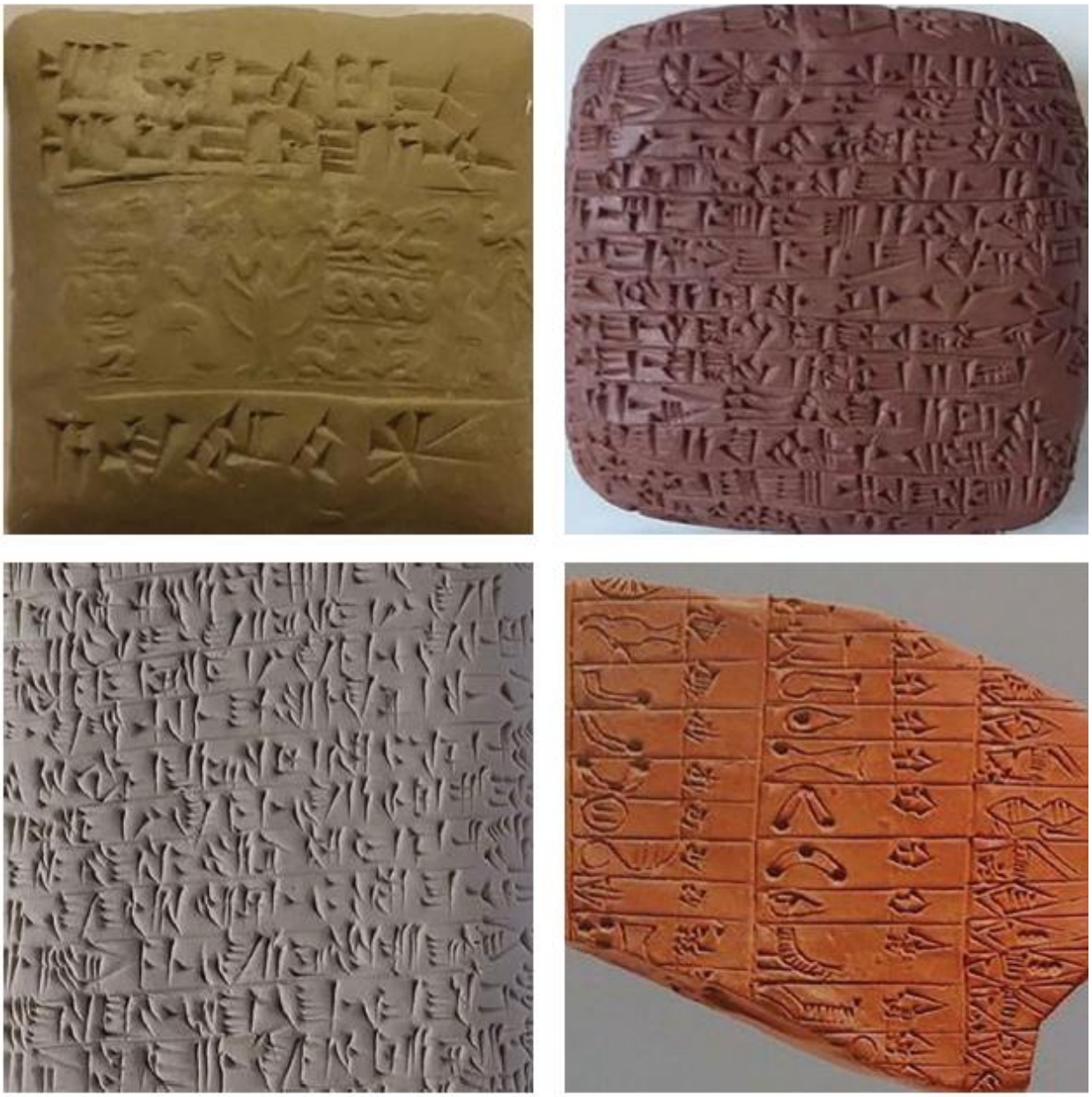

Figure 4. Four modern replicas. A clay envelope and its tablet enclosed inside (upper left corner), and tablets produced by the author in experiments (8).

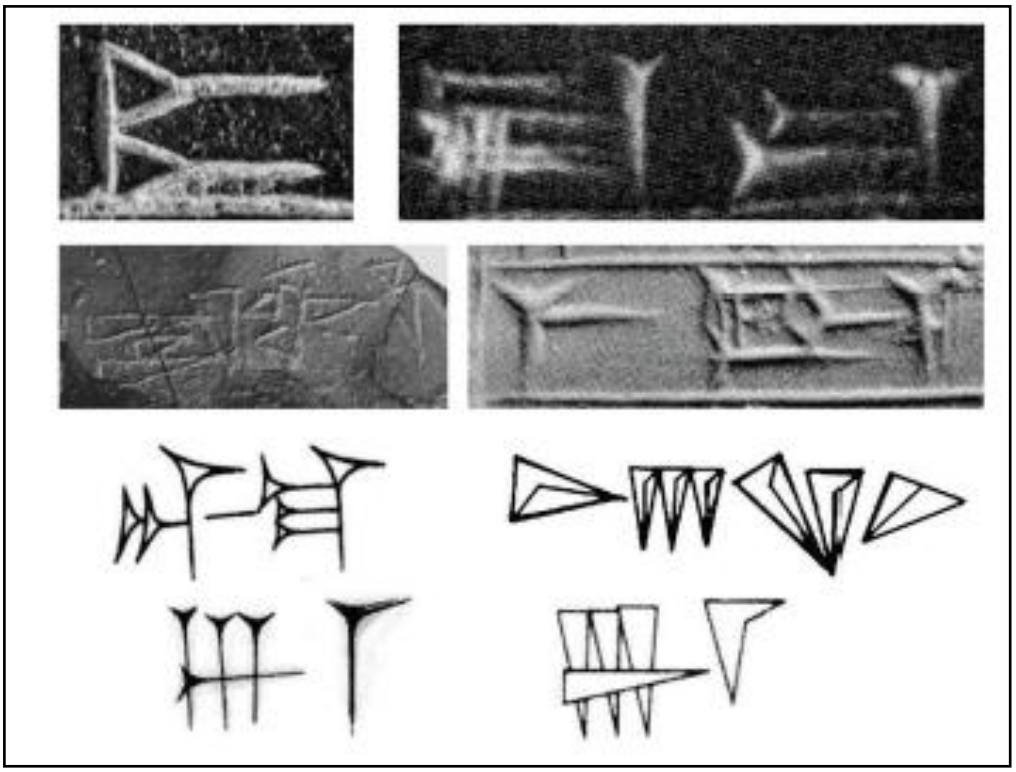

Figure 5. Multiple approaches, old as well as contemporary, for representing cuneiform characters in two dimensions (4).

