

Chapter 13

The Sciences

Objective

To learn about ancient Egyptian writing, astronomy, mathematics and medicine, as well as the calendar that was used at the time.

Mystery

While much of the world was living in primitive conditions, the ancient Egyptians were inventing writing and advancing the sciences. What sparked the advancement of learning in the Nile Valley?

Discussion and Research Projects

1. Egyptian hieroglyphs have been called the most beautiful writing in the world. What makes them so different from modern forms of writing?
2. Who knew how to write in ancient Egypt? What tools did they use in their craft?
3. How did the ancient Egyptians make paper from papyrus stems?
4. Why was it important for people to have their names inscribed on their tombs in hieroglyphs?
5. Name the months in the Egyptian calendar and the seasons.
6. Why was the Egyptian calendar not accurate in relation to the yearly cycle of the earth's rotation?
7. How were the stars used to determine the orientation of the pyramids and temples?
8. How did the ancient Egyptians align the pyramids with the earth's four cardinal points?
9. What was the ancient Egyptian number system based on?



10. How did the Egyptians write numbers? Can you explain how they added and multiplied?
11. How did the Egyptians measure length? Do you know of any other measuring system that used the human body as a basis of measurement?
12. How did the ancient Egyptians explain the causes of illness?
13. Besides prescribed medicines, what else did doctors use to treat their patients? Do you think this would have had a positive effect on patients? Explain why.
14. What test did women use to find out if they were pregnant?
15. Where does the modern symbol for prescriptions come from?

Creative Projects

1. Use **Activity Sheet 31** to learn about hieroglyphs.
2. Use **Activity Sheet 32** to make a cartouche.
2. Use **Activity Sheet 33** to write numbers the way the ancient Egyptians did.

For Further Research

1. Find out more about the three types of hieroglyphic symbols: phonograms, logograms and determinatives.
2. Find out how Jean-François Champollion unlocked the secrets of hieroglyphs by studying the Rosetta Stone and other documents.

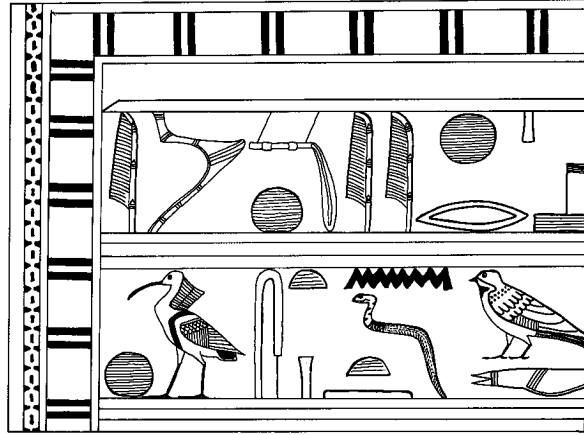
FACT SHEET: The Sciences

Writing — Hieroglyphs

The word “hieroglyph” literally means “sacred carvings”. The Egyptians carved and painted hieroglyphic inscriptions on temple walls. This form of pictorial writing was also found on tombs, sheets of papyrus, wooden tablets covered with a stucco wash, potsherds and fragments of limestone.

The ancient language was written by scribes who went through a long apprenticeship before they mastered the skill of writing. A scribe’s equipment consisted of a stone or wooden palette containing two cakes of ink, usually red and black, a leather bag or pot filled with water, and a set of reed brushes.

To make the paper-like writing material, the exterior of the papyrus stems was discarded and the interior was cut into thin strips. The strips were soaked in water and beaten to break down and flatten the fibres. They were then layered crosswise and lengthwise to produce a sheet, which was beaten again to mesh the strips together. Weights were placed on the sheets while they dried. Once dry, the sheets were rolled up and stored until needed.



A spell (written in hieroglyphs) to unite the ba (soul) of a deceased person with its mummy

Drawing: Catherine Fitzpatrick
Photo: Harry Foster (CMC S98 3518)



Hieroglyphic text from the Book of the Dead
Photo: Harry Foster (CMC S98 3572)

Hieroglyphics are an original form of writing out of which other forms have evolved. Two of the newer forms were called hieratic and demotic. Hieratic was a simplified form of hieroglyphics used for administrative and business purposes, as well as for literary, scientific and religious texts. Demotic, a Greek word meaning “popular script”, was in general use for the daily requirements of society. In the third century A.D., hieroglyphic writing began to be replaced by Coptic, a form of Greek writing. The last hieroglyphic text was written at the Temple of Philae in A.D. 450. The spoken Egyptian language was superseded by Arabic in the Middle Ages.