The oldest civilization in Mesopotamia developed near the mouths of rivers, around -3000, in the Sumer region. Most of the technical knowledge of Mesopotamia appears to date from the time of the Sumerians, i.e., the third millennium BC. The origin of the Sumerian people is unknown, but in the second millennium, people from the west settled in the region, and power moved a little towards the north; the city of Babylon (or Babel) became the most important center. In the middle of the second millennium, people skilled in the use of iron (the Hittites) invaded Mesopotamia. Subsequently, in the first millennium, power shifted north to the region known as Assyria.

Mesopotamian literature is a significant cultural achievement, but its resurrected form is not fully appreciated due to fragmentary clay tablets, lack of duplicates, and inadequate knowledge of languages. Many texts are fragmented and have not been found, leaving large gaps. Additionally, the language's vocabulary and grammar are insufficient, leading to difficulties in understanding the texts. Thus, for modern readers to truly understand the high degree of literary originality of those periods, future Assyriologists must appropriately present the great myths, epics, lamentations, hymns, "law codes," wisdom literature, and pedagogical treatises.

In general, This period was the cradle of ancient civilizations. The biological practices are as follows: - Inventors of writing (Cuneiform), - Approximate knowledge of general and functional biology, but very precise in anatomy. - Selective breeding methods: crossbreeding between horses and donkeys, - Distinction of various breeds of horses, - For them, the heart is the seat of intelligence and blood circulation.

The following civilizations governed across the seven periods that make constitute Mesopotamian civilization:

• Sumerian, around 2400–5000 BC

• Sami, circa 2100–2400 BC

Some 1000 to 1650 BC;

Assyrian 612 to 1000 BC;

Chaldean or modern Babylonian 539 to 612 BC;

Elamite 1800 to 2100 BC;

First Babylon 1650 to 1800 BC;

Some 1000 to 1650 BC

A. Sumerian civilization

The Sumerians were the first civilization to inhabit the Tigris and Euphrates valleys, settling there between 5,000 and 4,000 BC, as stated in the Perennial Journal of History, Vol III. No. I240BC. The concept of their homeland is rooted in their migration from Central Asia to this location. Although they spoke a strange foreign language, many aspects of their society closely resembled the Indus Valley Civilization. They migrated from the Indus Valley and established here. He established the basis for the advanced civilization that developed in the Tigris and Euphrates valleys, with further information to be provided later. The Semitic population has recently settled in a specific valley called Aqad.

Sargon I triumphed over the Sumerians in 2400 BC and established the Semitic regime. The empire was magnificent. Expand to the Mediterranean, where the empire thrived through

conquests. Consequently, their foundations were revealed to be feeble, and at the demise of Sargoon-I, the conquered nations initiated uprisings. Despite temporarily suppressing these revolts, the empire experienced a decline in strength.

Subsequently, a partially uncivilized civilization unintentionally entered and took control of the northern region. The monarch's name was Marut. The Semitic population has recently settled in a specific valley called Aqad2. Sargon I emerged victorious against the Sumerians circa 2400 BC, establishing the Semitic government. The empire was magnificent. Expand to the Mediterranean, where military conquests established the empire.

Consequently, their foundations were revealed to be feeble, and at the demise of Sargun I, the enslaved nations initiated uprisings. Despite temporarily suppressing these revolts, the empire experienced a decline in strength. Subsequently, a partially uncivilized civilization unintentionally entered and took control of the northern region. The monarch's name was Marut. Nevertheless, in the 21st century, the city's inhabitants assumed dominion over the valley by diminishing the authority of the Tekas. Dungi was their primary monarch.

The Sumerians lived in cities and their way of life can be reconstructed as follows: they had temples and residential areas, and their economy relied largely on intensive agriculture, stock breeding, fishing, and date palm cultivation. Additionally, they had specialized industries such as sculpting, seal writing, blacksmithing, carpentry, shipbuilding, pottery, and working with reeds and textiles. A segment of the population received rations from a central distribution center, alleviating the need for individuals to procure their own basic sustenance. In exchange, they were required to work continuously throughout most of the year. The cities maintained robust commerce with foreign nations.

The Sumerians developed mathematics and astronomy. In general, this period was the cradle of ancient civilizations, and the biological practices are as follows:

• Inventors of writing (Cuneiform)

• Approximate knowledge of general and functional biology, but very precise in anatomy.

• Selective breeding methods: crossbreeding between horses and donkeys

• Distinction of various breeds of horses

• For them, the heart is the seat of intelligence and blood circulation.

B. Babylonian civilization:

In the oldest inscriptions in cuneiform characters, Babylonia is designated under the name of "land of Sumer and Akkad" (around 3000-2000). Babylon became the predominant city and imposed its name on the entire region, which, from then on, was designated under the name of Chaldea, or that of Babylonia. It was one of the wealthiest and most fertile countries in the world.

The Babylonians made significant contributions to the fields of mathematics and astronomy. One such contribution is the sexagesimal system, which is still useful today for calculating time and angles due to the high divisibility of the number 60. They also introduced the Greek day consisting of 12 "double-hours" and the zodiac with its several signs. Often, the origins and paths of borrowings are unclear, such as in the challenge of understanding the preservation of ancient Mesopotamian legal thought.

C. Assyrian civilization:

Numerous cuneiform tablets reported medical diagnoses and remedies, such as pharmacological and healing rituals, which concern various health problems. The Babylonians had recourse to one of the two men who complete each other when a person falls ill: either resort to the doctor or the Baptist.

The doctor (the asû), who would practice what comes closest to modern medicine, would have a pragmatic, rational approach to healing his patients. Conversely, the Baptist (L'āšipu) is a "magical expert" who is responsible for the "supernatural" approach to illness and who is, therefore, a kind of sorcerer responsible for dealing with the gods and demons who cause the disease.