Egyptian hieroglyphs were deciphered in the early nineteenth century. Several people had been trying to crack the code when a brilliant young Frenchman, Jean-François Champollion, discovered the

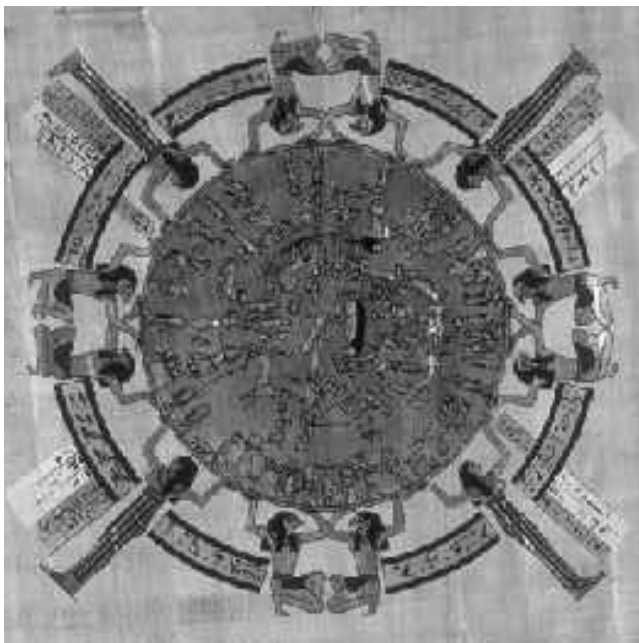
secret to this ancient writing. After Thomas Young deciphered the demotic text, Champollion used the information to break the code by comparing the texts written on the Rosetta Stone. Three scripts were inscribed on the Stone: hieroglyphics, demotic and Greek. The text described a decree issued at Memphis (near Cairo) on March 27, 196 B.C. In 1828, Champollion published the results of his work in the famous “Précis” that marked the first real breakthrough in reading hieroglyphs.

Hieroglyphs are written in columns or in horizontal lines. They are generally read from right to left and from top to bottom. Sometimes the script is read from left to right. The reader can determine the orientation by looking at the animal and human figures — they face the beginning of the text. For example, if a figure faces right, the text should be read from right to left.

Words and names written in hieroglyphs were believed to have magical powers. For this reason, funeral texts and the names of the deceased were written on coffins and tomb walls. A name written in hieroglyphs embodied a person’s identity. If it was obliterated, the person’s identity was lost, along with his or her means to continue living in the afterworld. The names of pharaohs such as Tutankhamun and Queen Hatshepsut, for example, were removed from temple walls by their successors.

Calendar

The Egyptian civil calendar was based on a year of 365 days, with twelve months and three seasons. It was invented in the third dynasty, around the time Djoser built the first pyramids. Each month had three ten-day weeks, for a total of 30 days. The last five days of the year corresponded to the birthdays of five deities: Osiris, Isis, Horus, Seth and Nephthys. Since the Egyptians did not take leap years into account, their calendar got further and further away from the actual seasons. This meant that at one point the summer months actually fell in winter. Only every 1,460 years did their calendar year synchronize with the seasonal year.



The Denderah zodiac with 36 decans, the constellations that enabled the Egyptians to tell the time at night. Each decan appeared on the horizon for about ten days. By observing the position of the decan, priests could determine the hour.

CMC S97 10807

The three seasons corresponded to the cycle of the Nile and agriculture. New Year’s day was on July 19 (in the Julian calendar) and marked the beginning of the first season, *akhet*. This was the time of the flooding of the Nile. The second season, during which the crops began to emerge, was called *peret* and started on November 16. *Shemu*, the third season, began on March 17. The last five days of the year, corresponding to the birthdays of the deities, were July 14 to 18, days which were considered unlucky and dangerous.

Besides the civic calendar, there was a religious calendar that marked the festivals and ceremonies associated with particular deities and temples. This calendar was based on a 29.5-day month, which made it more accurate according to the phases of agriculture and the astronomical cycle of the stars.

Astronomy

Like many ancient peoples, the Egyptians studied the night sky, taking measurements from the stars to accurately align their pyramids and sun temples with the earth's four cardinal points. Taking sightings of the Great Bear and Orion with an instrument called a *merkhet* (similar to an astrolabe), astronomer-priests marked out the foundations of buildings with astonishing accuracy.



The pyramid of Chephren, the second-largest at Giza
CMC ECD98-033 #99

The Great Pyramid at Giza provides an example. This remarkable building has a footprint of over 13 acres and consists of approximately 6.5 million limestone blocks. Its four sides are accurately aligned to face north, east, south and west, with an error of less than half a degree. They are also virtually identical in length, with less than a 20-centimetre (8 inch) variance between one side and another.

The Egyptians believed that the gods lived in the Duat, the kingdom of Osiris. It was located in the region of the sky where Orion and Sirius rise heliacally just ahead of the sun at dawn on the summer solstice. Some Egyptologists have proposed that the Giza plaza, with its three large pyramids, the Sphinx and the Nile, is a mirror reflection of the Duat. The three pyramids represent the three stars in the belt of Orion, the Sphinx corresponds to the constellation Leo, and the Nile corresponds to the Milky Way. The concept of creating sacred landscape on earth that reflects the night sky is not uncommon in other ancient cultures. By building pyramids, temples and tombs aligned with stars and the earth's cardinal points, ancient peoples venerated their gods, bringing divine energy to the earth, which prevented the world from falling into chaos.