The Assyrians exerted a substantial influence on the cultural development of the Tigris and Euphrates regions. These individuals resided in seclusion within the northern highland area of Mesopotamia for an extended period of time. This represents the collective viewpoint of the inhabitants of Babylon.

The Sumerian religion mirrored the disposition of their nation. While his faith lacked profound spiritual principles, it held significant importance in his everyday existence. Their

pantheon consisted of numerous gods who exhibited human anatomical features, characteristics, and vulnerabilities.

The manuals of Ark contain a compilation of around five thousand divine names. Various deities were worshiped in various cities around the country. The additional deity was known as "Nanar," the god associated with the moon. Rarsa was another major urban center. The deity worshipped by this civilization was "Shamash," who was revered as the god of the sun. A selection was made from various celestial bodies, with a smaller proportion originating from Earth. Individuals comprehended their own subneeds associated with these celestial bodies.

2.2.2. Egypt in History

Egypt was host to the first great civilization of Antiquity. This country depends entirely on its artery, the Nile, and annual floods, fertilizing the soil. Ancient historians classified the kings who reigned over Egypt (pharaohs) into thirty dynasties.

Character of Egyptian knowledge: Ancient Egypt was a centralized monarchical state. The scribes and accounting officials were responsible for the inventory and distribution of crops. It was in their hands that the transmissible knowledge of the Egyptians rested, particularly in mathematics. Paradoxically, the era most fertile in technical inventions is the Old Kingdom (the era of the great pyramids). For example, the great pyramids of Cheops and Chephren have their faces oriented towards the four cardinal points with a precision of 228, and we do not know how the builders achieved this. We also need to find out how the Egyptians assembled these monuments.

The contribution of the ancient Egyptians, whose very advanced and refined civilization is well known, to biology essentially consists of:

- Has perfect human and animal anatomy knowledge through embalming corpses and successfully performing surgical operations.

- Use of selection for animals.

- The identification and description of a large number of diseases.

- They are competent in cardiological, gynecological, eye, intestinal, and urinary medicine.

Egyptian knowledge was indeed technical and utilitarian. The Egyptians did not feel the need to develop a coherent system of Nature.

3. Western antiquity

3.1. Greek civilization in history

Those called Greeks but who call themselves Hellenes are of Indoaryan origin and populated present-day Greece around 2000 (Ionians and Achaeans) or around 1100 (Dorians).

• Greek civilization spread over almost the entire Mediterranean and the Black Sea. However, no political unity was achieved, and each city was independent, even if the colonies often retained a bond of loyalty to the mother city (metropolis).

Characteristics of Greek science: It is characterized by: - The emergence of scientific thought.

- The writings and ideas that shaped science history until the seventeenth century. Greek philosophy is primarily distinguished by its concern for comprehensibility: we sought to explain facts by incorporating them into a framework. While logical (or plausible) thinking is another characteristic, it is typically highly speculative.

Above all, the Greeks were skilled dialecticians who worked hard to persuade others. Many so-called philosophers, or "sophists," were skilled in persuasion during Socrates's time. They sold their skills and expertise and were not above using deceptive and false reasoning to win people over. One of the main tasks of the great Greek philosophers was the sanitation of logic and dialectics. The Greeks were the first actual mathematicians in that they conceived mathematics for its own sake and not always in association with a practical problem.

Greek civilization results from a significant mixture of cultures: Chinese, Indian, etc. Thales (from –640 to –548) writes in his "Cosmology" that water is at the origin of all life. Anaximander (from –610 to –546) is the first Greek physiologist; he thinks that animals were born in the sea, that man came from another species, and that life originally came from water and would have evolved to adapt to terrestrial life.

a. Aristotle (from –384 to –322), a student of Plato who is the student of Socrates, is considered the most outstanding biologist of the time. He works with methods, logic, and inductive rationing. He wrote many books on animals and plants, which still serve as

references, although most have not come down to us. He has the idea of heredity. He also said a lot of stupid things. Alexander the Great created the Library of Alexandria, a gigantic mine of knowledge and study for the entire Mediterranean.

b. Hippocrates:

Hippocrates was a doctor who left us important works written by himself or his students. These treatises describe diseases and remedies in an essentially empirical manner. However, certain biological theories have attempted to develop.

The best known is the theory of humors: In this theory, the body comprises four humors (blood, pituitary or phlegm, yellow bile, and black bile) whose production varies according to the seasons. Health corresponds to the balance of humor, and illness to the imbalance. The blood is attached to the heart, the pituitary to the brain, the liver to yellow bile, and the spleen to black bile. Depending on the predominance of one of these humors, it defines several temperaments.

For example, too much lymph would cause lung problems, and the body would try to cough up and spit out the lymph to restore balance.

Hippocrates's therapeutic method aimed to restore this balance.

According to this model, the disease is then considered to progress in three phases: 1- degeneration of humors;

2- collection (fever reaction);

3- the crisis (evacuation of excess mood)

The theory of humors: For the ancients, there are four moods:

• Blood: produced by the liver and received by the heart (warm blood character);

• Pituitum or phlegm or lymph: attached to the brain (lymphatic character);

• Yellow bile: also coming from the liver (bilious character, somewhat prone to violence. It is said of the bilious that they give off an impression of strength and control);

• Atrabile or black bile: coming from the spleen (melancholic/anxious character).

A "theory" (from the Greek theory or "view of the world") is a model or framework for understanding nature and man. In physics, the term theory generally refers to the mathematical support derived from a small set of fundamental principles and equations to produce experimental predictions for a given category of physical systems. The theory is often a model between experimentation and observation that remains to be confirmed. Thus, the scientific design of the theory becomes a provisional phase of the experimental method.

c. Galien

Of all the Greek doctors, the most influential in the centuries that followed was undoubtedly Claude Galien. Galen was strongly influenced in his practice by the Hippocratic School and in his physiological conceptions by Aristotle. It seems that Galen carried out numerous dissections, but only on animals.