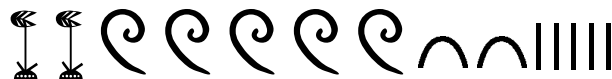


The Hall of Osiris in the Duat (Land of the Gods)

Photo: Harry Foster (CMC S98 3575)

Mathematics

Although the Egyptians lacked the symbol for zero, they calculated numbers based on the decimal and the repetitive (numbers based on the power of 10). Numbers were usually written from left to right, starting with the highest denominator. For example, in the number 2,525 the first number to appear on the left would be 2000, then 500, 20 and 5, as follows:



The following signs were used to represent numbers in the decimal system:

1	
10	⤿
100	⤿
1000	🌿
10,000	🐍
100,000	🦎
1,000,000 (often means "more than I can count")	👤

The Egyptians did not develop abstract mathematical formulas. They used the simple arithmetic of addition and subtraction. To multiply and divide, they referred to tables of duplication that gave the multiplier and the multiplicand. For example, to multiply 9 by 15, they would double and redouble the multiplier as follows:

Multiplier		Multiplicand		
1	x	15	=	15
2	x	15	=	30
4	x	15	=	60
8	x	15	=	120
16	x	15	=	240

Once a multiplier was reached that was equal to half or more of the desired multiplier, no further doubling was required. For example, to arrive at the correct answer for 9×15 , they would refer to the table ($8 \times 15 = 120$ plus $1 \times 15 = 15$) to arrive at 135 ($120 + 15$). Division was achieved by reversing this process.

The Egyptians knew about fractions and used special signs for two-thirds, three-quarters, four-fifths and five-sixths. They also had some basic knowledge of geometry, such as the fact that the area of



Colossal pillars and statues at Karnak Temple
CMC ECD98-018 #16



Giant statues of Osiris in the courtyard of Ramses III,
Karnak Temple
CMC ECD98-021 #51

a rectangle was equal to its length multiplied by its width, and they were able to calculate the area of a circle according to the length of its diameter.

When building the pyramids; the hypostyle hall at Karnak, with its gigantic pillars and colossal statues; and the many temples and palaces throughout the land, architects and engineers used their knowledge of mathematics to design and develop the specifications. To calculate length, they used a cubit, which was equal to the length of the forearm, from the elbow to the tip of the thumb (approximately 52.3 centimetres or 20.6 inches). A cubit was subdivided into seven hands, each equalling one-seventh of a cubit. A short cubit, measuring 45 centimetres (17.7 inches) was also in use.

Medicine

The doctors of ancient Egypt combined magic spells with remedies. If a person fell sick for no apparent reason, the illness was thought to be caused by the wrath of the gods or by an evil spirit that had entered the body. Both priests and doctors were called upon to heal the sick. The most common cure for maladies was an amulet and a magic spell to modify the incorrect behaviour that had caused the illness in the first place.

By the fifth century B.C., Egyptian doctors had their own specialization. Most of the doctors were men, and within their ranks there was a hierarchy. At the top were the Greatest Physicians of Lower and Upper Egypt, followed by the chief medical officer of the land. Under him were superintendents and inspectors of physicians, the chief of physicians and, at the bottom, the physicians themselves. Throughout the pharaonic times, the most sought-after positions were in the royal court. These doctors looked after the health of the pharaohs, their families and members of their court.

Although the Egyptians practised mummification, doctors did not understand the internal functioning of the body. They did not realize that the brain had anything



Brain hooks and other mummification tools
Photo: Steven Darby (CMC S97 10830)



Isis nursing her son Horus
Photo: Royal Ontario Museum
CMC ECD98-040 #46

to do with thinking; it was believed that the heart was the centre of reason. They also thought that blood, urine, excrement and semen circulated constantly around the body.

Women practised contraception by using concoctions such as honey and natron, which they injected into their vaginas. The Egyptians also devised the earliest-known pregnancy test. Women moistened a sample of barley and emmer (wheat) with their urine each day. If the barley grew, it meant the child would be a male; if the emmer grew, it would be a female. If neither grew, it meant the woman was not pregnant. The effectiveness of this test has been validated by modern science. The urine of non-pregnant women will prevent barley from growing!

Remedies and prescriptions for various ailments, wounds, stomach complaints, skin irritations, broken bones and many other conditions were recorded on sheets of papyrus. Some prescriptions had definite physical benefits, while others would have had a purely psychological effect.

The modern symbol for prescriptions is believed to have originated from the Eye of Horus symbol. In the second century, a Greek physician named Galen first adapted this symbol to impress his patients. Gradually, the symbol evolved into the one we use today.