Galen's views on the vascular system are particular. Like Aristotle, Galen thinks that it is the blood that nourishes and preserves the body. However, the role of the heart is rather curious: Between the liver and the right ventricle, a back-and-forth movement of the blood, charged with natural spirits coming from digestion, occurs. The left ventricle receives the pneuma from the lungs, which becomes a vital spirit distributed by the arteries after receiving part of the blood, passed from the right ventricle to the left ventricle via the interventricular septum through invisible pores. Galian medicine became a true dogma in the Middle Ages.

d. Empedocles (from 483 to 423)

Greek doctor studying organisms in their environments. He puts forward the idea of transmitting characters and thinking about species selection. He is also the precursor of ecology as a science that studies living beings and their environments. For him, all biological phenomena would be reacted by mechanical causes and changes in environmental conditions imposed on the living being an adaptation by organs appropriate. He also attempted to classify 400 animal species.

3.2. Roman civilization

Biological sciences began to deteriorate during the Roman Empire. The Roman leader (prosecutor and later admiral) Pliny the Elder (23–79) wrote “Natural Histories,” a massive book that cataloged current knowledge in biology. Even if beliefs strongly influence his writing, it will serve as a reference for a long time.

Gallienus (131 to 201) was passionate about anatomy and created several anatomical models, all based on animals. He was also an experimental physiologist who understood the role of motor nerves and knew that arteries carry blood (not air).

Chapter 3

The middle Ages (Medieval)

The period that extends between the Vth and XVth centuries is considered a dark period for the life sciences. Even if it was much more progressive than the image that historians have long given, the collapse of the Roman Empire and the political and economic disorders that followed it caused the loss of a large part of the heritage of the Roman Empire.

1. The Middle Ages (The Dark Age or Medieval) In the West

In the West, the Middle Ages were An era of the reign of theology (the Inquisition). The sciences are blocked, in regression, and have even become prohibited. There was a decline in Learning, and ordinary people became illiterate: There was no learning except in monasteries. • Loss of a common language due to many dialects that gradually become new languages (Latin becomes French, Spanish, Italian, Romanian…). • The Church rose in power, and Christianity became the dominant religion in Europe during the Middle Ages

a. Albert the Great (1193-1280)

Wrote 21 works on anatomy and many books. His natural science treatises condense Greek and Latin texts, but Albert adds his criticisms and observations. He corrects errors whenever he deems it proper of ancient heritage.

Albert the Great is also the author of an imposing encyclopedia on zoology, which classified around 420 species. He relates in his book a certain number of observations of zoological studies that he seems to have done himself, notably on the behavior of spiders and ants, as well as considerations on the anatomy of bees and the description of the cycle of a butterfly.

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Often, we only talk about Europe, but other parts of the world flourished during this time: North Africa, the Middle East, China, India, and other regions experienced significant changes.

b. Frederick II of Hohenstaufen

King of Sicily and then emperor of Germany, is the author of a remarkable treatise on Falconry (Ornithological Encyclopedia on morphology, physiology, etc. of various birds). Passionate about scientific research, he promulgated in 1241 a law authorizing the dissection of human corpses, which was unfortunately reported by the church after his death.

2. The Middle Ages in the Orient: The Arab and Islamic World (Muslim civilization)

It is regarded as the Islamic world's golden phase in the Middle Ages. With their connections to Europe, the Persian Gulf and other Arab territories were strategically positioned to contribute to advancing science, which was founded on Greek and Indian sciences. Persians were among the most influential scientists, although there were also Turks and Arabs.

The influence of Arab mathematics and science on Western civilization is apparent in the scientific and mathematical terminology we employ in contemporary times. Several scientific terms in English originate in Arabic, such as alchemy, algebra, alkaline, antimony, chemistry, elixir, zero, alcohol, algorithm, almanac, azimuth, cipher, sine, and zenith. Furthermore, numerous celestial bodies identified by Arab astronomers retain their original Arabic designations. For example, the star at the end of the constellation Cygnus is named Deneb, derived from the Arabic word meaning tail.

During the ninth century, the Islamic religion had spread to areas where an understanding of celestial bodies and their motions had been traditionally utilized to measure time, forecast weather and river floods, and navigate through barren deserts. In the eighth and ninth centuries, under the governance of the initial Islamic kingdoms (the Umayyads and Abbasids), scientists expanded upon this knowledge to formulate novel ideas and construct advanced equipment. The practice of court patronage had a crucial role in maintaining significant knowledge by supporting a rigorous translation effort of Greek, Sanskrit, and Pahlavi (early Persian) astronomical books into Arabic.

Muslim doctors used the scientific method in the field of medicine with notable experimentation, medical research, evidence-based medicine, clinical trials, dissection, animal experimentation, human experimentation, and post-mortem examination (autopsy) by Muslim doctors. At the same time, hospitals in the Islamic world invented the first therapeutic trials, ensured the purity of drugs, and evaluated the skills of doctors (Fig. 6).

In one century (until 750), the Arabs conquered the entire Middle East, North Africa, and Spain, a pace of conquest never seen before. They thus captured more than half of the Eastern Roman Empire (Byzantine Empire) and all of Sassanid Persia, highly civilized countries. The Arabs imposed their religion on the conquered peoples but assimilated the knowledge of these same peoples for their benefit.

a) Characteristics of Arabic Science

First, Arabic science is not only the science of Arab peoples but also science written in Arabic, which includes many Persian and even non-Muslim (Jewish) scholars. In fact, during the first century of Islam, most scholars in Muslim territory were Christians. To a certain extent, the Islamic religion was more favorable to the development of scientific knowledge than the Christian religion to the same extent era. Not only is astronomical knowledge crucial in accurately determining the start of Ramadan and the direction of Mecca, but the Quran also encourages the study of nature.

The Greeks greatly inspired the Arabs. We can roughly consider that Arab science is the logical extension of Greek science, or at least, of what remained during the Roman era. Let us quote Al-Bîrî.

However, the Arabs have a more practical mentality than the Greeks of the classical era and do not practice "science for science's sake"; practical applications are always present in their minds. Immediately after their conquest of the Middle East, the Arabs were open to existing cultures (Greek-Byzantine and Persian) and were thus able to assimilate knowledge.

These civilizations accumulated the Arab world for centuries without, however, putting into question their religion. The scientific texts of Antiquity were translated from Greek into Arabic, often through Syria (one of the late forms of Aramaic).

The Caliph Al-MA' Mun (814/833) founded the Bayt al-Hikma ("House of Wisdom") in Baghdad, the institution responsible, among other things, for translating Greek texts. Many

translators were Christians, and the caliph imported the manuscripts from Constantinople when he did not have them.

The development of Arab science is significant, especially from the 8th to the 11th century around Baghdad and from the 10th to the 12th century around Cordoba. Arab science stagnated and declined from the 14th century.

The disastrous Mongol invasions were partly responsible for this decline, but also a change in religious attitude, emphasizing respect for ancient authors' authority. Compared to the West, the Arabs played a dual role on the scientific level: Transmitting Greek (and Indian) knowledge that they had assimilated and commented on this ancient knowledge in addition to transmitting it. Establish new and original results, especially in mathematics and medicine. The Contacts with the West were made mainly through border areas: several Westerners went to study in Muslim Spain or Sicily. Some examples of Islamic civilization innovations:

Figure 6. Preparing Medicine from Honey: Folio from a dispersed manuscript of an Arabic translation of the Materia Medica of Dioscorides. Dated a.h. 621 / a.d. 1224, Calligrapher: ʻAbdullah ibn al-Fadl, Iraq, Baghdad or northern Jazira

1. Al-Khawarizmi

Clearly explained in his treatise how to resolve problems with one unknown using two operations: Al-Jaber: the word algebra became algebra in Latin and algebra in French. Al-muqabala: balancing the positive values remaining in the equation. The Latinized name of AlKhawarizmi is Algorismus, which is the origin of the French word algorithm.

The prosperity of the Islamic Empire was supported by both trade and conquest, which in turn promoted the intellectual and scientific inquisitiveness of its inhabitants. Certain researchers expanded upon existing or foreign concepts and designs, drawing upon the knowledge of the ancient Greeks or examining advancements from the African civilization. The Banu Musa brothers, who lived in the 9th century, created remarkable inventions like an automated flute-playing device that could be fully customized to play your preferred rhythms.

2. Ibn al Nafis

In the 13th century, he wrote the "complete manual of the art of Medicine," and he created daily examinations of patients. The Arab historians from the 13th (13th) century considered Ibn al-Nafis to be the most crucial physician; some referred to him as the "seco" d Ibn Sina," and" others consider him more important than Ibn Sina. The discovery of the "small" circulation" (pu" money) by Ibn-Al-Nafis (1210-1288) (which will be clarified in the 16th century by Michel Servet).

3. Avicenna (980-1037 AD)

His full name is Abu Ali al-Husayn Ibn Abd Allah Ibn Sina, a medieval Persian philosopher, physician, and scientist of the Muslim religion. Avicenna played a vital role in biology and made many discoveries. He is often considered the father of modern medicine and history's most significant medical thinkers and researchers. His medical encyclopedia, the "Cano" of Medicine (circa 1020), remained a reference manual in Europe for centuries.

He also wrote "The "ook of Healing the Soul" (a "ore general encyclopedia of science and philosophy), becoming another famous textbook in Europe. Among other things, Contributions to medicine are discovering the contagious nature of infectious diseases, introducing experimental medicine, medicine based on the facts, clinical trials, and clinical pharmacology effectiveness tests…etc.

• The creation of the oldest anatomical diagrams of the eye (Hunain: 809-873).

• Dissection was also performed. This is how aspects of ancient Greek doctors' misunderstood anatomical features were discovered. The translation of Latin and Greek texts was encouraged, and scholars came to Baghdad from all parts of the empire.

4. Abu Al-Qasim (Abulcasis)

The father of modern surgery, wrote the Kitab al-Tasrif (1000), a medical encyclopedia in thirty volumes taught in Muslim medical schools and Europe until the 17th century. He used many surgical instruments, including instruments specific to women, and introduced the use of catgut surgery, forceps, ligatures, suture needles, scalpels,

5. Abu Bakr Mohammad Ibn Zakariya al-Razi,رازی (865-925)

He was an Iranian multidisciplinary scholar who made significant contributions to medicine, alchemy and philosophy. An alchemist who became a doctor, he is said to have isolated sulfuric acid and ethanol, the medical use of which he was among the first to advocate. Regarding medical practice, he vigorously defended the scientific approach in diagnosis and therapy and largely influenced the hospital organization's design in connection with future doctors' training. Empiricist and rationalist, he was criticized for his opposition to Aristotelianism and his free-thinking toward the Muslim religion.

With the widespread availability of this enormous collection of medical publications, the necessity for organization and categorization became increasingly crucial. Al-Razi, a renowned medical innovator from Iran in the ninth century, and also known as Rhazes in the Western world, undertook the immense endeavor of consolidating the entire body of Islamic medical knowledge into a single authoritative work, which came to be known as the mighty Comprehensive Book of Medicine. Notably, Al-Razi was the first to document information regarding measles and smallpox. Scientists from the Islamic world made significant contributions to science and medicine by introducing numerous innovative ideas.

6. Ibn Al-Haytham

An example is Ibn Al-Haytham, a renowned physicist from early times who authored a well-known and impactful treatise on the functioning of the human eye. This book continues to serve as the foundation for contemporary optical theory. During the early thirteenth

century, Islamic medical texts, consisting of original writings and translations of classical treatises, spread to the Western world. Eventually, these sources were integrated into European medical theory and practice.

7. Other characteristics of Islamic civilization:

• They greatly improve knowledge and culture.

• They created medical schools.

• Important innovations in plant pharmacology

• Translation of Biological writings from Greek into Latin by Muslim scholars and Jews.

• The first hospitals opened, initially as leprosariums, then evolved to treat illnesses of the human body as well as those of the mind. Anesthesia, practiced in Antiquity by the ingestion of opium, mandrake or various other substances that make you want to sleep, is perfected by the use of a sponge soaked with a mixture of these substances. Dried, this spongia somnifera as it will be called allows the surgeon to operate by subjecting the patient to vapors from the sponge moistened before use and which immersed the patients in a state close to general anesthesia, but more like an analgesic state accompanied by loss of consciousness.

- There is still one area in which Arab science is particularly active, and that is alchemy. Many scholars such as Al-Razi and Avicenna devoted a lot of time to it because, at that time, it concerned the transformations of matter.

Chapter 4

Sixteenth and seventeenth centuries: century of rediscoveries: the Renaissance

This is the period during which modern and experimental sciences was born, and are identified with the renaissance, a broader social transformation also including changes in society, culture and particularly art.

The Renaissance led to the Scientific Revolution: Scientists begin to question traditional beliefs; and start to use logic and reason; observation and experimentation.

We will distinguish two periods with quite different characteristics.

1. Sixteenth century

Biological and medical sciences experienced three major developments during this period:

- Progress in the description of human anatomy
- The publication of numerous illustrated works of zoology and botany.
- The meeting between alchemy and medicine.
- The portable watch was invented by German Peter Henlein in 1505.

2. The seventeenth century

It is characterized by the significant growth of the experimental method, mechanistic interpretations of life, and the introduction of the microscope in biological observations.

• Dissection of the human body: gradually developed in Salerno, Bologna, Padua, and Montpellier.

• Lenses were used for more than eyeglasses. In 1606, Galileo used lenses to make an astronomical telescope to observe the stars and planets. Isaac Newton made the first reflecting telescope in 1668.

• Printing: In the Middle Ages, books were copied by hand. Around 1450, Jean Gutenberg invented printing with movable characters for each letter: this technique made it possible to print books in large numbers, favoring the publication of texts and maps. The habit of reading is spreading throughout Europe and not just for the rich. The invention of printing allowed the dissemination of information and knowledge.

• Astronomy: The work of the Polish astronomer Nicolas Copernicus demonstrated in 1543 that the Earth is not at the center of the universe (as was believed in the Middle Ages) and revolves around the Sun.

The Italian astronomer Galileo developed an astronomical telescope, which allowed him to observe the volcanoes of the Moon and the spots on the surface of the Sun.

• Zoology and botany are divided into two schools:

• Classification of observations already reported.

• Direct observation and experimentation, explorations (America), creation of botanical gardens.

3. Leonardo Da Vinci (from 1452 to 1519)

He is recognized as the initiator of paleontology and comparative anatomy. He should have been a pioneer, but his work was never published.

He understood sea level changes and crustal deformations, and he had the intelligence to not believe shitty religion by dating an event 200,000 years old years. He did remarkable work in comparative anatomy, zoology, and physiology, using many observations and dissections of human and non-human animals. His Published anatomy drawings are still studied in the xix th century.

• Dissects animals and human corpses.

• Recognizes the fourth chamber of the heart

• Describes the valves

• Makes sections of eyes embedded in coagulated egg white

• Injects wax into the ventricles of the ox brain…!

• Physiologist, he is passionate about bird flight, vision…

4. Gutenberg

Johannes Gensfleisch zur Laden zum Gutenberg, known as Johannes Gutenberg or simply Gutenbergnote, was born around 14001 in Mainz, in the Holy Roman Empire, and died on February 3, 1468, in his hometown. Is a German printer whose invention of movable metal type in Europe was decisive in disseminating texts and knowledge.

Around 1454, the German Johannes Gutenberg invented movable type. As a significant event in the Renaissance era, his work will mark a turning point in the history of printing and humanity. Until then, reserved for monks, knowledge will spread widely, and the Bible will give way to writings of a new genre: literature.

5. Galileo

Galileo invented The Thermometer in 1593. For the first time, Thermometers measure temperature by using materials that change in some way when they are heated or cooled.

6. Gabriel Fallope (from 1626 to 1697)

He discovered the fallopian tubes. He also left the name of the placenta. It was believed at that time that certain invertebrates were born by spontaneous generation.

7. Von Lee Uwenhoek (1632 to 1723) described red blood cells, bacteria and spermatozoa.

8. In 1628, William Harvey studied blood circulation and put forward the correct hypothesis that capillaries exist. He also declared that the heart is a pump for blood. This time is also that of diseases (pox, cholera, plague, etc.), so we observe some observations and applications in immunology.

Chapter 5

The 18th century: Darwinism

The English naturalist Charles Darwin (1809/1882) offers a partial explanation of evolution in his work on the origin of species using natural selection, published in 1859,

Before Darwin, biological thought had slowly begun to accept various ideas of evolution and the ideas of similarities between living things reflecting recent common ancestry and dissimilarities between living things reflecting ancient common ancestry.

Other scientists adopted the theory of evolution, for instance:

1. Jean Baptiste Lamarck

First biologist to Propose evolution, Link diversity with environmental adaptation, and propose a progressive evolution in which organisms strive to improve. He concluded that more complex organisms are descended from less complex organisms and proposed the inheritance of acquired characteristics – **Lamarckianism.**

2. Georges Curvier (1769-1832)

He was a French naturalist. Curvier developed support for the idea that fossil remains of unknown organisms were not just the remains of some ' freak of nature' but were the remains of organisms that had existed at one point in history and had since become extinct. Much of his work and findings lent credence to Darwin's Theory of Evolution. Cuvier stated that organisms were perfectly adapted and could not survive change.

3. Darwin

Proposed the theory of Natural Selection as a mechanism of evolution.

Darwin's Theory of Evolution contains two significant ideas:

1. One idea is that evolution occurs. In other words, organisms change over time. Life on Earth has changed as descendants diverged from common ancestors in the past.

2. The other idea is that evolution occurs by natural selection. *Natural selection* is the process in which living things with beneficial traits produce more offspring than others do. This results in changes in the traits of living things over time.

In Darwin's day, most people believed that all species were created at the same time and remained unchanged thereafter. They also believed that Earth was only 6,000 years old. Therefore, Darwin's ideas revolutionized biology. How did Darwin come up with these important ideas? It all started when he went on a voyage.

Darwin's theory is based on five points:

1. Evolution: the world is old enough to allow the evolution of species.
2. Common ancestry: all species, all living organisms, have a common ancestor. The further back in time we go, the more we discover a link of related to many species.
3. The multiplication of species: one species can give rise to daughter species which evolve differently due to geographical isolation.
4. Gradualism: evolution is a slow and progressive phenomenon (nature does not make jumps).
5. Natural selection: in an animal or plant population, the fittest survive the best, reproduce with more probability and their characters are preferably transmitted.

Darwin's Theory of Evolution by Natural Selection

Evolution of Darwin's Theory It took Darwin years to form his Theory of Evolution by Natural Selection. His reasoning went like this:

1. Like Lamarck, Darwin assumed that species can change over time. The fossils he found helped convince him of that.

2. Darwin saw that Earth and its life were very old. Thus, there had been enough time for evolution to produce the great diversity of life Darwin had observed.

3. Darwin knew that populations could grow faster than their resources. This "overproduction of offspring" led to a "struggle for existence," according to Darwin.

4. Darwin was convinced that specific progeny can inherit random mutations. In the natural world, various mutations in offspring may increase their chances of surviving and procreating. If so, their progeny would inherit their advantageous variants.

5. Darwin used the term "fitness" to describe the relative capacity of an organism to endure and procreate. The most beneficial variations are chosen by nature. He, therefore, gave this kind of selection the name "natural selection."

6. Darwin was aware that domestic creatures could evolve through artificial selection. He concluded that species might evolve naturally over time. He believed that a species may evolve into a new one if it underwent significant enough change.

Chapter 6

Nineteenth-century: cellular theory (microscopy), Sexuality Embryology, Biology, Molecular (DNA) Genetics.

The 19th Century was an era of rapidly accelerating scientific discovery and invention, with significant developments in different fields.

1. Genetics

All body cells contain "Blueprints" with instructions on how an animal will look or act, etc. Modern genetics began in an abbey garden, where a priest named Johann Gregor Mendel (1822-1884), an enlightened "monk" originally from Moravia, present-day Slovakia, documented a particulate inheritance mechanism. He discovered the basic principles of heredity by breeding garden peas in carefully planned experiments. – Between 1856 and 1863, crossbreeding experiments between various breeds of peas (smooth -L- and wrinkled -r) (importance of choice) – Outlined the laws of hybridization (1865, Mendel's laws, dominant and recessive characters).

Gregor Mendel, renowned as the progenitor of genetics, established his reputation through his research on garden peas, which exhibit distinct and contrasting traits, such as tallness versus shortness and spherical seeds versus wrinkled seeds. When Mendel cross-pollinated short plants with pollen from tall plants, he observed that all the offspring in the first filial generation were consistently tall. Nevertheless, if he permitted the plants from that particular generation to undergo self-pollination, their descendants (the second filial generation) consistently displayed the traits of the grandparents in a ratio of three tall plants to one short plant.

In addition, when allowed to self-pollinate, the short plants consistently exhibited genuine breeding, meaning they did not generate any offspring that were short in height. Mendel derived the concept of dominance from these data, positing that each plant has two trait units, with one unit exerting dominance over the other. There was a lack of knowledge regarding chromosomes or meiosis throughout that period.

Nevertheless, Mendel inferred from his findings that the units of traits, after that referred to as genes, could be a form of tangible particle passed on from one generation to the next via

the reproductive mechanism.1900: HUGO de VRIES and other scientists rediscovered Mendel's laws.

- Discovery of Mutations
- Application of Mendel's laws to animals: MORGAN Study on Drosophila.
- Observation of genes on giant chromosomes (1933)
- Discovery of nucleic acids RNA and DNA (1930)
- DNA: discovery of the double helix structure by Watson & Crick (1953) … and Rosalind.

2. The appearance of microbiology

1. Biology comes from bios, which refers to living organisms, and logy, which means the study of biology. Thus, biology is the study of living organisms.
2. Micro means very small, viewed by a microscope.
3. Microbiology is the study of microscopic living organisms called microorganisms or microbes; these include bacteria, algae, protozoa, fungi, and viruses.

The spread of certain diseases from one person to another long ago suggested the existence of invisible, transmissible infection agents. Microscopic organisms (microbes) were only seen when Antony Van Leeuwenhoek (1632-1723) made microscopes with sufficient magnification. Then, the science of microbiology began. He was the first scientist to perform observations on living microorganisms. Using a microscope with a single lens, he achieved a magnification of 50-300X. He documented his findings on various microorganisms such as bacteria, algae, protozoa, and fungi in a series of written publications.

• **Louis Pasteur (1822-1895)**, a biologist, chemist, and French mineralogist, refutes the theory of spontaneous generation. –Showed microbes caused fermentation and spoilage. Found a way to reduce deterioration time in products through pasteurization (Pasteurization kills microbes and prevents deterioration of milk and other products). Louis Pasteur, in 1885, discovered Vaccines against various diseases.

3. Endosymbiotic Theory: The first cells were prokaryotic and straightforward in structure, but over time, they evolved into the eukaryotic cells we know today.

The architecture of contemporary cells supports the endosymbiotic concept. Prokaryotes that may have formed share features with mitochondria and chloroplasts.

The endosymbiotic theory explains the origin of eukaryotic cells. It describes how smaller cells that may have produced energy were consumed by more massive cells. The larger, more symbiotic cells allowed the smaller ones to live inside of them rather than eating them. The smaller cell supplied energy, and the larger one offered protection. Scientists think that mitochondria and chloroplasts were previously free-living organisms because of these structures. More gigantic cells absorbed them, and symbiotic partnerships developed.

4. Classification of living beings

The classification of living beings had yet to evolve in the 19th (19) century and since Aristotle.

Classification: is the grouping of things according to similar characteristics.

Carl Von Linné (from 1707 to 1778) is a Swedish scientist who developed the classification system we use today. He grouped organisms according to similarities in form and developed a simple naming system where each kind of organism is given its 2-part scientific name: Genus and species. This was called Binomial nomenclature; it is a two-part scientific naming system:

In the Binomial nomenclature, scientists use Latin words, and the names are always written in italics. Binomial nomenclature has two parts: the genus name and species.

Genus name and species: The initial component of the scientific nomenclature is referred to as the genus. The genus term is consistently written first and capitalized, typically shown in italics or underlined. The species name constitutes the second component of the scientific name. This term is consistently written in the second position, is not capitalized, and is presented in italics or underlined. The scientific designation for humans is Homo sapiens. Homo is the genus, and sapiens is the species.

Linnaeus' hierarchical classification system comprises seven levels. The hierarchical classification of organisms, arranged in descending order of size, is as follows: kingdom, phylum, class, order, family, genera, and species.

5. Cell theory

In the 1800s, Louis Pasteur designed an experiment to show that cells can only arise from preexisting cells. At the time, it was commonly believed that cells could occur spontaneously, which means they arise from nothing. Pasteur began his experiment with two swan-necked flasks:

1. the first flask was filled with nutrient broth and then boiled. Boiling killed any organisms, and the neck prevented particles in the air from floating in.

2. The second flask was also boiled, but the neck was broken, allowing unrestricted airflow. After waiting some time, he observed growth in the flask with the broken neck and none in the other. From this, he deduced that organisms in the air had colonized the open flask and that the observed growth was not spontaneous.

Cells were discovered in 1665 by Robert Hooke. Jakob Schleiden (1804 to 1881) observed that all plants comprise cells. In 1937, Schleiden concluded that the cell is the unit of structure in plants. In other words, all plants are made of cells. Théodore Schwann (from 1810 to 1882) extended this observation to all animals. Schwann concluded that this is also true for animals. In other words, that all animals are also made of cells. Based on both scientists' findings, the first principle of the cell theory was developed: The cell is the unit of structure of living organisms.

Rudolf Virchow (from 1821 to 1902) discovered that the cells are born from other cells. Virchow studied the physiology of cells and concluded that every cell carried out the three vital functions: Nutrition, interaction, and reproduction. His work led to the completion of the other two principles of the cell theory: The cell is the unit of function of living organisms. All cells come from preexisting cells.

1. All organisms are composed of cells.

2. Cells are the minors of life.

3. Cells arise only from preexisting cells.

4. Cell size is limited because as a cell grows, the time required for materials to permeate from the cell membrane to the inside of the cell also increases.

6. Microscope development

In the 19th Century, optical microscopes were greatly improved, enabling scientists to explore cells in more detail due to the more transparent and magnified images offered by the instruments. Microscopes continue to evolve today. The development of the electronic microscope revolutionized cell biology. It can magnify images up to one million times their actual size, meaning we can observe tiny details inside cells and organelles.

Chapter 7

1. Cloning

Cloning mainly refers to multiplying an organism, a stem cell, or a gene in large numbers of identical copies (either in vitro or in vivo). Therefore, it is possible to produce exact genetic copies of the gene, the original cell or organism.

The cloning of living beings mainly refers to two processes. On the one hand, it is the natural or artificial multiplication identical to a living being, which is to say, with exact conservation of the same genome for all descendants (clones). In February 1997, Mr. Wilmut's team announced Dolly's arrival. Dolly is a sheep with precisely the same genetic code (DNA) as his mother. If Dolly came from normal sexual reproduction, half of its DNA would come from a female and the other half from a male.

Cloning" can mean several things: making many identical copies of a DNA molecule, replicating an entire organism (reproductive cloning), or producing undifferentiated cells (stem cells) to study and treat diseases (therapeutic cloning)**.**

We will distinguish two different types of cloning:

1.1. Reproductive cloning

Its goal is to create an individual who is identical to another individual but could develop differently. Reproductive cloning involves transferring the nucleus of a germ line cell (eggs or sperm) into an enucleated egg cell to generate an individual identical to the donor.

1.2. Therapeutic cloning

Reproducing cells distinguished with precise functions. Therapeutic cloning involves transferring the nucleus of a somatic cell adult in an enucleated egg cell to generate stem cell embryos whose in vitro culture could provide differentiated cell lines or tissues likely to be used, in particular by grafts, to treat a disease.

2. Gene therapy

Gene therapy encompasses a collection of procedures to rectify the malfunctioning of a "diseased" gene, typically by substituting said gene with a functional or therapeutic gene.

Gene therapy is the process of delivering genetic material into cells to treat a disease. It induces the production of a deficient or dysfunctional protein within a cell, making it a preferred method for addressing rare genetic disorders.

Initially designed for the treatment of uncommon medical conditions, gene therapy is currently being utilized or investigated for the treatment of prevalent ailments such as cancer or degenerative disorders and for the development of vaccines.

Drug genes are transported into cells using specialized carriers known as "vectors." These vectors are viral components utilized for their exceptional cell infiltration capacity. AAV (adeno-associated viruses) and lentiviral vectors are the predominant viral vectors in scientific research and medical applications. A significant obstacle in gene therapy is the precise and efficient targeting of vectors to afflicted cells and tissues. Multiple methodologies are employed. Particular diseases, especially those related to blood, can be treated outside of the body:

1. Stem cells are extracted from either the blood or bone marrow.
2. The functioning gene is introduced in a controlled environment.
3. The corrected cells are subsequently reintroduced into the body, where they will undergo multiplication.

The preferred method for treating illnesses such as myopathies is administering the gene through in vivo injection, which involves directly introducing it into the body or the specific organ requiring treatment.

The different gene therapy strategies: Gene therapy for gene replacement: The initial approach involves introducing a functioning gene into a specific cell, causing it to be expressed and synthesized to produce the deficient protein. The gene is introduced into the organism using a vector (refer to the information below).

This is the initial approach devised in gene therapy to treat monogenic illnesses. The imported therapeutic gene does not alter the diseased gene; it merely contributes to the genetic makeup of the cells to offset the impaired function. Based on the instructions, this task can be performed in vivo, which means immediately inside the patient's body, or ex vivo, where the cells are genetically modified in a laboratory and reintroduced into the patient.

Working ex vivo lets you regulate the steps better, use fewer vectors, and avoid therapy dispersion in non-targeted organs. This solution's primary application is in treating hematological disorders, as it allows for the retrieval of the cells requiring correction by a straightforward blood test. As an illustration, the initial ex vivo gene therapy medication called Strimvelis, introduced in 2016, involves extracting CD34+ hematopoietic cells from individuals suffering from severe immunodeficiency (ADA-DICS). These cells are then altered in the laboratory to express their deficient gene before reintroducing into the patient.

In the case of other disorders, such as muscular, respiratory, ophthalmic, cardiac, or neurological diseases, the gene transfer is performed in vivo. This involves injecting the vectorized gene directly into the body or the specific organ that requires treatment, similar to administering medication. Several clinical trials are currently in progress using this method, and a few medications, such as Glybera and Luxturna, have already reached the marketing stage.

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